

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ARASHI VISION (U.S.),

LLC (d/b/a INSTA360),

Inter Partes Review

Petitioner,

IPR2024-01164

VS.

IPR2024-01186

GOPRO, INC.,

IPR2024-01165

Patent Owner.

~~~~~

DEPOSITION OF  
AGGELOS K. KATSAGGELOS

April 4, 2025

9:01 AM Central

VERITEXT

One North Franklin, Suite 2100

# Chicago, Illinois

Stenographically Reported By:

Deanna Amore - CRR, RPR, CSR - 084-003999

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

APPEARANCES OF COUNSEL

On Behalf of the Petitioner, ARASHI VISION (U.S.),  
LLC (d/b/a INSTA360):

MORRISON & FOERSTER  
STELLA MAO  
MEHRAN ARJOMAND  
707 Wilshire Boulevard  
Los Angeles, California 90017  
smao@mofo.com  
marjomand@mofo.com

On Behalf of the Patent Owner:

QUINN EMANUEL URQUHARDT & SULLIVAN  
PATRICK T. SCHMIDT  
865 South Figueroa Street  
10th Floor  
Los Angeles, California 90017  
patrickschmidt@quinnemanuel.com

- and -

QUINN EMANUEL URQUHARDT & SULLIVAN  
JOSEPH MILOWIC III (via Zoom)  
295 5th Avenue  
9th Floor  
New York, New York 10016  
josephmilowic@quinnemanuel.com

Job Number: 7277891

\* \* \* \* \*

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

I N D E X

| WITNESS                    |                           | EXAMINATION |
|----------------------------|---------------------------|-------------|
| AGGELOS K. KATSAGGELOS     |                           |             |
| EXAMINATION BY MR. SCHMIDT |                           | 5           |
|                            | EXHIBITS                  |             |
| Exhibit 1                  | U.S. Patent Number        | 5           |
|                            | 10,574,894 to Derbanne    |             |
| Exhibit 2                  | U.S. Patent Number        | 6           |
|                            | 10,958,840 to Douady      |             |
| Exhibit 3                  | Declaration of            | 6           |
|                            | Dr. Aggelos Katsaggelos - |             |
|                            | IPR 2024-01186 Re: '894   |             |
|                            | Patent                    |             |
| Exhibit 4                  | Declaration of            | 6           |
|                            | Dr. Aggelos Katsaggelos - |             |
|                            | IPR2024-01164 Re: '840    |             |
|                            | Patent                    |             |
| Exhibit 5                  | Declaration of            | 7           |
|                            | Dr. Aggelos Katsaggelos   |             |
|                            | IPR2024-01165 Re: '840    |             |
|                            | Patent                    |             |
| Exhibit 6                  | U.S. Patent 7,674,438 to  | 7           |
|                            | Zhou                      |             |
| Exhibit 7                  | U.S. Patent Application   | 18          |
|                            | Number 61/407,630         |             |

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

EXHIBITS

| NUMBER     | DESCRIPTION                     | PAGE |
|------------|---------------------------------|------|
| Exhibit 8  | U.S. Patent 8,531,535 to Kwatra | 19   |
| Exhibit 9  | U.S. Patent 10,027,893 to Bell  | 45   |
| Exhibit 10 | U.S. Patent 10,462,370 to Shi   | 99   |
| Exhibit 11 | U.S. Patent 10,158,802 to Cai   | 141  |

1 (Whereupon, the witness was  
2 duly sworn at 9:01 AM.)

3 AGGELOS K. KATSAGGELOS,  
4 called as a witness herein, having been first duly  
5 sworn, was examined and testified as follows:

6 EXAMINATION

7 BY MR. SCHMIDT:

8 Q. Good morning, Doctor.

9 A. Good morning.

10 Q. Before we started this morning's 09:01:06  
11 deposition, I marked a series of exhibits for  
12 identification. They are in front of you. I'm  
13 just going to go through them for the record.

14 So Exhibit 1 to the deposition is the  
15 '894 patent that you've opined upon.

16 Do you see that?

17 (Whereupon, Exhibit 1 was  
18 marked for identification.)

19 THE WITNESS: I see that, yes.

20 BY MR. SCHMIDT: 09:01:27

21 Q. And Exhibit 2, for the record, is the  
22 '840 patent that you've opined about in a separate  
23 proceeding. Do you see that?

24

25

Page 5

1 (Whereupon, Exhibit 2 was  
2 marked for identification.)

3 THE WITNESS: I do.

4 BY MR. SCHMIDT:

5 Q. Exhibit 3, I've marked, is the declaration  
6 that you provided regarding your opinions  
7 pertaining to the '894 patent.

8 (Whereupon, Exhibit 3 was  
9 marked for identification.)

10 BY MR. SCHMIDT: 09:01:43

11 Q. Do you see that?

12 A. I do.

13 Q. Exhibit 4 is the declaration that you  
14 provided regarding the '840 patent in what I'll  
15 call the 1164 proceeding.

16 Do you see that?

17 (Whereupon, Exhibit 4 was  
18 marked for identification.)

19 THE WITNESS: I see 4 -- 116 -- oh, I see that,  
20 1164 you said, yes. 09:02:09

21 BY MR. SCHMIDT:

22 Q. And that's the first of two proceedings  
23 involving the '840 patent that you're participating  
24 in; correct?

25 A. Correct, yes.

Page 6

1 Q. And then Exhibit 5 is the declaration  
2 regarding the '840 patent that you provided in that  
3 second proceeding, which I'll call the 1165  
4 proceeding.

5 Do you see that?

6 (Whereupon, Exhibit 5 was  
7 marked for identification.)

8 THE WITNESS: I do.

9 BY MR. SCHMIDT:

10 Q. And Exhibit 6, for the record, is a 09:02:34  
11 U.S. Patent Number 7,674,438, which I'll refer to  
12 as Zhou in the deposition.

13 (Whereupon, Exhibit 6 was  
14 marked for identification.)

15 BY MR. SCHMIDT:

16 Q. Do you see that?

17 A. I do.

18 Q. And you're familiar with all these  
19 documents; correct?

20 A. Yes, I am. 09:02:48

21 Q. That out of the way, I want to start with  
22 Exhibit 6, which is the Zhou patent, and I want to  
23 direct you to column 1.

24 A. I'm there.

25 Q. Beginning on line 29 of column 1, Zhou

Page 7

1 reads "One way to stabilize a video is to track a  
2 salient feature in the image and use this as an  
3 anchor point to cancel out all perturbations  
4 relative to it."

5 Do you see that?

6 A. Yes.

7 Q. You agree that as of the filing of Zhou,  
8 that was one possible approach to stabilize a  
9 video?

10 MS. MAO: Objection. Form.

09:03:43

11 BY MR. SCHMIDT:

12 Q. Is that right?

13 A. Yes, tracking the salient feature in the  
14 image use this as an anchor point to cancel out  
15 perturbations is one way.

16 Q. Then Zhou goes on to state "This approach  
17 requires a priori knowledge of the image's content  
18 to, for example, identify and track a person or  
19 other salient object in the scene."

20 Do you see that?

09:04:18

21 A. Yes, I do.

22 Q. Do you understand what's being described  
23 there.

24 A. It mentions that the person can be an  
25 example of a salient object -- other salient object

Page 8

1 in the scene.

2 Q. What does Zhou mean when it says that  
3 tracking salient feature requires a priori  
4 knowledge of the image's content?

5 A. That there's an example -- this is just an  
6 example, like, might use the knowledge that there  
7 is a person in the scene and use this as a salient  
8 object.

9 Q. Why does an image stabilization approach  
10 that relies on tracking salient features require 09:05:26  
11 a priori knowledge of the image's content in your  
12 understanding?

13 MS. MAO: Objection. Form.

14 THE WITNESS: This is one example of doing  
15 stabilization, and this is also one example of  
16 requiring prior knowledge of ways to pull out these  
17 salient features from an image automatically.

18 BY MR. SCHMIDT:

19 Q. Do you disagree with Zhou's teaching that  
20 a stabilization approach that tracks salient 09:06:14  
21 features requires a priori knowledge of the image's  
22 content?

23 MS. MAO: Objection. Form.

24 THE WITNESS: I see this just as an example.  
25 It doesn't always require to know the content of an

1 image. There are a lot of approaches that pull out  
2 these salient features automatically.

3 BY MR. SCHMIDT:

4 Q. Well, Zhou teaches that this approach  
5 requires a priori knowledge of the image's content.

6 Do you see that?

7 MS. MAO: Same objection.

8 THE WITNESS: I see that the writing here that  
9 "this approach requires," but I view it as an  
10 example because it's not indeed always the case. 09:07:10

11 BY MR. SCHMIDT:

12 Q. So, in your view, as of 2014, when Zhou  
13 was filed, your understanding is that stabilizing a  
14 video by tracking a salient feature did not require  
15 a priori knowledge of the image's content. Is that  
16 fair?

17 MS. MAO: Objection. Form.

18 THE WITNESS: What I said is this is an  
19 example. In some cases we might know there is a  
20 person in the image and use this as a salient 09:07:48  
21 feature, but, also, we may not know the content  
22 a priori and again extract the salient feature  
23 automatically from an image.

24 BY MR. SCHMIDT:

25 Q. The embodiment that you rely on in Zhou is

1 a technique that relies on an on-board position  
2 sensor to estimate the motion of the camera;  
3 correct?

4 A. Where exactly are you referring to in the  
5 patent?

6 Q. I'm just asking about your opinions.

7 Your opinion is that the motion estimation  
8 disclosed in Zhou is provided by an on-board motion  
9 sensor; correct?

10 MS. MAO: Objection. Objection. Form. 09:08:40

11 BY MR. SCHMIDT:

12 Q. Let me help you out, Doctor. Try  
13 paragraph 70 of Exhibit 3.

14 Do you see in the first sentence of  
15 paragraph 70, you write "Zhou states that these  
16 sensors, which comprise 'motion sensors such as  
17 gyroscopes or accelerometers' provide 'motion  
18 information.'"

19 A. Yes, I see that.

20 Q. So in your opinions regarding Zhou, you're 09:09:53  
21 relying on motion sensors within the image capture  
22 device as the components that provide the motion  
23 information; correct?

24 A. This is definitely something discussed by  
25 Zhou and the device sensors and the architecture

Page 11

1 that's shown there.

2 Q. That's your opinion; right, Doctor?

3 That's what you're relying for your invalidity  
4 opinion?

5 MS. MAO: Objection. Form.

6 MR. SCHMIDT: You have to let me finish asking  
7 my question.

8 BY MR. SCHMIDT:

9 Q. That's what you're relying on for purposes  
10 of your invalidity opinions; correct? 09:10:43

11 MS. MAO: Let me put in my objection. Form.

12 THE WITNESS: Zhou discloses techniques for  
13 stabilizing a motion smoothing trajectory, but the  
14 technique could be applicable to trajectory data  
15 obtained by sensors or with motion data obtained  
16 from images. It focuses on how to stabilize the  
17 trajectory.

18 BY MR. SCHMIDT:

19 Q. Well, claim 1 of the '894 patent requires  
20 a position sensor carried by the housing of the 09:15:02  
21 image capture device. You're aware of that;  
22 correct?

23 A. Yes, I see that.

24 Q. And for purposes of your invalidity  
25 opinion, you map that claim limitation for the

Page 12

1 position sensor against Zhou's disclosure of motion  
2 centers in the form of gyroscopes or  
3 accelerometers; correct?

4 A. Addressing, yeah, this imitation of an  
5 '894, in my declaration, I use these device sensors  
6 that Zhou discloses in Figure 7.

7 Q. And in the remaining part of your  
8 invalidity analysis, you cite portions of Zhou that  
9 are based on motion information that's derived from  
10 those on-board position sensors; correct? 09:17:30

11 A. Can you point me to specific claim  
12 regarding that?

13 Q. Paragraph 74, for example, where you map  
14 against the position output signal.

15 Another example would be paragraph 78  
16 where you map against the appeared trajectory.

17 These are all examples of you citing  
18 motion information that's derived from Zhou's  
19 on-board position sensor. Fair?

20 A. The permutations that you mentioned, this 09:18:22  
21 information is provided by these device sensors  
22 that Zhou discloses.

23 Q. Okay. Now, the method of obtaining  
24 position information using an on-board sensor is  
25 different from the method that's described in

1 column 1 of Zhou that we spoke about before, which  
2 involved tracking salient features.

3 Do you agree?

4 MS. MAO: Objection. Form.

5 THE WITNESS: Column 1 of Zhou is background  
6 information, and it's correct that one approach to  
7 obtain motion information is by analyzing the  
8 images, an image-based approach. The other is to  
9 obtain motion information based on some device  
10 sensors such as gyroscopes.

09:19:55

11 BY MR. SCHMIDT:

12 Q. And those are two alternative ways of  
13 doing it. Do you agree?

14 MS. MAO: Objection. Form.

15 THE WITNESS: In the literature they are  
16 distinguished as two different approaches. They  
17 could be combined at times, or the teachings of the  
18 one approach can influence the limitation of the  
19 others. So there's also some interaction.

20 BY MR. SCHMIDT:

09:20:33

21 Q. But with regard to obtaining motion  
22 information, those are two distinct approaches to  
23 estimating the motion of the image capture device  
24 during capture. Fair?

25 MS. MAO: Same objection.

Page 14

1 THE WITNESS: The two directions, if the device  
2 sensors are not available, one relies on the images  
3 to obtain this motion information. If the device  
4 sensors are available, one might rely exclusively,  
5 or to a large extent, on that information but by  
6 combining image information as well.

7 BY MR. SCHMIDT:

8 Q. Are you familiar with the terms EIS and  
9 OIS?

10 A. EIS, electronic image stabilization, and 09:21:36  
11 OIS, optical image stabilization.

12 Q. Can you provide your understanding of what  
13 is involved in optical image stabilization?

14 MS. MAO: Objection to form.

15 THE WITNESS: I would have to look if this is  
16 something that I offered an opinion in my  
17 declarations.

18 BY MR. SCHMIDT:

19 Q. You can't answer that question without  
20 reading through your 150-page declaration? 09:22:17

21 MS. MAO: Objection. Form.

22 THE WITNESS: I can answer at a high level but  
23 not other fine details. Electronic stabilization  
24 relies, by and large, on utilizing the trajectory  
25 of -- the motion trajectory that has been obtained

Page 15

1 with different means and stabilizing that  
2 trajectory, while optical is to manipulate optical  
3 elements to perform the stabilization.

4 BY MR. SCHMIDT:

5 Q. When you say "manipulate optical  
6 elements," you mean things like physically moving  
7 the lens; is that right?

8 A. That could be one example.

9 Q. Another example would be physically moving  
10 the image sensor to offset movement of the camera; 09:23:46  
11 correct?

12 A. It's not a clear-cut situation in my mind  
13 if moving the camera belongs to EIS or OIS.

14 Q. In the portions of Zhou that you rely on  
15 for your invalidity opinions, do those relate to an  
16 EIS system or an OIS system in your mind?

17 A. I would have to look at my declaration  
18 here to answer my question. It does not have to  
19 belong exclusively to one or the other. The  
20 boundaries are not clear-cut. They are fuzzy 09:25:08  
21 boundaries, and the stabilization has multiple  
22 steps: planning the trajectory, smoothing the  
23 trajectory, cropping the output and so on. So each  
24 and every disclosure can address one or two or  
25 all elements of that.

Page 16

1 Q. Let me just ask you this: Does it matter  
2 to your invalidity opinions whether Zhou's  
3 disclosures are directed to an EIS or OIS system or  
4 is it not relevant?

5 MS. MAO: Objection. Form.

6 THE WITNESS: Unless you point me to my  
7 declaration where I make this statement whether  
8 it's EIS or OIS, given the fact that it is not  
9 clear-cut situation, I cannot answer this question.

10 BY MR. SCHMIDT: 09:26:19

11 Q. I am just asking your methodology when you  
12 formed your expert opinions. Were you looking only  
13 to disclosures relating to EIS systems or were you  
14 also considering disclosures relating to OIS  
15 techniques as well?

16 MS. MAO: Objection. Form.

17 THE WITNESS: Again, this distinction between  
18 EIS and OIS is not -- is not clear, as it's an  
19 overlap area, and, as I mentioned, depending on  
20 which part of the stabilization process one is 09:27:19  
21 referring to, one can use approaches that tell us  
22 how to do -- how to smooth the trajectory  
23 independently of how this trajectory was obtained.

24 BY MR. SCHMIDT:

25 Q. So I don't want to put words in your

Page 17

1 mouth, but it sounds like you did not limit your  
2 analysis to prior art embodiments pertaining to EIS  
3 systems and also considered OIS systems; is that  
4 right?

5 MS. MAO: Objection. Form.

6 THE WITNESS: What I said is that I don't  
7 provide an analysis between OIS, EIS systems in my  
8 declaration.

9 BY MR. SCHMIDT:

10 Q. Okay. Let's look at a new document. This 09:28:33  
11 is going to be 7.

12 (Whereupon, Exhibit 7 was  
13 marked for identification.)

14 BY MR. SCHMIDT:

15 Q. For the record, Doctor, I placed before  
16 you the next exhibit, Exhibit 7. On the front page  
17 can you see that this is a U.S. Patent Application  
18 Number 61/407,630?

19 A. Yes, I do.

20 Q. Take a moment and just flip through this 09:29:36  
21 document. My question is going to be have you ever  
22 seen this document before?

23 A. Not in this form.

24 Q. Do you know what this document is?

25 A. It is the first time I see this document.

Page 18

1 MR. SCHMIDT: This will be 8.

2 (Whereupon, Exhibit 8 was  
3 marked for identification.)

4 BY MR. SCHMIDT:

5 Q. I've now placed before you the next  
6 exhibit in order, Exhibit 8. For the record, this  
7 is U.S. Patent 8,531,535, which I'll refer to in  
8 the deposition as Kwatra. Is that okay?

9 A. Yes.

10 Q. And you're familiar with the Kwatra 09:31:04  
11 patent; correct?

12 A. Correct.

13 Q. I want to direct your attention, on the  
14 first page, do you see in the left-hand column at  
15 line 60 there's something called "Provisional  
16 application"? Do you see that?

17 A. Yes.

18 Q. "Provisional Application  
19 Number 61/407,630"?

20 A. Yes. 09:31:28

21 Q. And that's the same application number  
22 that's on Exhibit 7 that we looked at before. Do  
23 you see that?

24 A. Yes, I do.

25 Q. So in forming your invalidity opinions,

Page 19

1       you did not review the provisional application that  
2       the inventors in Kwatra filed; is that correct?

3           MS. MAO:  Objection.  Form.

4           THE WITNESS:  This is a document that --  
5       application that I did not analyze.

6       BY MR. SCHMIDT:

7           Q.  Turn back to Exhibit 7, which is the  
8       provisional application, and I want to direct you  
9       to page 3 of the document.  Actually, there's  
10      multiple documents put together.  So it's actually       09:32:43  
11      the one -- it's the sixth page of the document, but  
12      it has a 3 at the bottom of it.

13          A.  Okay.

14          Q.  At about a third of the way down, there's  
15      a paragraph that begins with "As the estimation of  
16      per-frame models," and it continues from there.

17                Do you see that?

18          A.  Yes, I do.

19          Q.  I actually want to direct you to the  
20      second sentence of that paragraph.  It reads       09:33:22  
21      "The optimal algorithm could estimate all  
22      parameters for all frames jointly, similar  
23      to Bundle Adjustment."

24                Do you see that?

25          A.  Yes.

Page 20

1 Q. And it goes on to say "However, the  
2 concatenation of parameters is not linear anymore,  
3 requiring a more complex nonlinear optimization  
4 method which is not fast enough for real-time  
5 performance."

6 Do you see that?

7 A. Yes, I do.

8 Q. Do you understand what's being described  
9 there?

10 MS. MAO: Objection. Form.

09:33:50

11 THE WITNESS: As I mentioned, I haven't  
12 analyzed this document. So I cannot offer an  
13 opinion just on the fly by just looking at a  
14 sentence or two.

15 BY MR. SCHMIDT:

16 Q. Generally speaking, based on your  
17 understanding of Kwatra, do you understand that  
18 Kwatra is a technique that is favoring linear  
19 processing approaches to nonlinear processing  
20 approaches?

09:34:22

21 MS. MAO: Objection. Form.

22 THE WITNESS: I do not recall unless you point  
23 me to where Kwatra mentions this. I need to read  
24 Kwatra to be able to answer your question.  
25

Page 21

1 BY MR. SCHMIDT:

2 Q. Sure.

3 So turn to Exhibit 8, which is Kwatra, and  
4 in column 5, line 47, do you see the reference to  
5 "Linear motion models (e.g., translation,  
6 similarity, affine) may be fit to the tracked  
7 features to estimate a motion of the camera between  
8 two frames," and it continues from there?

9 A. I'm sorry. 5, 45 you said?

10 Q. 5, 47. 09:35:12

11 A. 47. Okay.

12 Q. And the sentence begins with "Linear  
13 motion model (e.g. translation, similarity, affine)  
14 may be fit to the tracked features to estimate a  
15 motion of the camera between two frames," and it  
16 continues from there.

17 Do you see that?

18 A. Yes.

19 Q. So my question is do you agree that Kwatra  
20 expresses a preference for linear motion models as 09:35:41  
21 opposed to nonlinear motion models?

22 MS. MAO: Objection. Form.

23 THE WITNESS: The way I read this is it's just  
24 one example of what Kwatra brings up. In this  
25 example linear model, such as the ones mentioned

Page 22

1       there, may be used.

2       BY MR. SCHMIDT:

3           Q.    Is it your view that Kwatra encompasses  
4       nonlinear motion models?

5           A.    By looking at this paragraph, certainly  
6       does not exclude the use of nonlinear models, and  
7       the teaching of Kwatra of minimizing the first and  
8       the second and the third derivative of the path  
9       does not constrain us to a linear or nonlinear  
10      model. 09:37:22

11          Q.    But minimizing the first, second, and  
12      third order derivative of the path is a different  
13      question from whether or not the path is modeled in  
14      a linear or nonlinear fashion; isn't that right?

15          MS. MAO:  Objection.  Form.

16          THE WITNESS:  The path is created based on the  
17      linear or nonlinear motion model going from one  
18      position of the camera to the next.  Rotation might  
19      be considered, translation.  So what is the model  
20      in developing the path is not constrained or 09:38:20  
21      specifically indicated by the fact that the first  
22      or the second derivative of the path is minimized.

23      BY MR. SCHMIDT:

24          Q.    Do you agree that modeling a path  
25      involving rotation requires a nonlinear model?

Page 23

1 MS. MAO: Objection. Form.

2 THE WITNESS: The affine model that Kwatra is  
3 calling a linear motion model involves rotation.

4 BY MR. SCHMIDT:

5 Q. Were you done with your answer?

6 A. Yes.

7 Q. My question was, based on your knowledge  
8 in the field, is it your understanding that  
9 modeling a path involving rotation requires a  
10 nonlinear motion model or can it be done linearly? 09:39:55

11 MS. MAO: Objection. Form.

12 THE WITNESS: Well, I did not analyze  
13 linear/nonlinear models. There is perturbation.  
14 There's angular rotation. There's, I said, what  
15 Kwatra calls a linear motion model, the affine  
16 model, contains rotation and translation. That's  
17 how it's defined. But the position in Kwatra paper  
18 is not constrained against using linear/nonlinear  
19 model.

20 BY MR. SCHMIDT: 09:41:19

21 Q. Turn to column 17 in Kwatra, Exhibit 8.

22 Do you see equation 17 from scale?

23 The question was do you see that, Doctor?

24 A. I'm sorry. Yes. I do, I do.

25 Q. Do you see equation 18 for the rotation

Page 24

1 angle data?

2 A. Yes, I do.

3 Q. In the next paragraph, Kwatra reads  
4 "While constraining smoothness on a,b, rotation and  
5 scale may not remain smooth. Since imposing  
6 smoothness constraints on the s and theta may be  
7 nonlinear, the estimated camera path can be used to  
8 ensure that s and theta do not deviate too much."

9 Do you see that?

10 A. Yes, I do. 09:42:55

11 Q. Do you understand that to be discouraging  
12 the use of a nonlinear motion model?

13 MS. MAO: Objection. Form.

14 THE WITNESS: These equations define  
15 information through these parameters, t, a,b, based  
16 on which scale is defined, rotation is defined,  
17 and then a commentary that constraining  
18 a and b rotation scale may not remain smooth.

19 It just an example of how things are  
20 connected or what the constraint on some parameters 09:44:18  
21 has, the effect of this constraint on other  
22 parameters. I don't really there's -- I think it's  
23 just one example of showing the mathematical  
24 relationship of the parameters.

25

1 BY MR. SCHMIDT:

2 Q. Isn't what Kwatra is saying between  
3 line 17 and 20 that imposing a smoothness  
4 constraint on s and theta would be nonlinear?

5 A. Maybe.

6 Q. Do you agree with that?

7 MS. MAO: Same objection.

8 THE WITNESS: I need to spend time and analyze  
9 these relationships. I have not been doing --  
10 I have not done it for my deposition, and Kwatra 09:45:17  
11 says may be nonlinear.

12 BY MR. SCHMIDT:

13 Q. Kwatra never teaches imposing any  
14 smoothness constraint directly on s and theta,  
15 which are nonlinear, according to this disclosure;  
16 isn't that right?

17 MS. MAO: Objection. Form.

18 THE WITNESS: Kwatra teaches how to impose  
19 smoothness constraints on what he calls -- what he  
20 calls a path that's the P parameter and then 09:46:13  
21 provides examples of different quantities, how they  
22 may be related and so on, but it does not constrain  
23 the derivation of this path how I'm going from one  
24 position on the path to the next, what kind of  
25 transformations that apply there to generate this

Page 26

1 path.

2 BY MR. SCHMIDT:

3 Q. Doctor, isn't it true that the passage  
4 I read to you in column 17 is teaching that  
5 imposing a smoothness constraint on s and theta is  
6 nonlinear, and therefore, it's not a good idea to  
7 do that? Isn't that what that's saying?

8 MS. MAO: Same objection.

9 THE WITNESS: That's not exactly how I read it.  
10 It says that it may be, first of all, nonlinear, 09:47:08  
11 and it does not tell us that this is excluded from  
12 the teaching of the patent.

13 BY MR. SCHMIDT:

14 Q. Okay. But in the discussion that follows,  
15 there's absolutely no disclosure of any smoothness  
16 constraint being placed directly on the parameters  
17 s and theta; isn't that right?

18 MS. MAO: Same objection.

19 THE WITNESS: What are you reading, please?

20 BY MR. SCHMIDT: 09:47:41

21 Q. Let me ask you this: You didn't cite any  
22 disclosure in Kwatra of a smoothness constraint  
23 being applied to the values s and theta in your  
24 declarations; correct?

25 MS. MAO: Objection. Form.

Page 27

1 THE WITNESS: I'd have to look through my  
2 declaration to be able to answer your question.

3 BY MR. SCHMIDT:

4 Q. Take all the time you need. If I missed  
5 it, then feel free to point it out to me where  
6 there's a citation to a smoothness constraint being  
7 placed on  $s$  and  $\theta$  in your sworn declaration.

8 A. Kwatra mentions in 1, 17-19, the "Image  
9 stabilization techniques may compensate for pan and  
10 tilt (angular momentum) of a camera or imaging 09:52:29  
11 device," and also mentions in 16, 13-32, that using  
12 the set of equations limit the range of change in  
13 zoom and rotation.

14 So he's teaching that quantities such as  
15 the angular movement and the rotation can be  
16 minimized, can be limited.

17 Q. Let me ask you a general question. Isn't  
18 it true that placing a constraint on the amount of  
19 a value is different from smoothing the range of  
20 values for that same parameter? 09:53:22

21 MS. MAO: Objection. Form.

22 THE WITNESS: Can you repeat the question,  
23 please?

24 BY MR. SCHMIDT:

25 Q. Sure.

1           There's a difference between placing a  
2       constraint on the range of values for a parameter  
3       and smoothing the parameter across a range of  
4       values; correct?

5           MS. MAO: Objection. Form.

6           THE WITNESS: Smoothing the parameter can be  
7       accomplished in many different ways, one of which  
8       is placing a constraint or utilizing a constraint  
9       in the optimization problem.

10       BY MR. SCHMIDT: 09:54:11

11           Q. So, in your view, placing a constraint on  
12       a range of values like a cutoff is a form of  
13       smoothing?

14           MS. MAO: Objection. Form.

15           THE WITNESS: "Constraint" is a general term.  
16       So you're asking me placing bound constraints on  
17       the values of the parameter, if that's a form of  
18       smoothing; is that correct?

19       BY MR. SCHMIDT:

20           Q. Yes, that's my question. 09:54:44

21                   Is placing bound constraints on the values  
22       of a parameter a form of smoothing?

23           A. It could be thought of as a form of  
24       smoothing, not allowing, you know, larger  
25       deviations than certain bounds.

Page 29

1 Q. And is that the type of smoothing, the  
2 bound constraint -- strike that.

3 Isn't it true that bound constraints is  
4 what Kwatra uses for things like rotation and  
5 scale?

6 MS. MAO: Objection. Form.

7 THE WITNESS: No. In general, Kwatra is trying  
8 to smooth quantities, such as angular motion,  
9 rotational motion, acceleration in the general form  
10 of minimizing quantities, derivatives, for example. 09:55:51

11 BY MR. SCHMIDT:

12 Q. When I asked you before whether or not  
13 Kwatra imposed a smoothness constraint on scale and  
14 rotation, you pointed me to the bound constraints  
15 in column 16; correct?

16 MS. MAO: Objection. Form.

17 THE WITNESS: I just mentioned examples of --  
18 in Kwatra that I just used in my declaration, but  
19 my view of those rotational examples suggest there  
20 are some, but Kwatra gives us the general 09:56:42  
21 methodology of how to go about reducing, removing,  
22 minimizing quantities that determine the path of  
23 the trajectory.

24 MS. MAO: Mr. Smith, it's been almost an hour.  
25 So it would be good for us to take a break.

1 MR. SCHMIDT: All right. Let's take a break.

2 MS. MAO: Okay.

3 (A short break was taken at  
4 9:57 AM to 10:09 AM.)

5 BY MR. SCHMIDT:

6 Q. Welcome back, Doctor. During the break,  
7 did you have any discussions about Kwatra?

8 A. No.

9 Q. I want to direct you to Exhibit 3, which  
10 is your declaration. Let's take a look at 10:10:03  
11 paragraph 117.

12 A. Yes, I'm there.

13 Q. In the third sentence of paragraph 117,  
14 you write "Both Zhou and Kwatra disclose using  
15 similar mobile device components for video  
16 stabilization."

17 Do you see that?

18 A. Yes, I do.

19 Q. Isn't it true that the stabilization  
20 calculations in Kwatra are done in a server as 10:11:12  
21 opposed to a mobile device?

22 MS. MAO: Objection. Form.

23 THE WITNESS: Kwatra teaches various  
24 implementations of the technology. One could be  
25 done, the calculations, on a server, but another

Page 31

1 teaching is that these calculations could be done  
2 on a mobile device.

3 BY MR. SCHMIDT:

4 Q. That's your opinion?

5 A. Yes.

6 Q. In support, the only citation you provide  
7 for Kwatra is Figure 13 and its associated  
8 discussion in column 26.

9 Do you see that?

10 MS. MAO: Objection. Form. 10:13:53

11 BY MR. SCHMIDT:

12 Q. I'm referring to your declaration.

13 A. Paragraph?

14 Q. In paragraph 117, the only support for  
15 your assertion that Kwatra discloses using similar  
16 mobile device components is your citation to  
17 Figure 13 and the discussion in column 26.

18 Do you see that?

19 A. Yes, I do.

20 Q. If you turn to column 26 of Kwatra, which 10:14:19  
21 is Exhibit 8, there's a discussion of example  
22 computing device 1300.

23 Do you see that?

24 A. I'm reading column 26.

25 I'm sorry. What is the question again?

Page 32

1 Q. The question is do you see that column 26  
2 refers to example computing device 1300?

3 A. Yes, I do.

4 Q. And this discussion in column 26 is the  
5 only support in Kwatra for your assertion that the  
6 stabilization techniques of Kwatra can be  
7 implemented in a mobile device; correct?

8 MS. MAO: Objection. Form.

9 THE WITNESS: This is the example I mention,  
10 indeed, in my declaration of this paragraph 117. 10:15:35  
11 I'm not certain if I mention another example in my  
12 declaration, and I'm not sure if there is other  
13 examples in Kwatra's patent, but nevertheless, this  
14 is the one example that I mentioned here in 117.

15 BY MR. SCHMIDT:

16 Q. Setting aside anything else that might be  
17 in your declaration, you're not aware of any other  
18 support, sitting here today, other than what you  
19 cited in paragraph 117 of the ability to implement  
20 Kwatra's techniques in a mobile device; correct? 10:16:10

21 MS. MAO: Objection. Form.

22 THE WITNESS: I'm not able to answer the  
23 question without looking at my declaration and  
24 Kwatra patent.

25

1 BY MR. SCHMIDT:

2 Q. Understood.

3 Beginning at about line 15 and column 26  
4 of Kwatra, Exhibit 8, the disclosure reads "The  
5 computing device may be a personal computer, mobile  
6 device, cellular phone, video game system, or  
7 global positioning system, and may be implemented  
8 as a client device, a server, a system, a  
9 combination thereof, or as a portion of components  
10 described in Figures 1 through 2." 10:17:00

11 Do you see that?

12 A. Yes, I do.

13 Q. And if you turn to Figures 1 through 2 of  
14 Kwatra, do you see the architecture of client  
15 devices communicating with video hosting  
16 service 200?

17 A. In Figure 2; right?

18 Q. Yes.

19 A. Yes.

20 Q. And, in Figure 2, the camera path 10:17:30  
21 translation system 202 is part of the video hosting  
22 service 200.

23 Do you see that?

24 A. Yes, I do.

25 Q. That's a server-based system; correct?

Page 34

1           A.    Figure 2 discloses a server-based system,  
2           yes.

3           Q.    And if there are any mobile devices in  
4           Figure 2, they are only the client devices that  
5           interact with the camera path translation system  
6           through the network 206; right?

7           A.    Figure 2 shows a host-based implementation  
8           of the teachings, but device 1300 can be any of the  
9           examples there, and these are just examples when it  
10          says may be implemented as a client -- so, yeah,           10:18:25  
11          this is, indeed, one of the implementations that  
12          Kwatra teaches, but another implementation is just  
13          to have this technology on a mobile device, a  
14          stand-alone mobile device, as depicted by  
15          Figure 13.

16          Q.    Let me ask you this:  When Figure 13 is  
17          implemented as a client device in accordance with  
18          Figure 2, that client device would not have a  
19          camera path translation system on it; correct?

20          MS. MAO:  Objection.  Form.                               10:19:08

21          THE WITNESS:  Can you repeat the question,  
22          please?

23          BY MR. SCHMIDT:

24          Q.    If the example computing device 1300 that  
25          you cite was implemented as a client device of

1 Figure 2, that client device would not have the  
2 camera path translation system 202; correct?

3 MS. MAO: Objection. Form.

4 THE WITNESS: What I'm stating is that device  
5 1300 is a stand-alone device. Device 1300 does not  
6 make sense to be a client in Figure 2 because then  
7 both the client would do the stabilization and the  
8 server could do the stabilization, it does not seem  
9 compatible, and device 1300 is a stand-alone  
10 device.

10:20:13

11 BY MR. SCHMIDT:

12 Q. That's not what column 26 says. Column 26  
13 says that "it may be a personal computer, mobile  
14 device, cellular phone, video game system, or  
15 global positioning system and may be implemented as  
16 a client device, a server, a system, a combination  
17 thereof, or as a portion of components described in  
18 Figures 1 through 2"; right?

19 A. May be: So they're examples,  
20 possibilities.

10:20:47

21 Q. Where do you see example of computing  
22 device 1300 described as a stand-alone device, in  
23 your words?

24 A. It has processor. It has memory. It has  
25 applications there to do various stabilizations.

Page 36

1 It has all the elements of a stand-alone device,  
2 and, again, combining Figure 13 with Figure 2 does  
3 not seem compatible because then you have two  
4 places to do stabilization, on the server and on  
5 the device, and it doesn't make much sense, I would  
6 say.

7 Q. Based on your experience -- actually,  
8 strike that.

9 We spoke before about, in the context of  
10 Zhou, a stabilization approach that estimates 10:22:01  
11 motion based on trackable features in the image.  
12 Do you recall that?

13 A. I'm sorry. Estimates motion based on  
14 trackable features? Is one possibility the motion  
15 can be estimated from image data by tracking  
16 features?

17 Q. Right.

18 A. Yes.

19 Q. You recall that discussion; correct?

20 A. I do. 10:22:40

21 Q. That's the technique that Kwatra uses for  
22 motion estimation. Agreed?

23 MS. MAO: Objection. Form.

24 THE WITNESS: It's one example. Kwatra can  
25 estimate the trajectory based on image data, but

1       that's just one example.

2       BY MR. SCHMIDT:

3           Q.    And you would agree with me that Kwatra  
4       doesn't cite any mobile device with a position  
5       sensor; correct?

6           MS. MAO:  Objection.  Form.

7           THE WITNESS:  I cannot answer the question.  
8       I'll need to look at Kwatra and look at my  
9       declaration to be able to answer the question.

10       BY MR. SCHMIDT:  10:24:02

11          Q.    Okay.  Well, you haven't relied on Kwatra  
12       for disclosing a mobile device with any position  
13       sensor.  Do you recall that?

14          MS. MAO:  Objection.  Form.

15          THE WITNESS:  No, I need to look at my  
16       declaration to be able to answer the question.

17       BY MR. SCHMIDT:

18          Q.    Okay.  That's fine.  I'm perfectly capable  
19       of reading your declaration.  So if you can't  
20       answer the question, I'll just move on.  10:24:25

21                In 20 -- let's just say, 2018, are you  
22       aware of any mobile device in the field that was  
23       capable of estimating motion of the camera based on  
24       trackable features within an image itself?

25          A.    This is not an analysis I performed for my

Page 38

1 declaration. Cell phones were quite advanced in  
2 2018, but I cannot answer definitely your question.

3 Q. But doing motion estimation of the camera  
4 based on trackable features frame to frame within  
5 an image, you would agree, is a very  
6 computationally intensive exercise; correct?

7 MS. MAO: Objection. Form.

8 THE WITNESS: It's a relative question. What  
9 computationally -- I'm sorry -- intensive means in  
10 2000, 2015, 2018 is a different consideration. So 10:25:52  
11 that's one question, but mobile devices were  
12 extremely powerful in 2018, capable of doing a lot  
13 of things, and the other is that it all depends on  
14 how such an algorithm is implemented. It can have  
15 a light implementation or a heavy implementation.  
16 So it depends on a number of factors.

17 BY MR. SCHMIDT:

18 Q. You've seen in the prior art that you've  
19 reviewed the teaching that implementing this sort  
20 of image tracking optical analysis on a mobile 10:26:33  
21 device is undesirable; correct?

22 MS. MAO: Same objection.

23 THE WITNESS: I do not characterize it  
24 undesirable. It's a matter of what is available to  
25 the implementer. There are gyro data. They can be

1 used by themselves or in addition to the image  
2 data. It's -- pulling out motion trajectory data  
3 is a very well studied topic with a lot of  
4 techniques and a lot of publications out there.

5 BY MR. SCHMIDT:

6 Q. You said, "Pulling out motion trajectory  
7 data is a very well studied topic with lots of  
8 techniques and a lot of publications out there."

9 You're referring to the trackable features  
10 approach? 10:27:39

11 MS. MAO: Objection. Form.

12 THE WITNESS: That is one approach to just have  
13 features that are tracked or without specific  
14 features is a very well-studied topic in image  
15 process implementation.

16 BY MR. SCHMIDT:

17 Q. Isn't it true that in the -- strike that.

18 Isn't it true that, in the 2018 time  
19 frame, the conventional wisdom in the art was that  
20 motion estimation on a mobile device should be done 10:28:16  
21 with an on-board position sensor rather than  
22 through this image tracking technique disclosed in  
23 Kwatra?

24 MS. MAO: Objection. Form.

25 THE WITNESS: I would not completely agree with

Page 40

1 this general statement. It all depends on the  
2 application, what the sources are, what sensors are  
3 available and so on and so forth define  
4 implementations of both approaches separately or in  
5 combination.

6 BY MR. SCHMIDT:

7 Q. Isn't it true that using an on-board  
8 position sensor makes filtering and analyzing the  
9 motion data consume much less processing power in  
10 comparison to trying to estimate camera rotations 10:29:24  
11 from the image data after the fact?

12 MS. MAO: Objection. Form.

13 THE WITNESS: These are engineering trade-offs.  
14 If you have a lot of sensor data, you try to make  
15 use of them. If you have less sensor data, you try  
16 to work with those and so on.

17 So image-based approaches can be  
18 computationally involved. You can have a lighter  
19 version that makes them appealing since one does  
20 not need other sensors such as gyro sensors, 10:30:06  
21 accelerometers, may or may not be available. So it  
22 is -- it's not a clear-cut situation. It all  
23 depends on what we have available and what the  
24 application requires.

1 BY MR. SCHMIDT:

2 Q. I'm going to ask the question again  
3 because I don't think that was responsive.

4 Do you agree that using an on-board  
5 position sensor requires much less processing power  
6 in comparison to trying to estimate camera  
7 rotations from the image data after the fact?

8 MS. MAO: Same objection.

9 THE WITNESS: I think I answered the question,  
10 but it all depends on the application. In some 10:30:53  
11 cases, that may be the case. In others, the  
12 computational expense could be just similar with  
13 image data and with gyro data. It's not just a  
14 very kind of black and white answer.

15 BY MR. SCHMIDT:

16 Q. So you disagree with the categorical  
17 statement I made?

18 MS. MAO: Objection. Form.

19 THE WITNESS: In some cases, that may be the  
20 case; in others, may not be the case. 10:31:35

21 BY MR. SCHMIDT:

22 Q. Okay. Isn't it true, Doctor, that  
23 on-board motion sensing system estimates can be  
24 calculated with a relative few multiplications and  
25 additions while image-based methods require

Page 42

1 processing of thousands or even millions of picture  
2 elements? Isn't that true?

3 A. The feature-based motion estimation,  
4 if I can use two features as an example in an image  
5 and manage to do motion estimation based on that,  
6 then it would be compatible using image data.

7 So, yeah, in general, you deal with more  
8 data, and you have this engineering trade-off, but  
9 it doesn't exclude the image-based methods from  
10 being utilized in certain applications including 10:32:31  
11 mobile system applications.

12 Q. You agree that the motion estimation based  
13 on image analysis requires more data though?

14 You'll agree with that? Fair?

15 MS. MAO: Objection. Form.

16 THE WITNESS: It all depends. As I mentioned,  
17 if there's just one feature in the image that, if  
18 I drag this feature, I can have a micromotion  
19 estimation, then that can be a very, very light  
20 computational approach to find the motion 10:33:14  
21 estimation. If, on the other hand, I need to  
22 finalize all, each and every, pixel image, that is  
23 going to be more involved. So we have a spectrum  
24 of what is required in getting out this  
25 implementation.

1 BY MR. SCHMIDT:

2 Q. But I'm asking you, in general, those  
3 feature tracking-type systems involve more data  
4 which requires more computational resources. Isn't  
5 that true?

6 MS. MAO: Same objection.

7 THE WITNESS: Yeah. I'm trying to answer the  
8 question.

9 So, I mean, there are applications, for  
10 example, where you can use a feature that just, 10:33:58  
11 again, can only track this feature. This feature  
12 stands out. I don't need to process all the data.  
13 This could be a feature that gives me the highest  
14 value and data and so on. So it becomes a very  
15 straightforward implementation of this approach.  
16 So I'm not disagreeing completely with you, but I'm  
17 trying to depict that there's a range of this  
18 computational complexity when using image-based  
19 approaches.

20 BY MR. SCHMIDT: 10:34:39

21 Q. Isn't it true, Doctor, that image-based  
22 motion estimation methods can fail when features  
23 are sparse or when large objects move in the  
24 foreground?

25 MS. MAO: Objection. Form.

Page 44

1 THE WITNESS: Well, "failure" is a very general  
2 term.

3 Yeah, the accuracy of the estimated motion  
4 depends on a lot of factors, and this accuracy,  
5 depending on the method, can be higher or lower.  
6 It's a matter of the performance of the system.

7 BY MR. SCHMIDT:

8 Q. And isn't it true that on-board position  
9 sensors allow for the accurate correction of  
10 rolling shutter on the individual frames without 10:35:29  
11 needing to estimate the motion distortion from  
12 other frames?

13 MS. MAO: Objection. Form.

14 THE WITNESS: Are you referring to something  
15 specific in my declaration or the patents you're  
16 getting this?

17 BY MR. SCHMIDT:

18 Q. I'll show you what I'm referring to. You  
19 can tell me if you agree with it or not.

20 (Whereupon, Exhibit 9 was 10:36:00  
21 marked for identification.)

22 MR. SCHMIDT: This will be Exhibit 9.

23 BY MR. SCHMIDT:

24 Q. Doctor, for the record, I've marked the  
25 next exhibit in order, Exhibit 9. This is

Page 45

1 U.S. Patent 10,027,893, which I'll refer to as the  
2 Bell patent.

3 A. I see that.

4 Q. You're familiar with this document;  
5 correct?

6 A. Yes, I am.

7 Q. And you studied this document in forming  
8 your invalidity opinions; correct?

9 A. That's correct.

10 Q. Is there anything in this document you 10:36:47  
11 disagree with in terms of its characterization of  
12 prior art?

13 MS. MAO: Objection. Form.

14 THE WITNESS: That's a question I cannot answer  
15 in -- it's not an analysis I did regarding this  
16 patent.

17 BY MR. SCHMIDT:

18 Q. You're aware that Bell teaches a system  
19 that estimates motion based on an on-board position  
20 sensor; correct? 10:37:18

21 A. That's what Bell discloses in the abstract  
22 and also in other parts of his specification.

23 Q. Now, take a look at column 6 and line 45.  
24 Bell writes "Using the on-board multi-axis motion  
25 sensing system of a mobile phone or other device

1 for motion tracking has a number of advantages."

2 Do you see that?

3 A. Yes, I do.

4 Q. Why don't you read the discussion that  
5 follows through to line 62 and tell me if you  
6 disagree with anything that Bell has to say about  
7 the state of the art.

8 A. Yeah, Bell makes some general statement  
9 comparing the -- analyzing the motion sensing  
10 system measurements and so on. It focuses -- he 10:40:54  
11 focus in real-time implementations. So at the  
12 level of this general discussion is not that he's  
13 saying something that is wrong, but what I'm adding  
14 to this is that there might be cases for which  
15 image-based methods are comparable both in terms of  
16 computation and performances as methods that use a  
17 multi-axis motion-sensing system, and, again, it's  
18 an engineering trade-off. If you have this  
19 information, you might as well use it.

20 Q. You mentioned that Bell was focused on 10:41:51  
21 real-time implementations. What were you referring  
22 to there?

23 A. The second sentence "Filtering and  
24 analyzing the motion sensing system measurements in  
25 real time requires much less processing power..."

Page 47

1 Q. And that would be as opposed to filtering  
2 and analyzing the motion sensing system in post  
3 processing; correct?

4 A. Yes, non-real-time. After you acquire the  
5 data, you perform processing, yes.

6 Q. And is it fair to say that the  
7 non-real-time post processing applications are  
8 typically implemented in the server?

9 MS. MAO: Objection. Form.

10 THE WITNESS: It depends on the application 10:42:49  
11 whether implemented.

12 BY MR. SCHMIDT:

13 Q. Okay. I want to turn back to Kwatra.  
14 I believe it is Exhibit 8.

15 A. Okay.

16 Q. And I want to turn to column 9 at about  
17 line 41. There's a description of block 308.

18 Do you see that?

19 A. Yes.

20 Q. And what Kwatra is discussing in this 10:44:04  
21 passage is solving for a linear motion model  
22 between frame pair It-1It.

23 Do you see that?

24 A. Yes.

25 Q. And what that means is that the linear

1 model takes the horizontal and vertical position of  
2 a feature in one frame and computes the horizontal  
3 and vertical position of that feature in the next  
4 frame; correct?

5 MS. MAO: Objection. Form.

6 THE WITNESS: Linear model has a very specific  
7 mathematical definition. If a model is linear and  
8 you give a weight to some of the inputs, you get as  
9 the output the weight of some of the responses of a  
10 system as a definition of linearity. They mention 10:45:47  
11 affine model includes rotation and translation and  
12 unless the translations are seen to be zero, your  
13 affine model is nonlinear.

14 BY MR. SCHMIDT:

15 Q. Are you testifying that an affine model is  
16 nonlinear by definition?

17 MS. MAO: Objection. Form.

18 THE WITNESS: There may be different  
19 definitions of an affine model, but a standard  
20 definition is a rotational vector multiplied to the 10:47:05  
21 rotational matrix, and then you add the  
22 translation. So this model, if we pass it  
23 through -- yeah, the translation seems to make it  
24 nonlinear. So all I'm saying is here we have to  
25 see the definition of the affine model in Kwatra to

1 call it a linear, but for -- what was your question  
2 again?

3 BY MR. SCHMIDT:

4 Q. Do you see in column 9 at line 47, there  
5 is a mention of a linear motion model  $F_t(x)$  modeling  
6 the motion of feature points  $x$  from  $I_t$  to  $I_{t-1}$ .

7 Do you see that?

8 A. I do.

9 Q. And that's the goal of Kwatra, to fit a  
10 linear motion model between the feature points from 10:48:24  
11 one frame to another; correct?

12 MS. MAO: Objection. Form.

13 THE WITNESS: Kwatra goes through a number of  
14 examples of models that one can consider and so on  
15 and so forth. So, yeah, this is one example that  
16 this  $F_t(x)$  is a model. He calls it linear, if it's  
17 an affine model, which I have a question mark as to  
18 which expression of the affine model he's using,  
19 but, in general, yeah, there's a mapping of the  
20 features of one frame to the next. That's the 10:49:13  
21 whole idea in 2D and 3D and so on. So these are  
22 all examples. I don't read it as this is the only  
23 model that Kwatra is considering.

24 BY MR. SCHMIDT:

25 Q. Okay. Now, Doctor, when you fit a linear

1 motion model between features appearing in two  
2 consecutive images, that motion model is  
3 representing the motion of the feature between the  
4 frames; correct?

5 MS. MAO: Objection. Form.

6 THE WITNESS: This model maps features from one  
7 frame to a consecutive frame or any other frame for  
8 that matter.

9 BY MR. SCHMIDT:

10 Q. And isn't it true that the motion of the 10:50:06  
11 feature between those two frames is not necessarily  
12 going to correspond to the motion of the actual  
13 camera in physical space?

14 MS. MAO: Objection. Form.

15 THE WITNESS: It depends on the model and the  
16 complexity of the model. One can assume more  
17 complicated model working with image data. I can  
18 fit more complicated models that follow to a good  
19 extent the motion of the camera.

20 BY MR. SCHMIDT: 10:50:53

21 Q. In the model described here,  $F_t(x)$ , that's  
22 the motion between two images between frames, which  
23 does not necessarily correspond to how much the  
24 camera moved in physical space; isn't that right?

25 MS. MAO: Objection. Form.

1 THE WITNESS: This is a two-dimensional linear  
2 motion model as an example, and this shows the  
3 projection of the motion of the camera in the 3D  
4 space onto the 2D space. So unless -- we have to  
5 see, again, what is in this  $F(x)$  model and  
6 depending on what's in this  $F(x)$  model, it could be  
7 a good or not so good approximation of the  
8 3D motion of the camera. So this is, again, a very  
9 specific two-dimensional model, but if I consider  
10 the three-dimensional model, I'll go closer to the 10:52:08  
11 motion of the camera.

12 BY MR. SCHMIDT:

13 Q. Okay. For example, in the two-dimensional  
14 model, if you pan a camera, the images in the  
15 foreground are going to appear to move more than  
16 the images in the background for a given range of  
17 motion of the camera; right?

18 MS. MAO: Objection. Form.

19 THE WITNESS: Yeah, the 2D model is a  
20 projection of the 3D world. So we lose some 10:52:41  
21 information by restricting ourselves to a 2D model.

22 BY MR. SCHMIDT:

23 Q. Turn to your declaration, Exhibit 3.

24 A. Which declaration?

25 Q. Exhibit 3.

1 A. Oh, sorry.

2 Q. Paragraph 108.

3 In paragraph 108 you mention a camera path  
4  $P(t)$ . Do you see that?

5 A. Yes.

6 Q. The function  $P(t)$  in Kwatra is the smooth  
7 camera path; correct?

8 MS. MAO: Objection. Form.

9 THE WITNESS:  $P(t)$  is the path that you want to  
10 smooth. 10:54:11

11 BY MR. SCHMIDT:

12 Q. Take a look at Kwatra, Exhibit 8.

13 In column 13, line 52, Kwatra writes  
14 "Given a continuous original camera path motion  
15  $C(t)$ , for example as found above, you see  
16 Equation (5), a desired smooth  $P(t)$  can be  
17 expressed as," and then there's a formula set forth  
18 in Equation (6).

19 Do you see that?

20 A. Yes, I do. 10:55:15

21 Q. So  $P(t)$  is the smooth camera path in  
22 Kwatra; correct?

23 MS. MAO: Objection to form.

24 THE WITNESS:  $P(t)$  is the path for which they  
25 want to set the first, second, third derivative to

Page 53

1 go to zero. So the result of this optimization is  
2 the smooth path, but  $P(t)$  is the acquired path,  
3 original motion path, that they want to optimize.

4 So the notation here is maybe not  
5 consistent or something. It calls  $C(t)$  the  
6 original, and  $P$  is the result of the optimization  
7 of  $P$ , but it doesn't make sense. Right?

8  $P$  is the result of the optimization of  $C$ ,  
9 but it's shown as -- when I said  $d(p)/dt=0$ , what  
10 would the answer be? Right? Usually, in math, you 10:57:18  
11 say it would be  $p$ -hat, the result of the  
12 optimization. It's another; right? You have the  
13 parameter  $B$ . You try to say it goes to zero and  
14 what -- the result is the smooth. You have to give  
15 it another name. Here you give it the same name.  
16 So it's -- but it's crystal clear that what we try  
17 to optimize is the original path, and the result of  
18 the optimization would give you the smooth path.  
19 Right? So it's a matter of interpretation of the  
20 equation really. 10:57:52

21 BY MR. SCHMIDT:

22 Q. Doctor, I asked a very simple question.  
23 In column 13 Kwatra describes the desired smooth  
24 path as the function  $P(t)$ ; right?

25 MS. MAO: Same objection.

1 BY MR. SCHMIDT:

2 Q. That's what it says?

3 A. Yeah, it's a desired smooth path that  
4 results from the optimization of C, but here he has  
5 the optimization of P. It's a matter of -- you  
6 know, it's clear in the understanding of somebody  
7 that looks at these that you optimize something,  
8 and result of the optimization is something else.

9 You cannot be the same thing. You cannot optimize

10 DP dt. It wouldn't make sense to set the 10:58:32

11 derivative of the smooth path equal to zero. It's

12 already smooth. Right? So it's not -- it's clear

13 what the equations are saying.

14 Q. The original camera path is C(t) and the  
15 desired smooth path is P(t). That's what Kwatra  
16 says. Isn't that right, Doctor?

17 MS. MAO: Same objection.

18 THE WITNESS: It is understood in saying this

19 that to make this statement consistent with the

20 second derivative equal to zero that either the 10:59:08

21 derivative would have been -- should have been

22  $D(c) dt$  equal to 0 or if the  $P dt$  equal zero should

23 give us a P prime or a p-hat. So it's clear that

24 the result of the optimization, if you call the

25 result of the optimization of dP, also P, then P is

Page 55

1 the smooth line, but in the equation, you set the  
2  $\frac{dP}{dt}$  equal to zero. That cannot be the smooth  
3 path. If it's smooth, why smooth it further?  
4 Right?

5 BY MR. SCHMIDT:

6 Q. What makes you think the derivatives are  
7 smoothing?

8 MS. MAO: Objection. Form.

9 BY MR. SCHMIDT:

10 Q. You're skipping ahead to Equation (7) with 10:59:53  
11 derivatives  $P(t)$ .

12 What makes you think that's a smoothing  
13 operation?

14 MS. MAO: Objection. Form.

15 THE WITNESS: Setting the derivative of a  
16 function equal to zero is a smoothing operation.

17 BY MR. SCHMIDT:

18 Q. In the last sentence, column 13, it says  
19 "The optimization may determine a stable camera  
20 path  $P(t)$  by minimizing the cost function," and 11:00:15  
21 then it sets forth Equation (7).

22 Do you see that?

23 A. Yes.

24 Q. And those derivatives are derivatives of  
25  $P(t)$  which Kwatra described just a few lines

1 earlier as the smooth camera path; correct?

2 A. No, I do not agree with that.

3 Q. Well,  $P(t)$  is described as the smooth  
4 camera path in line 54?

5 A. It's the desired smooth path, which how do  
6 you get this desired smooth path by -- because  
7 it's clear to the POSITA what's going on here, the  
8 fact that I call  $P(t)$  smooth and then I set the  
9 derivative of the smooth with respect to equal to  
10 zero, it's inconsistent. So -- because there's 11:01:01  
11 some loose mathematical notation, but it's easy to  
12 understand what is going on. Right?

13 When I set the  $DP/dt$  equal to zero, I get  
14 the new function, and that new function is the  
15 smooth function. Right?

16 Q. You agree that it doesn't make sense for a  
17 first, second, and third order derivative to be  
18 minimized of a camera path that's already smooth;  
19 correct?

20 MS. MAO: Objection. Form. 11:01:51

21 THE WITNESS: I try to explain the  
22 interpretation of this equation and the notation.

23 If I have a smooth the function, further  
24 smoothing it by setting the derivative of a smooth  
25 function equal to zero does not seem meaningful and

1 similarly, the third derivative and the second  
2 derivative.

3 BY MR. SCHMIDT:

4 Q. Let's take a closer look at what's going  
5 on in this Equation (7). I want to direct you to  
6 column 13, lines -- beginning at line 13 at  
7 block 406. Do you see that?

8 A. Yes.

9 Q. "At block 406 a cost function is received  
10 and minimization is performed. For example, the 11:02:49  
11 smooth or optimal camera path (P) can be  
12 partitioned into three segments where only one may  
13 be present at each time t: A constant path,  
14 representing the static camera, i.e.," and then we  
15 get to the equation.

16 Do you see that?

17 A. Yes, I do.

18 Q. What's your interpretation of receiving  
19 the smooth or optimal camera path and partitioning  
20 it into three segments where only one of which is 11:03:16  
21 present at each time?

22 MS. MAO: Objection. Form.

23 THE WITNESS: This is an example, just an  
24 example, where in one segment I can have a constant  
25 path so the first derivative is zero, and another

1 segment I can have the velocity equal to zero by  
2 taking the second derivative, and a third path  
3 where the acceleration is constant, so the third  
4 derivative is zero, but this is just an example.

5 BY MR. SCHMIDT:

6 Q. And in this example you can take three  
7 different segments of the path where each one of  
8 those conditions is satisfied per segment and link  
9 them together; correct?

10 MS. MAO: Objection. Form.

11:04:09

11 And, Patrick, we are near the one-hour  
12 mark.

13 MR. SCHMIDT: Let me just finish up this line  
14 of questioning.

15 THE WITNESS: I'm sorry.

16 What's the question again?

17 BY MR. SCHMIDT:

18 Q. In this example, Kwatra is describing that  
19 you can take three different segments of the path  
20 where each one of these conditions is satisfied per 11:04:28  
21 segment and then link them together into one  
22 continuous path; correct?

23 MS. MAO: Objection. Form.

24 THE WITNESS: This is what is mentioned here,  
25 that these conditions can be applied separately in

Page 59

1 different paths of the -- different parts of the  
2 motion path, and, of course, you have issues. The  
3 boundaries potentially might have issues.

4 BY MR. SCHMIDT:

5 Q. You would agree with me that forming a  
6 path where a single derivative is equal to zero  
7 over one segment of the path and a different  
8 derivative is equal to zero over a different  
9 portion of the path doesn't meet the claim language  
10 of the '894 patent; correct?

11:05:28

11 MS. MAO: Objection. Form.

12 THE WITNESS: Which claim are you referring to?

13 BY MR. SCHMIDT:

14 Q. Referring to claim 1, which refers to  
15 "wherein the captured trajectory is determined to  
16 include a path that minimizes a combination of  
17 rotational velocity and rotational acceleration of  
18 the housing."

19 My question for you, Doctor, that language  
20 is not satisfied by an approach that minimizes the  
21 first derivative in one segment and minimizes the  
22 second derivative in a second segment and then just  
23 links them together; correct?

11:06:18

24 MS. MAO: Objection. Form.

25 THE WITNESS: This is just an example in Kwatra

Page 60

1 where one can apply this derivatives equal to zero  
2 by themselves, but another example, which is more  
3 applicable to the communication you read, is  
4 Equation (7) where two or three derivatives can be  
5 applied at the same time, and 7 is, of course, a  
6 generalization of the first case we discussed.

7 BY MR. SCHMIDT:

8 Q. Okay. So that's not my question. You  
9 have to answer my question.

10 My question is the approach that 11:07:44  
11 I described in column 13 where a first derivative  
12 is minimized in segment 1 and the second derivative  
13 is minimized in segment 2 of the path, that example  
14 doesn't meet the claim limitation of the '894  
15 patent that we're discussing; correct?

16 MS. MAO: Objection. Form.

17 THE WITNESS: Yeah, the claim limitation reads  
18 that minimize a combination of velocity and  
19 acceleration.

20 BY MR. SCHMIDT: 11:08:36

21 Q. So you agree it doesn't meet the claim  
22 language?

23 MS. MAO: Objection. Form.

24 THE WITNESS: If combination is two, mean that  
25 I need to have both velocity and acceleration to

Page 61

1 minimize at the same time for the same path. So  
2 for any path I have to have both. This does not  
3 seem to satisfy that. It is interpret that given a  
4 path I do -- I use both, I use a combination but  
5 for different parts of the path, then it satisfies  
6 this.

7 But, again, this is just an example, and  
8 Kwatra gives us the general equation that has these  
9 equations as a special case, and that's

10 Equation (7).

11:10:52

11 BY MR. SCHMIDT:

12 Q. Well, the claim limitation does require a  
13 minimization of both rotational velocity and  
14 rotational acceleration in combination over the  
15 same path. Can we agree on that?

16 MS. MAO: Same objection.

17 THE WITNESS: Yeah, that seems a reasonable  
18 interpretation that is of a -- again, it's the same  
19 path and that part of the path I apply velocity,  
20 the other acceleration, but it's, like, for any  
21 given segment of the path, I need to have both, and  
22 that's the interpretation of this. Right?

11:11:35

23 MR. SCHMIDT: Okay. Let's take a break.

24 (A short break was taken at  
25 11:11 AM to 11:26 AM.)

1 BY MR. SCHMIDT:

2 Q. Welcome back, Doctor.

3 A. Thank you.

4 Q. I want to turn to Kwatra, which is  
5 Exhibit 8, and I want to direct you to Figure 5.  
6 There's a 5A, 5B, 5C, and 5D.

7 Do you see that?

8 A. Yes, I do.

9 Q. Just for context, I'll also direct you to  
10 the specification that describes this. This is at 11:26:55  
11 column 14, line 22 for the description of 5A and  
12 5D.

13 A. Okay.

14 Q. And according to the specification and the  
15 figure, 5A is an example of a path that has only  
16 constant position for the camera; correct?

17 MS. MAO: Objection. Form.

18 BY MR. SCHMIDT:

19 Q. At line 30 it says "Figure 5A illustrates  
20 the optimal camera path 500 including constant 11:27:41  
21 noncontinuous path with weights chosen such that  
22  $a=1$  and  $b=c=0$ ."

23 Do you see that?

24 A. Yes, I saw that paragraph in the  
25 specification.

1 Q. So this is an example where the smooth  
2 camera path is optimized such that the velocity is  
3 zero; correct?

4 A. 500 is the result of setting the  
5 derivative of 502 equal to zero.

6 Q. And where do you see that?

7 MS. MAO: Objection. Form.

8 THE WITNESS: You can get Figure 5A but setting  
9 the derivative of 502 equal to zero you get 500.

10 BY MR. SCHMIDT:

11:29:41

11 Q. You can tell that just by looking at the  
12 figure?

13 A. Not just by looking at the figure, by  
14 reading the specification.

15 Q. Okay. And then Figure 5B is an example  
16 where the optimal camera path is a series of linear  
17 paths with jerks. Do you see that?

18 A. With abrupt changes, yes.

19 Q. And that would be an example where the  
20 smooth camera path's second derivative is equal to 11:30:37  
21 zero; correct?

22 A. Yes, an example of setting the second  
23 derivative of 503 to zero, you get 500.

24 Q. And then Figure 5C is an example where the  
25 third derivative is set equal to zero; correct?

1 A. Correct.

2 Q. And then Figure 5D is an example where you  
3 have two different paths; correct?

4 MS. MAO: Objection. Form.

5 BY MR. SCHMIDT:

6 Q. Let me withdraw the question. Let me  
7 re-ask the question.

8 Figure 5D is an example where you have two  
9 different segments within the path; isn't that  
10 right? 11:31:39

11 MS. MAO: Objection. Form.

12 THE WITNESS: 5D is the result of minimizing  
13 the first and second and third derivative of 502  
14 with weights a=1, b=1, and c=100.

15 BY MR. SCHMIDT:

16 Q. Isn't what's shown in line 500 of  
17 Figure 5D a concatenation of the constant velocity  
18 path combined with the path where the third order  
19 derivative is zero?

20 MS. MAO: Objection. Form. 11:32:24

21 THE WITNESS: I'm sorry.

22 You're referring to Figure 5D?

23 BY MR. SCHMIDT:

24 Q. Let me re-ask the question.

25 Isn't it true Figure 5D is a combination

1 of Figure 5A and 5C?

2 MS. MAO: Objection. Form.

3 THE WITNESS: No.

4 BY MR. SCHMIDT:

5 Q. Well, the path starts off straight during  
6 the beginning part in 5D.

7 Do you see that?

8 A. Qualitatively speaking, yes, but the  
9 specification is crystal clear how 5D is obtained.

10 Q. And what the specification describes is 11:32:59  
11 partitioning the smooth or optimal camera path into  
12 different segments where only one minimized  
13 derivative may be present at each time; correct?

14 MS. MAO: Objection. Form.

15 BY MR. SCHMIDT:

16 Q. That's column 13.

17 A. I'm reading column 14, line 44.

18 "Figure 5D illustrates the optimal camera path with  
19 weights chosen such that  $a=10$ ,  $b=1$ , and  $c=100$ ."

20 Q. You don't interpret Figure 5D to be a path 11:34:20  
21 segmented into different partitions?

22 A. No, I see absolutely no reason to do so  
23 since the specification tells us exactly how 5D was  
24 obtained.

25 Q. And what you're relying on is the

1 specification's disclosure of the weights having  
2 certain values; correct?

3 A. That's correct, and trying to make a point  
4 that if the third weight is much larger than the  
5 other, then the third derivative becomes smaller.

6 The relative importance of the three  
7 derivatives and the third order becomes more  
8 important than the other two, and that's why we see  
9 more of a telephotic shape.

10 Q. Let me ask you this: Is Figure 5D 11:35:12  
11 representing, in your mind, an embodiment of the  
12 '894 invention?

13 MS. MAO: Objection. Form.

14 THE WITNESS: Are you referring to a specific  
15 claim in '894 or...

16 BY MR. SCHMIDT:

17 Q. The same limitation we were speaking about  
18 before the break: the minimization combination of  
19 velocity, rotational velocity, and rotational  
20 acceleration. 11:35:59

21 Does Figure 5D represent a system  
22 satisfying that limitation?

23 A. The limitation reads to include minimize  
24 the combination.

25 So, certainly, it minimizes rotational

1 velocity and rotational acceleration, but it also  
2 minimizes the third derivative.

3 Q. Were you done with your answer?

4 A. One second.

5 The main point of this figure is to show  
6 that one can choose the three terms, use them one  
7 at a time, two at a time, three at a time and so  
8 on. So if we just need velocity and acceleration,  
9 then we set  $C=0$  and this then satisfies the  
10 limitation.

11:38:14

11 Q. Let me direct you to Figure 8A.

12 Do you see Figure 8A has --

13 A. Excuse me. In Kwatra; right?

14 Q. Yes.

15 A. Yeah. Thank you.

16 Q. You see the heavy lined segments that are  
17 overlaid on the trajectory in Figure 8A?

18 A. Yes, I do.

19 Q. Those segments are labeled "constant,"  
20 "linear," and "parabolic."

11:39:06

21 Do you see that?

22 A. Yes.

23 Q. And each one of those segments is  
24 minimizing just one derivative of the smooth path.  
25 Do you agree?

Page 68

1 MS. MAO: Objection. Form.

2 THE WITNESS: I have to see where Figure 8A is  
3 described.

4 BY MR. SCHMIDT:

5 Q. Column 19.

6 A. Yes. Thank you.

7 So according to this specification,  
8 Figure 8A illustrates portions of the path. Some  
9 have constant -- it's a constant path. So it's a  
10 constant velocity, a constant acceleration, yes. 11:40:25

11 Q. But, in Figure 8A, none of those segments  
12 have a combination of constant path velocity and  
13 acceleration; correct?

14 MS. MAO: Objection. Form.

15 THE WITNESS: I'm sorry. Can you repeat that  
16 question?

17 BY MR. SCHMIDT:

18 Q. Yeah. Let me ask a different question.

19 Isn't it true that, in Figure 8A, none of  
20 those segments represent a path having a 11:41:01  
21 minimization of a combination of velocity and  
22 acceleration?

23 MS. MAO: Objection. Form.

24 THE WITNESS: This seems to be the case. This  
25 is just one example of how one can use these terms

Page 69

1 by themselves, in combination, but reading the  
2 specification, the point that it tries to make and  
3 points to the fact that I might have the ABC and  
4 the ABCs can be adjustable along the path to have  
5 the one or the other, but, here, it just makes the  
6 point that the path can be nicely approximated with  
7 a straight line, a constant line, or a parabolic.

8 BY MR. SCHMIDT:

9 Q. So you would agree with me that Figure 8A  
10 is not describing a system that meets the claim 11:42:04  
11 limitation required in minimization of a  
12 combination of rotational velocity and  
13 acceleration; correct?

14 MS. MAO: Objection. Form.

15 THE WITNESS: Yeah, again, this is an example  
16 that makes the point that depending on where you  
17 might have one of the terms better describing this,  
18 but it's crystal clear that this is an example and,  
19 as we saw in Figure 5C -- D rather, you can use all  
20 three terms. 11:42:45

21 BY MR. SCHMIDT:

22 Q. Turning back to Figure 5D, do you see the  
23 portion of the path from the very beginning to,  
24 I guess, on the X axis a little after 40, that  
25 straight portion of the path?

1 A. Yes.

2 Q. That's a path of zero velocity; correct?

3 MS. MAO: Objection. Form.

4 THE WITNESS: Again, Figure 5, we have exact  
5 description of how it was created, and since the  
6 inventor tells us exactly how Figure 5 was created,  
7 just trying to visually interpret which part does  
8 what is not that meaningful.

9 BY MR. SCHMIDT:

10 Q. You have to focus on my question. 11:43:51

11 I'm asking you about the segment of the  
12 path in Figure 5D from zero to approximately 50 on  
13 the X axis. That portion is a path of zero  
14 velocity; correct?

15 MS. MAO: Same objection.

16 THE WITNESS: Yeah. I'll avoid to visually  
17 interpreting this.

18 That's a path for which, as we already  
19 described, ten times the first derivative plus one  
20 time the second derivative, plus 100 times a third 11:44:28  
21 derivative, all 502 is equal to zero. If it  
22 appears like a straight line, so be it, but we know  
23 exactly what that path means.

24 BY MR. SCHMIDT:

25 Q. I'll give you one more chance to answer

Page 71

1 the question.

2 Do you agree that the segment of the path  
3 from zero to about 50 on the X axis of Figure 5D is  
4 a path or segment of zero velocity?

5 MS. MAO: Same objection.

6 THE WITNESS: It appears to be a separate line,  
7 but this is within the accuracy of the resolution  
8 of the printing machine here, but we know exactly  
9 mathematically what the part is, as I already  
10 mentioned. The inventor tells us it's ten times 11:45:25  
11 the first derivative plus one time the second  
12 derivative plus a hundred times the third  
13 derivative, all the original data 502 being equal  
14 to zero.

15 BY MR. SCHMIDT:

16 Q. And what makes you think that Figure 5D is  
17 describing a minimization of all three of those  
18 derivatives across the entire path as opposed to  
19 segments of the path?

20 A. There's absolutely no indication that it 11:45:57  
21 is done on the segments. It tells us that it's the  
22 optimal camera path with its weights by minimizing  
23 Equation (7). It's for the whole -- for the whole  
24 path.

25 Q. Okay. Turn to Exhibit 3, which is your

1 declaration, paragraph 108.

2 A. I'm sorry? 108?

3 Q. Yes. In the last sentence of  
4 paragraph 108, you say "Kwatra discloses estimating  
5 camera rotation three dimensions and two dimensions  
6 and three dimensions as example camera motion  
7 during video capture."

8 Do you see that?

9 A. Yes, I do.

10 Q. Where do you see in Kwatra a disclosure of 11:48:13  
11 estimated camera rotation in three dimensions?

12 A. I have multiple references in my  
13 declaration there, and if we start going down the  
14 line of this example.

15 So in 11, 9 to 10, he talks about affine  
16 transformation, which is rotation plus translation  
17 and homography, which has eight degrees of freedom.

18 Homography is a three-dimensional mapping.

19 Then in 58, we talk about estimates from  
20 lower to higher dimension motion models. 11:52:08  
21 Homography may be performed.

22 Q. Let me stop you there. You just were  
23 referring to column 11, line 58?

24 A. Yes.

25 Q. And your testimony is that a homography is

1 a three-dimensional mapping?

2 MS. MAO: Objection. Form.

3 THE WITNESS: It can be a three-dimensional  
4 modeling.

5 BY MR. SCHMIDT:

6 Q. But not necessarily; right, sir?

7 A. Conditions not being lines to lines and  
8 having the -- conditions listed for homography, but  
9 it can be higher dimensional because that's exactly  
10 what it says here, going from low to high 11:53:19  
11 dimensional motion models.

12 Q. Where do you see that?

13 A. In 11, 58.

14 Q. In the example of going from a lower to  
15 higher dimension motion model is, for example,  
16 going from similarity to homography; correct?

17 A. These are examples, but going from lower  
18 to higher dimensional motion models, going from a  
19 2D model to 3D model, is a reasonable understanding  
20 of this passage here. 11:53:58

21 Q. Okay. But you agree that a homography  
22 motion model can be in two dimensions; correct?

23 A. Yeah, could be in two, could be in three.

24 Q. And an affine motion model can be in two  
25 dimensions as well; correct?

1 A. And three dimensions, yes.

2 Q. Both; right?

3 A. Yes.

4 Q. And nowhere in column 11 does it specify  
5 three dimensions as opposed to two; fair?

6 MS. MAO: Objection. Form.

7 THE WITNESS: But it does tell us going from  
8 lower to higher dimension motion models. So what's  
9 higher than two? It's three.

10 BY MR. SCHMIDT: 11:54:53

11 Q. It says an example of going from lower to  
12 higher dimension models is going from similarity to  
13 homography with more degrees of freedom; right?

14 A. It's an example. But it's dimensions;  
15 it's not degrees of freedom. It doesn't say going  
16 from lower degrees of freedom, number of degrees of  
17 freedom to higher number of degrees of freedom. It  
18 says dimension. So dimension is, again,  
19 two-dimensional space or three-dimensional space.

20 Q. Okay. So -- and that's your basis for 11:55:21  
21 opining that Kwatra discloses three-dimensional  
22 model?

23 A. This is one example.

24 Then in my declaration I have additional  
25 examples.

Page 75

1 Q. Well, let's just -- 17 --

2 A. I'm sorry.

3 MS. MAO: Can you let him finish?

4 He hasn't finished yet.

5 THE WITNESS: I am going to 17, 7-8, where we  
6 talk about combination of scale rotation  
7 translation.

8 BY MR. SCHMIDT:

9 Q. That doesn't tell us whether it's two  
10 dimensional or three dimensional; fair? 11:56:21

11 A. As you said, rotation translation can be  
12 two or three dimensions, and similar, scale, all of  
13 them can be two or three. These are just examples  
14 of increasing the dimensionality that we talked  
15 about earlier.

16 Q. Okay. Focus on my question, please.

17 Column 17, lines 7 through 8, does not  
18 tell us whether what's being referred to is two  
19 dimensional or three dimensional. Agreed?

20 MS. MAO: Same objection. 11:57:07

21 BY MR. SCHMIDT:

22 Q. It could be either.

23 A. It could be either, but given the fact  
24 that we were motivated, we were actually guided to  
25 go to higher dimensions. The disclosure is stating

Page 76

1 that what is disclosed here could be applied to  
2 three dimensions as well.

3 Q. Okay. And at lines 38 through 48, you  
4 have some trigonometric relationships.

5 Do you see that?

6 The question, Doctor, was, do you see  
7 that?

8 A. Of course, yes, I see that.

9 Q. The fact that there's these trigonometry  
10 relationships don't tell us whether what's being 11:59:21  
11 referred to is two dimensions or three dimensions.  
12 Fair?

13 MS. MAO: Objection. Form.

14 THE WITNESS: I haven't analyzed this part in  
15 my declaration in detail, but it is, again, clearly  
16 stated that you can take everything to higher  
17 dimension, and even if the examples are in 2D, it  
18 is understood with POSITA that you can take the  
19 three dimensions as the patent suggests as we saw  
20 earlier. 12:00:00

21 BY MR. SCHMIDT:

22 Q. Are you saying you didn't analyze  
23 column 17 in detail?

24 A. In my declaration.

25 Q. Okay. And then the last thing you cite is

Page 77

1 column 18, lines 54 through 56, which reads  
2 "As still another example, for camera rotation,  
3 feature point motion derivatives may diminish as a  
4 square of angular velocity."

5 Do you see that?

6 A. Yes, I do.

7 Q. That doesn't tell us anything about 2D  
8 versus 3D, does it?

9 A. It tells us exactly that this camera  
10 rotation -- to capture the camera rotation and the 12:00:40  
11 angle of velocity you have to consider a 3D model.

12 Q. Why does what's being described here in  
13 column 18 tell you that you have to consider a 3D  
14 model?

15 I don't understand.

16 MS. MAO: Objection. Form.

17 THE WITNESS: I need to consider a model that  
18 captures camera rotation, and this is a  
19 three-dimensional model, and it also talks about  
20 the angle of velocity, which is also a 12:01:31  
21 three-dimensional model. So this is my reading is  
22 that it's a clear indication that a  
23 three-dimensional model of the camera motion is  
24 considered.

1 BY MR. SCHMIDT:

2 Q. Can you have angular velocity considered  
3 in a two-dimensional model?

4 MS. MAO: Objection. Form.

5 THE WITNESS: The two-dimensional models we  
6 talked about cannot -- cannot cover that, cannot  
7 cover the camera rotation in the 3D space, cannot  
8 cover the angle and velocity of the camera. I need  
9 a 3D model to be able to capture this quantity.

10 BY MR. SCHMIDT: 12:02:44

11 Q. Thank you.

12 Let's turn back to Bell, which we looked  
13 at previously, the Bell patent, Exhibit 9.  
14 Actually I'm going to direct you to your  
15 declaration. I want to look at Exhibit 4, which is  
16 one of the declarations you submitted for the '840  
17 patent. I want you to turn to page 23.

18 And on page 23 you set forth your opinions  
19 for ground 1 relying on the Bell and Shi reference.

20 Do you see that? 12:03:38

21 A. I do.

22 Q. Now I want to turn to paragraph 105.

23 And this is still in ground 1. This is  
24 where you're analyzing claim limitation 1(g(i),  
25 which is "determine a smoothed trajectory of the

Page 79

1 housing based on a look-ahead of the trajectory and  
2 one or more of a weight-balance parameter, a  
3 low-light high-pass parameter, and/or stickiness  
4 parameter."

5 Do you see that?

6 A. Yes, I do.

7 Q. And you opine that the combination of  
8 Bell and Shi discuss the low-light high-pass  
9 parameter that's recited in that limitation. Fair?

10 A. The answer is yes.

12:05:45

11 Q. You're not contending that the combination  
12 of Bell and Shi disclose a weight-balance  
13 parameter; correct?

14 MS. MAO: Objection. Form.

15 THE WITNESS: Bell and Shi are combined in  
16 ground 1.

17 Can you repeat your question, please?

18 BY MR. SCHMIDT:

19 Q. I just wanted to confirm you're not  
20 contending in this case that the combination of  
21 Bell and Shi disclose a weight-balance parameter as  
22 was cited in claim limitation 1(g)(i).

12:07:52

23 A. You're combining Bell and Shi to disclose  
24 this parameter.

25 Q. Okay. Let me back up so we're clear.

Page 80

1           On page 63, do you see claim limitation  
2   1(g)(i)?

3           A.    Yes, I do.

4           Q.    And that claim limitation requires that  
5   the determination of the smoothed trajectory be  
6   based on one of three alternative parameters.  
7   Agreed?

8           A.    Yes.

9           Q.    Low-light high-pass, weight balance, and  
10   stickiness; correct? 12:08:47

11          A.    Yes.

12          Q.    And you're relying on Bell and Shi to  
13   disclose the low-light high-pass parameter;  
14   correct?

15          A.    Correct.

16          Q.    That's because Bell and Shi don't disclose  
17   the weight-balance parameter. Fair?

18          MS. MAO:  Objection.  Form.

19          THE WITNESS:  For the weight-balance parameter,  
20   we combined Bell and Shi with Kwatra. 12:10:23

21   BY MR. SCHMIDT:

22          Q.    That's because you acknowledge that Bell  
23   and Shi by itself don't disclose the weight-balance  
24   parameter; right?

25          MS. MAO:  Objection.  Form.

Page 81

1 THE WITNESS: I think a stronger case is made  
2 by combining it with Kwatra.

3 BY MR. SCHMIDT:

4 Q. Well, you haven't rendered any opinion in  
5 this matter that Bell and Shi by themselves  
6 disclose a weight-balance parameter. Is that true?

7 A. I'll have to look at the whole declaration  
8 to make sure that that's correct, but I don't see  
9 in 1(g)(i) here disclosing that Bell and Shi render  
10 this weight-balance parameter obvious. 12:12:00

11 Q. Okay. Turning back to Bell, which is  
12 Exhibit 9, you're familiar with this patent; right,  
13 Doctor?

14 A. Yes, I am.

15 Q. And would you agree with me that Bell  
16 doesn't factor in rotational acceleration to its  
17 analysis?

18 MS. MAO: Objection. Form.

19 THE WITNESS: I don't recall off of my head.  
20 I would need to look at Bell again and my 12:12:59  
21 declaration as well to answer your question.

22 BY MR. SCHMIDT:

23 Q. Let me ask you a different question.

24 Turning back to your declaration, page 63,  
25 this is the same limitation we were looking at

Page 82

1 before, 1(g)(i). Do you see that?

2 A. Yes.

3 Q. "Determine a smoothed trajectory of the  
4 housing based on a look-ahead of the trajectory,"  
5 and then it continues from there.

6 Do you see that?

7 A. Yes, I do.

8 Q. Do you agree that the determination of the  
9 smoothed trajectory needs to be based on a  
10 consideration of the original trajectory under this 12:14:05  
11 claim language?

12 A. This doesn't say specifically what they  
13 have of the original trajectory.

14 Q. Okay. Well, when this claim limitation  
15 refers to the trajectory, it's referring back to  
16 the trajectory that's recited in the claim  
17 limitation on page 57.

18 Do you recall that?

19 A. Limitation of the housing and then --

20 (Stenographer clarification.) 12:16:28

21 THE WITNESS: Sorry. So determine trajectory  
22 of the housing -- that's what you're referring  
23 to -- right? -- in claim 1?

24 BY MR. SCHMIDT:

25 Q. Sure.

Page 83

1           A trajectory of the housing during the  
2 capture duration is the original trajectory. Do we  
3 agree on that?

4           A. Original in the sense of -- I mean, the --  
5 you collect data to determine a trajectory, and  
6 there may be processes taking place in determining  
7 this trajectory, but, so original in the sense that  
8 this is the trajectory that I need to use to  
9 determine a smoothed trajectory, but what kind of  
10 processing took place in determining this           12:17:48  
11 trajectory, it's not specified here.

12          Q. Okay. Fair enough.

13                 But when the claim recites "determine a  
14 smoothed trajectory of the housing based on a  
15 look-ahead of the trajectory," the look-ahead needs  
16 to be of that same trajectory that's determined in  
17 the prior claim limitation; correct?

18          A. That's right.

19          Q. If you turn to Bell, which is Exhibit 9,  
20 I want to look at column 8. At line 57, column 8,           12:18:36  
21 Bell reads "The physical and virtual camera  
22 orientations at frame k are represented with the  
23 quaternions p(k) and v(k).

24                 Do you see that?

25          A. Yes, I do.

1 Q. It goes on to say "The physical and  
2 virtual angular velocities are represented as the  
3 discrete angular changes from frame k to frame k+1  
4 and are represented as  $p \Delta(k)$  and  
5  $v \Delta(k)$ ."

6 Do you see that?

7 A. Yes, I do.

8 Q. Now, in Bell, the trajectory would be  $p(k)$   
9 and  $p \Delta(k)$ . Do I have that right?

10 MS. MAO: Objection. Form. 12:19:44

11 THE WITNESS: The trajectory is  $p(k)$  and from  
12  $p(k)$ , I can derive  $p \Delta(k)$ , but the trajectory  
13 is  $p$  of  $(k)$ .

14 BY MR. SCHMIDT:

15 Q. And the smoothed trajectory is the virtual  
16 camera orientation  $v(k)$ . Fair?

17 A. Yes.

18 Q. Now, turn back to your declaration at  
19 page 64 where you analyze this claim limitation  
20 1(g)(i), "determine a smoothed trajectory of the 12:20:31  
21 housing based on a look-ahead of the trajectory."

22 In paragraph 106 you cite Relation 10.

23 Do you see that?

24 A. I'm sorry. Relation?

25 Q. Relation 10. Do you see that formula?

Page 85

1           A.    I don't see the number 10.  The first  
2 equation?

3           Q.    It's in the sentence right before you say  
4 "For example" --

5           A.    Sorry.

6           Q.    And Relation 10 is what you contend is the  
7 determination of the smoothed trajectory based on a  
8 look-ahead of the trajectory?

9           MS. MAO:  Objection.  Form.

10          BY MR. SCHMIDT:  12:26:21

11          Q.    Do you remember the question, Doctor?

12          A.    Can you repeat it for me?

13          Q.    Let me ask a different question.

14                  What are you contending is the  
15 determination of the smoothed trajectory based on a  
16 look-ahead of the trajectory in Bell?

17          A.    So Bell uses this relation 7 -- 10 -- I'm  
18 sorry -- to project or to estimate the fragile  
19 check position alpha frames into the future, and  
20 then whether this estimate is going to be kept or  12:27:03  
21 not, we need to use the actual data to decide  
22 whether it will carry out the interpolation of  
23 Relation 11 or not.

24          Q.    Let me ask you this:  Relation 10 is  
25 expressed entirely in terms of the virtual camera;

Page 86

1 right?

2 A. That's correct.

3 Q. And Relation 11, which is the  
4 interpolation that you mentioned, that is an  
5 interpolation entirely of the parameters involving  
6 the virtual camera as well; correct?

7 A. That's correct.

8 But in order to utilize Relation 11,  
9 I have to use the actual data, camera data, whether  
10 to use or not to use because there's a comparison 12:28:06  
11 mechanism decision that involves the actual data.

12 Q. What is the comparison using the original  
13 data that you're referring to?

14 MS. MAO: Objection. Form.

15 And, Patrick, we are close to 12:30.

16 THE WITNESS: Perturbations is the projection  
17 of the polygon out of frames where the feature is  
18 outside the inner region.

19 BY MR. SCHMIDT:

20 Q. That comparison is a comparison between 12:28:54  
21 the projection of the virtual camera to where the  
22 camera is located at a given moment in time;  
23 correct?

24 MS. MAO: Objection. Form.

25 THE WITNESS: Is a comparison -- is a test that

1 would require the use of the p(k) data, the  
2 actual -- the actual camera trajectory.

3 BY MR. SCHMIDT:

4 Q. That's what I don't understand because you  
5 write in your declaration "If the projection of the  
6 crop polygon alpha frames into the future is  
7 outside the inner region," and then it continues  
8 from there.

9 So the task doesn't look like -- as you  
10 articulate, it doesn't look like it's considering 12:29:49  
11 actual camera motion data at all.

12 MS. MAO: Objection. Form.

13 BY MR. SCHMIDT:

14 Q. The test that you're articulating is just  
15 a comparison of the forward projection of the  
16 virtual camera to the location of the inner region;  
17 right?

18 MS. MAO: Objection. Form.

19 THE WITNESS: Those states in 10, 17  
20 "Embodiments in accordance with the present 12:31:02  
21 invention project the orientation forward in time  
22 and compare it to the orientation at the 'future'  
23 time."

24 And the orientation at the future time  
25 refers to the actual orientation.

Page 88

1 BY MR. SCHMIDT:

2 Q. The comparison between the projection of  
3 the orientation at the -- strike that.

4 The comparison is the comparison between  
5 the projection forward in time and the virtual  
6 camera at the future time; correct?

7 MS. MAO: Same objection.

8 THE WITNESS: Where it is -- the projection is  
9 the  $v(k)$  plus alpha, and the comparison is with the  
10 actual orientation. 12:32:12

11 BY MR. SCHMIDT:

12 Q. How does that make any sense comparing the  
13 virtual camera at some projected future time to the  
14 actual camera location --

15 MS. MAO: Same objection.

16 BY MR. SCHMIDT:

17 Q. -- future period in time?

18 MS. MAO: Same objection.

19 THE WITNESS: Well, this is what the  
20 specification tells us, and we have to look at the 12:33:01  
21 details of how this projection is taking -- of how  
22 this comparison with, you know, the crop polygon,  
23 whether it is satisfied is inside the inner region  
24 or not, but for that we need the actual values of  
25 the trajectory.

Page 89

1 BY MR. SCHMIDT:

2 Q. I mean, isn't it true that what's  
3 disclosed in column 10 of Bell is the buffering of  
4 the virtual camera positions in the future but not  
5 the actual positions of the camera?

6 MS. MAO: Same objection.

7 THE WITNESS: Relation 10 involves only the  
8 virtual positions, but the test comparisons that  
9 follow this projection which involve the actual  
10 camera positions.

12:34:07

11 BY MR. SCHMIDT:

12 Q. In Relation 11, which does the  
13 interpolation, is an interpolation between virtual  
14 camera values from the buffer and current virtual  
15 camera values; correct?

16 MS. MAO: Same objection.

17 THE WITNESS: That's correct.

18 But as I already mentioned, the method is  
19 based on which -- who would know whether we'd want  
20 to apply Relation 11 or not involves the actual --  
21 the actual trajectory data.

12:34:38

22 BY MR. SCHMIDT:

23 Q. Okay. In column 10, you don't see any  
24 discussion of actual P(k) values being stored in  
25 any buffer, do you?

Page 90

1 MS. MAO: Same objection.

2 THE WITNESS: I see they need to use such  
3 values. I would have to see if this is mentioned  
4 somewhere else in the specification or not.

5 MR. SCHMIDT: Okay. We could take a lunch  
6 break now.

7 (A lunch break was taken at  
8 12:35 PM to 1:29 PM.)

9 BY MR. SCHMIDT:

10 Q. Welcome back, Doctor. 13:28:57

11 To get us started in the afternoon I was  
12 going to ask you some general questions. In your  
13 view, as a person of ordinary skill in the art,  
14 what's your understanding of the term "filtering"?

15 MS. MAO: Objection. Form.

16 THE WITNESS: Applying an operation to a  
17 signal.

18 BY MR. SCHMIDT:

19 Q. What to you is the plain and ordinary  
20 meaning of the term "smoothing"? 13:29:33

21 MS. MAO: Objection. Form.

22 THE WITNESS: Reducing some of the high  
23 frequencies in a signal.

24 BY MR. SCHMIDT:

25 Q. What is the plain and ordinary meaning of

1 the term "jitter"?

2 MS. MAO: Objection. Form.

3 THE WITNESS: These are terms I didn't spell  
4 out in my declarations.

5 Having a signal with some low or high  
6 frequencies that could be thought as a jitter, but  
7 it's a term that might be subject to many  
8 definitions.

9 BY MR. SCHMIDT:

10 Q. What's the plain and ordinary meaning of 13:30:50  
11 the term "blur"?

12 MS. MAO: Objection. Form.

13 THE WITNESS: Again, they are terms that may be  
14 subject to multiple definitions.

15 But if I have an image and there's -- an  
16 object moves during the exposure time, this object  
17 may not look sharp, but we'll say it is blurred.

18 BY MR. SCHMIDT:

19 Q. Can blur occur due to motion of the object  
20 across frames as well as motion of the object 13:31:48  
21 within a frame?

22 A. These are notions that I did not consider  
23 in my analysis. It refers to motion within a  
24 frame. So it's a still image, and while the  
25 aperture is open, the object moves, it's subject to

1 blur with -- yeah, but across frames.

2 It's a bit harder to define how exactly it  
3 exhibits itself.

4 Q. Is blurring an issue across frames?

5 MS. MAO: Objection. Form.

6 THE WITNESS: We need to define what "blurring  
7 across frames" means.

8 BY MR. SCHMIDT:

9 Q. Blurring as a result of interframe motion  
10 as opposed to intraframe motion? 13:33:17

11 A. We have to analyze explicitly what  
12 happens, how the image or figure is acquired to  
13 talk about interframe, assuming it's a video, and  
14 then the video itself is displayed consists of  
15 frames.

16 So the question is during the time when  
17 I acquire an image, we have photons hitting the  
18 sensor, and then while this information is read  
19 from the sensor to buffer, let's say, then, if the  
20 camera moves, you can define that as an interframe 13:34:19  
21 motion, but how exactly it manifests itself is  
22 something you need to analyze in a bit more detail.

23 Q. What's the plain and ordinary meaning of a  
24 low-pass filter?

25 MS. MAO: Objection. Form.

1 THE WITNESS: A filter that allows most of the  
2 information of the signal at low frequencies to go  
3 through while attenuating the information at the  
4 high frequency of the signal.

5 BY MR. SCHMIDT:

6 Q. By the same token, would a high pass  
7 system be one that allows most of the information  
8 of the signal at high frequencies to go through  
9 while attenuating the information at the low  
10 frequency of the signal? 13:35:27

11 MS. MAO: Objection. Form.

12 THE WITNESS: That would be consistent with the  
13 first definition. It's a matter of what is  
14 attenuated and what is allowed to go through with  
15 some smaller distortion, yeah.

16 BY MR. SCHMIDT:

17 Q. What is a Gaussian low-pass filter?

18 MS. MAO: Objection. Form.

19 THE WITNESS: It's a filter that has an impulse  
20 is Gaussian. 13:36:04

21 BY MR. SCHMIDT:

22 Q. You said it's a filter that has an impulse  
23 that is --

24 A. Impulse response which is a Gaussian.

25 Q. And is Gaussian -- does that just mean a

1 normal distribution?

2 A. Yes. It's the same thing, the difference  
3 is the normal typically is zero mean while the  
4 Gaussian can have any mean, but, by and large, it's  
5 what's used in the change of P.

6 Q. And, typically -- well, actually, not  
7 typically.

8 A Gaussian distribution, by definition, is  
9 symmetrical around the center?

10 A. Not talking about distribution here. We 13:36:50  
11 are talking about the Gaussian curve, also known as  
12 the Bell curve. So the Gaussian curve is symmetric  
13 around its mean.

14 Q. Okay. Are you familiar with a phenomenon  
15 called rolling shutter in a camera system?

16 A. I am familiar.

17 Q. What's your understanding of the rolling  
18 shutter issue?

19 A. My understanding is that when the images  
20 are acquired by a sensor, which means the photons 13:37:34  
21 are hitting the sensor, the sensor is not exposed  
22 to these photons at the same time the whole sensor,  
23 but there's a rolling shutter that allows only  
24 parts of the sensor to be exposed or struck by  
25 these photons.

1 Q. And what sort of distortions or anomalies  
2 to the image can the rolling shutter issue cause?

3 MS. MAO: Objection. Form.

4 THE WITNESS: You can have no distortion if  
5 it's a station that is seen, but if it's a  
6 moving -- if there's a nonmoving object in the  
7 scene or the camera is moving, then different parts  
8 -- due to the rolling shutter, different parts of  
9 the image line by line is exposed at different  
10 times, and, therefore, if a change has happened due 13:38:43  
11 to the motion of the camera or a motion -- or a  
12 motion of the objects in the scene, you can see  
13 straight lines becoming slanted or the height of an  
14 object becoming enlarged or compressed.

15 BY MR. SCHMIDT:

16 Q. How do lighting conditions affect the  
17 rolling shutter issue in your understanding?

18 MS. MAO: Objection. Form.

19 THE WITNESS: The connection is that when you  
20 have low-lighting conditions, we need to have 13:39:27  
21 larger exposure times. We need to integrate the  
22 energy of the photons hitting the sensor for longer  
23 times, and therefore, as I mentioned, again, the  
24 exposure time is longer at low-lighting conditions,  
25 and because of the longer exposure time, the

1 chances that an object moves or the camera moves  
2 increase.

3 BY MR. SCHMIDT:

4 Q. Does a longer exposure time complicate or  
5 exacerbate the rolling shutter issue?

6 A. Yes, it has an effect. Low-lighting  
7 conditions increase exposure time and increase the  
8 chances of having the distortion due to the rolling  
9 shutter.

10 Q. Are you familiar with the term "global 13:40:29  
11 shutter"?

12 MS. MAO: Objection. Form.

13 THE WITNESS: It's not something that I've  
14 considered in my declarations.

15 BY MR. SCHMIDT:

16 Q. Okay. How does the rolling shutter issue  
17 in low-lighting conditions relate to the  
18 probable --

19 A. I'm sorry. The problem of?

20 Q. -- the problem of blurring in low light 13:40:53  
21 conditions?

22 A. I'm sorry. Can you repeat the question?

23 Q. Sure.

24 How does the rolling shutter issue we  
25 discussed in low light conditions relate to the

Page 97

1 problem of blurring in low light conditions?

2 MS. MAO: Objection. Form.

3 THE WITNESS: The low light conditions increase  
4 exposure time, and increased exposure time results  
5 in both blurring and -- blurring, you can call it,  
6 or distortion due to the rolling shutter.

7 BY MR. SCHMIDT:

8 Q. But are these two different issues caused  
9 by long exposure time, the blurring and the rolling  
10 shutter? 13:41:43

11 MS. MAO: Objection. Form.

12 THE WITNESS: They are related issues. The  
13 low-lighting conditions and the increase of the  
14 exposure time can have multiple effects on an image  
15 like the ones we are discussing here.

16 BY MR. SCHMIDT:

17 Q. But other than stemming from a common  
18 cause of low light conditions, are there any other  
19 similarities or relation between the rolling  
20 shutter problem and the blurring problem? 13:42:19

21 A. Yeah, you can have -- you can have  
22 blurring and rolling shutter distortions.

23 Q. Just by virtue of it stemming from the  
24 same cause?

25 MS. MAO: Objection. Form. Same objection.

1 THE WITNESS: Yeah, by virtue that you need  
2 longer exposure times, and moving objects would  
3 have both blurring and rolling shutter distortions.

4 BY MR. SCHMIDT:

5 Q. Okay. Let's take a look at Exhibit 5,  
6 which is one of the declarations you submitted  
7 regarding the '840 patent. I want to direct you to  
8 paragraph 113.

9 I think I have it wrong. It should be  
10 Exhibit 4. Sorry. Exhibit 4, paragraph 112. 13:44:07

11 A. Okay. I'm there.

12 Q. And, in paragraph 113, you're identifying,  
13 in Shi, the coefficient based on the motion blur  
14 kernel as the low-light high-pass parameter of the  
15 '840 patent; correct?

16 A. Yes, that's what I'm saying here.

17 Q. Why don't we take a look at Shi. This  
18 will be the next exhibit.

19 (Whereupon, Exhibit 10 was  
20 marked for identification.) 13:45:44

21 BY MR. SCHMIDT:

22 Q. Doctor, I placed the next exhibit before  
23 you. Exhibit 11 this is U.S. Patent 10,462,370 to  
24 Shi.

25 A. It's Exhibit 10; right?

Page 99

1 Q. I'm sorry. You're right. It is  
2 Exhibit 10.

3 And I want to direct you to column 18, and  
4 at the line 9 continuing on to 10 of column 18,  
5 Shi writes "The competing system then estimates a  
6 motion blur kernel 321."

7 Do you see that?

8 A. I'm sorry. Just a second. 18, 9 --

9 Q. Through 10.

10 A. I see that. 13:46:42

11 Q. Now, the motion blur kernel in Shi is  
12 calculated on the basis of all motion of an object  
13 that may occur during the exposure time; correct?

14 MS. MAO: Objection. Form.

15 THE WITNESS: In column 18 Shi tells us how --  
16 gives us an example of how this blur can be -- this  
17 coefficient based on the motion blur kernel can be  
18 calculated.

19 BY MR. SCHMIDT:

20 Q. And in the example provided by Shi, it's 13:49:12  
21 calculated based on all the motion that a feature  
22 will experience within a given exposure time;  
23 correct?

24 MS. MAO: Objection. Form.

25 THE WITNESS: There are multiple steps here

1 that need to be followed. That can just read  
2 through the steps, but "One technique for  
3 characterizing the blur is to compare the  
4 projection matrix components for two different  
5 positions along the frame. For example, for a  
6 frame with an exposure duration E, projection  
7 matrix components  $P_{iT-E/2}$  and  $P_{iT-E/2}$  can be  
8 determined, representing the projection matrices  
9 corresponding to the first and last scanlines for  
10 the particular frame. Because the projection 13:50:12  
11 matrices are generated using OIS position data and  
12 lens focal length, blur caused by changes in these  
13 parameters is reflected in the transformation. The  
14 computing system then calculates a transformation  
15 between the two projection matrices, and applies  
16 the resulting transformation to an origin point  
17 representing the center point of the image.  
18 Applying the transformation will move the projected  
19 point to an offset from the actual origin in the  
20 projected space. The magnitude of the offset from 13:50:44  
21 the origin point may be used as an estimate of  
22 blur."

23 BY MR. SCHMIDT:

24 Q. So the motion blur kernel of Shi is based  
25 on the total motion that's experienced within the

1 exposure time, not some subset of the motion. Is  
2 that fair?

3 MS. MAO: Objection. Form.

4 THE WITNESS: Well, in this particular example,  
5 you have to make two points to do this test, and  
6 depending on what these two points are chosen, it  
7 could be the whole frame or part of the frame.  
8 It's not specific to anything in particular.

9 BY MR. SCHMIDT:

10 Q. So will the motion blur kernel in Shi be 13:51:53  
11 different based on the selection of the two points?

12 MS. MAO: Objection. Form.

13 THE WITNESS: I could see applying this method  
14 to different points on some parts of the image and  
15 then finding different motion kernels in different  
16 parts of the image.

17 BY MR. SCHMIDT:

18 Q. Okay. So for any given image capture  
19 event, the image blur kernel may have a different  
20 value based on what parts of the image are selected 13:52:43  
21 for the analysis set forth in column 18. Fair?

22 A. There's examples. One does not exclude  
23 the other. What they write here suggests, as an  
24 example, to use the first and the last scanlines  
25 for the particular frame. So in that case it

1       refers to the whole frame, but it's just some of  
2       the steps could be applied to any two points one  
3       chooses to, and therefore, I could potentially have  
4       multiple blur kernels, but that's not so critical.  
5       It's how one implements this.

6           Q.     And you would agree, wouldn't you, sir,  
7       that the motion blur kernel is not being calculated  
8       specifically on the nature of the lighting  
9       conditions?

10       MS. MAO:  Objection.  Form.

13:54:00

11       THE WITNESS:  As we discussed, motion blur can  
12       be due to lighting conditions or due to fast motion  
13       of objects in the scene or the camera.  So this  
14       here, what Shi is discussing, is not excluding  
15       anything.  So this motion blur can be due to  
16       low-lighting conditions.  It's a well-understood  
17       phenomenon, but low-lighting conditions increase  
18       the chances of having this objectionable motion  
19       blur in the data.

20       BY MR. SCHMIDT:

13:55:08

21       Q.     Understood.

22           But you would agree with me that the  
23       motion blur kernel calculated in Shi can have a  
24       relatively high value even in well-lit conditions?

25       MS. MAO:  Objection.  Form.

1 THE WITNESS: As I already said, the motion  
2 blur is due to many different reasons, and if we  
3 have low-lighting conditions, we increase the  
4 chances of having motion blur, but even with  
5 low-lighting conditions even still you don't have  
6 motion blur. So it's just understood here that  
7 this is a method that is independent of what the  
8 cause of the motion blur is.

9 BY MR. SCHMIDT:

10 Q. Okay. So you anticipated my next 13:56:04  
11 question.

12 You agree that Shi's motion blur kernel  
13 can have a relatively low value even in poor  
14 lighting conditions; correct?

15 MS. MAO: Objection. Form.

16 THE WITNESS: Independently of Shi, as we  
17 discussed, what are the cause of motion blur?  
18 Many, two of which are low-lighting conditions --  
19 that's a very well-understood topic in the field  
20 for a long time -- and all fast moving objects. So 13:56:45  
21 multiple reason to provide this multiple resulting  
22 motion blur.

23 BY MR. SCHMIDT:

24 Q. I understand all that, but I'm asking you  
25 a very specific question to try to put a fine point

1 on your testimony. So please pay attention to my  
2 question.

3 Isn't it true, Doctor, that the motion  
4 blur kernel in Shi can have a relatively low value  
5 even when the lighting conditions are poor?

6 MS. MAO: Objection. Form.

7 THE WITNESS: I don't see the logic in the  
8 question.

9 BY MR. SCHMIDT:

10 Q. It doesn't matter if you see the logic in 13:57:38  
11 the question.

12 A. Yeah, I don't know --

13 MS. MAO: Patrick, let him finish his answer.

14 MR. SCHMIDT: He has to answer the questions.

15 MS. MAO: He's answering the questions. The  
16 fact is you're not happy with his answers but let  
17 him finish, please.

18 BY MR. SCHMIDT:

19 BY MR. SCHMIDT:

20 Q. I'm going to ask the question again, 13:57:52  
21 Doctor. Isn't it true that the technique in Shi  
22 can calculate a relatively low value for the motion  
23 blur kernel even in poorly late conditions?

24 MS. MAO: Same objection. Form. Asked and  
25 answered.

1 THE WITNESS: The way I interpret the question  
2 is that if low-lighting conditions always, no  
3 matter what, no matter what happens, create motion  
4 blur, and this is not the logical approach to the  
5 problem. We said that low-lighting conditions  
6 increase the chance of having motion blur.

7 BY MR. SCHMIDT:

8 Q. You misinterpreted the question because  
9 that wasn't the question. I wasn't asking you  
10 whether motion blur always occur in low light 13:58:56  
11 conditions. Listen to the question again.

12 Isn't it true that the system in Shi can  
13 calculate a relatively low value for the motion  
14 blur kernel as calculated in Shi even in poorly lit  
15 conditions?

16 MS. MAO: Objection. Form. Asked and  
17 answered. Harassing the witness.

18 And could you please refrain from pointing  
19 your glasses at Dr. Katsaggelos?

20 THE WITNESS: Yeah, I don't understand -- fully 13:59:32  
21 understand the question.

22 If the question is that there is motion  
23 blur but Shi won't calculate it, if the question is  
24 that if there's low-lighting conditions and no  
25 motion blur, what Shi will do?

1           That's why I mention that low-lighting  
2 conditions increase the chance is well known due to  
3 long exposures that motion blur will result.

4           Are there cases where there are  
5 low-lighting conditions and just taking a picture  
6 of a still wall and there's no motion blur? Of  
7 course.           So it's crystal clear to me that  
8 low-lighting conditions don't mean that you're  
9 going to have motion blur always.

10 BY MR. SCHMIDT:

14:00:40

11       Q.    You understand how Shi calculates what it  
12 calls the motion blur kernel; correct?

13       A.    We saw one example here, the one we went  
14 through here, but there may be other examples in  
15 Shi of how to estimate this motion blur kernel.

16       Q.    Let's stick with this example, which is  
17 what you cited in your declaration. This example  
18 is not tied specifically to the nature of the  
19 lighting conditions; isn't that right, Doctor?

20       MS. MAO: Same objection. Asked and answered.

14:01:07

21       THE WITNESS: This example gives us the  
22 algorithm of estimating this motion parameter,  
23 motion blur parameter. It can be applied to  
24 low-lighting conditions, normal lighting  
25 conditions. It's not tied to any of these

Page 107

1 situations. As long as blur, due to whatever it  
2 is, is one way to estimate the magnitude of this  
3 blur.

4 BY MR. SCHMIDT:

5 Q. Now, let's talk about how this coefficient  
6 based on the motion blur kernel is used. At  
7 line 30 -- actually, line 31, Shi discusses how  
8 "The coefficient could be used to weight a  
9 spherical interpolation between  $V1T$ " --

10 A. I'm sorry. Column 18?

14:02:14

11 Q. Yes.

12 Column 18, line 31, of Shi describes how  
13 "The coefficient can be used to weight a spherical  
14 interpolation between positions  $V1(T)$ , and  $R(T)$ ."

15 Do you see that?

16 A. Let me just get there.

17 I see the sentence you just read, the "for  
18 example," yes.

19 Q. And what that interpolation is is an  
20 interpolation between the smoothed trajectory and  
21 the real trajectory; correct?

14:03:04

22 A. That's correct.

23 Q. And this is actually the third  
24 transformation that Shi discusses in its overall  
25 process; correct?

Page 108

1 MS. MAO: Objection. Form.

2 THE WITNESS: I'm not sure which  
3 transformations you are counting to be the third  
4 one or...

5 BY MR. SCHMIDT:

6 Q. Let me walk you through it.

7 If you turn back a page to column 16,  
8 line 41, Shi writes "In addition, the computing  
9 system can determine a first virtual camera  
10 position V0T by filtering real device positions R(t) 14:03:55  
11 occurring during a window of time."

12 Do you see that?

13 A. Yes.

14 Q. And that is a smoothing operation;  
15 correct?

16 A. If this filtering is a low pass filtering,  
17 it's a smooth filtering. If it's a high pass  
18 filtering, it's not smoothing.

19 Q. Okay. Then if you turn to -- oh, and --  
20 strike that. 14:04:26

21 This first transformation results in a  
22 virtual camera position V0T.

23 Do you see that?

24 A. I'm sorry. The same line or where are  
25 we --

1 Q. Yeah, same line.

2 A. So "The computing system can determine a  
3 first virtual camera position,  $V_0T$  by filtering real  
4 device position  $R(t)$  occurring during a window of  
5 time." That one; right?

6 Q. Right.

7 All I was asking is the output was  $V_0T$ ;  
8 correct?

9 A. Right, you filter out of  $T$ , and  $V_0T$  is the  
10 result of the filter. 14:05:05

11 Q. And then if you turn to column 17 at  
12 line 4, Shi says "A second virtual camera position  
13  $V_1(T)$  can be generated using information about  
14 recording device movement after the time  $T$ . The  
15 future motion can be assessed by evaluating device  
16 positions occurring after time  $T$  up to time  $T+L$ ."

17 Do you see that?

18 A. Yes.

19 Q. This is where Shi takes into account  
20 future frames in a buffer; correct? 14:05:38

21 A. Yes.

22 Q. And the output of that process is  $V_1(T)$ ;  
23 correct?

24 A. Correct.

25 Q. And only once those first two

1 transformations have taken place, does Shi then  
2 perform the third transformation using the  
3 coefficient based on the motion blur kernel;  
4 correct?

5 MS. MAO: Objection. Form.

6 THE WITNESS: The way I read it, this is an  
7 example of creating these different virtual  
8 positions, but I would have to look at the whole  
9 specification to see if absolutely everything is  
10 needed.

14:07:15

11 BY MR. SCHMIDT:

12 Q. Were you done with your answer?

13 A. Yes.

14 Q. In the example we're looking at, isn't it  
15 true that this third transformation, which is an  
16 interpolation between  $V_1(T)$  and the real camera  
17 path, that's only performed after the other two  
18 transformations we spoke about are complete?

19 A. There's a lot in the specification here.

20 I have to read all what's in here to -- again, this  
21 is an example that might perform this estimation of  
22 the blur on the first zero through the first frame  
23 of the original data. I don't see this here as  
24 something that needs to be implemented this way.

14:08:42

25 Q. You're saying that you could imagine a

Page 111

1 system where this blur correction is done  
2 completely independently of the first two  
3 transformations?

4 A. I treat this as an example here, not as  
5 a -- as something that needs to necessarily be  
6 followed. These are very big steps. It doesn't  
7 change the teaching of the patent, which is to tie  
8 the blur to the amount of smoothing that you're  
9 going to perform.

10 Q. But, in Shi, the coefficient based on the 14:10:03  
11 motion blur kernel is only considered after the  
12 smoothing is complete. Isn't that true?

13 MS. MAO: Objection. Form.

14 THE WITNESS: I see this as an example. The  
15 important aspect is how to tie the amount of blur  
16 to the amount of smoothing and whether you have,  
17 you know, a smoothing operation very often or do  
18 smoothing operations to remove noise from the data,  
19 it's a kind of big processing and so on, but it  
20 doesn't change the main teaching of the patent. 14:11:15

21 BY MR. SCHMIDT:

22 Q. Stepping away from Shi for a second, just  
23 your understanding of the '840 patent, is that the  
24 low-light high-pass parameter needs to be a  
25 parameter that is used in the determination of the

1 smoothed trajectory; correct?

2 A. The low-light high-pass parameter controls  
3 the amount of smoothing applied to generate the  
4 smoothed trajectory and the extent of motion blur  
5 compensation.

6 Q. In the example in Shi when you take the  
7 camera path  $V_1(T)$  and perform the spherical  
8 interpolation with the real camera path  $R(T)$ , does  
9 the resulting trajectory include high frequency?

10 MS. MAO: Objection. Form. 14:14:50

11 THE WITNESS: Can you repeat your question?

12 BY MR. SCHMIDT:

13 Q. Sure.

14 In Shi, the coefficient based on the  
15 motion blur kernel is used in a spherical  
16 interpolation between positions  $V_1T$  and  $R(T)$ ;  
17 correct?

18 A. That's correct.

19 Q. When that interpolation is performed, what  
20 is the effect on the high frequency motion? 14:17:56

21 MS. MAO: Objection. Form.

22 THE WITNESS: The effect on the high frequency  
23 motion in which -- in which signal?

24 BY MR. SCHMIDT:

25 Q. In the real camera path.

1           A.   Well, Shi uses this parameter, this  
2   coefficient, based on the motion blur kernel. To  
3   do this spherical interpolation, as you mentioned,  
4   between the V1T and the R(T) positions and depending  
5   on the value of this motion blur coefficient, if  
6   it's 1, which means there's a lot of motion, then  
7   the new virtual position is very similar to the  
8   real position. If, on the other hand, there's  
9   little motion, the W is very close to zero, this  
10   virtual position, V1T, remains unchanged. 14:19:24

11           Q.   So short of the coefficient having a value  
12   of 1, the high frequencies will be attenuated as a  
13   result of this interpolation between V1T and the  
14   real camera path. Fair?

15           MS. MAO: Objection. Form.

16           THE WITNESS: I'm trying to understand the  
17   question. It's -- we are doing interpolation  
18   between these two values V1 and R, V1(T) and R(T),  
19   and this coefficient, W, varies continuously  
20   between 0 to 1. So we can look at the end 14:20:31  
21   positions, what happens at the 0 and 1, and then  
22   for values of W in between, it's combinations.  
23   Interpolation problem, both values are used, V1(T)  
24   and R(T).

1 BY MR. SCHMIDT:

2 Q. By the way, the fact that the coefficient  
3 ranges between the value of 0 and 1, that doesn't  
4 appear in Shi; right?

5 A. Shi describes a situation, for example,  
6 discloses that using the coefficient based on the  
7 motion blur kernel to adjust the second virtual  
8 camera position V1T towards the real device R(T) to  
9 an extent determined based on the amount of blur  
10 identified. 14:21:52

11 It's very, very common to take parameters  
12 that don't have any average range and normalize  
13 them. That's something very well known in the art  
14 and give this parameter values between 0 and 1.  
15 It's a normalization step that usually takes place.

16 Q. I know you write this mathematical formula  
17 and assign a variable mean to the coefficient, and  
18 you say that it can be between 0 and 1, but that's  
19 all just your gloss that you've added on top of  
20 Shi. That doesn't actually appear in the 14:22:31  
21 disclosure itself; correct?

22 A. Shi discloses that we want to adjust the  
23 V1T towards R(T) to an extent determined based on  
24 the amount of blur identified and keeps elaborating  
25 that when we have a lot of blur, I want to go

Page 115

1 toward R(T). So the teaching is clear what we try  
2 to accomplish with this.

3 Q. I just want to clarify that the  
4 normalization step and the assignee and the  
5 variable named W2, if that's something that you did  
6 in your declaration that is not from the express  
7 disclosure of Shi; correct?

8 A. I just put in specific terms what Shi is  
9 teaching. I'm not sure if Shi's using a W or not.

10 Shi discloses using spherical 14:23:51  
11 interpolation between V1 and R(T).

12 Q. Okay. Let's turn now to Exhibit 5, which  
13 is your other declaration, paragraph 84.

14 And, in paragraph 84, you discuss your  
15 opinion that Zhou also discloses the '840 patent  
16 low-light high-pass parameter; correct?

17 A. Yes, that's correct. I'm discussing it at  
18 this part of the declaration.

19 Q. And you point to the stabilization  
20 strength parameter of Zhou as the low-light 14:25:18  
21 high-pass parameter; correct?

22 A. Yes, what we discussed here is that this  
23 stabilization strength parameter of Zhou discloses  
24 the low-light high-pass parameter.

25 Q. Now, in Zhou, the stabilization strength

1 metric is something that's calculated for each  
2 individual frame; correct?

3 A. "Zhou discloses performing these  
4 techniques and ways to more effectively stabilize  
5 by using 'techniques...for estimating the amount of  
6 motion blur in the "current" frame to adjust the  
7 strength of the video stabilization metric value.'"

8 Q. So the stabilization strength metric  
9 changes from frame to frame; correct?

10 MS. MAO: Objection. Form.

14:28:30

11 THE WITNESS: Zhou discloses that techniques  
12 are disclosed herein for estimating the amount of  
13 motion blur in the current, in quote, frame, e.g.,  
14 by using motion data from either or both the past  
15 and future frames in addition to motion data for  
16 the current frame.

17 So certainly he mentions here using past  
18 and future frames for doing this calculation but  
19 also utilizing motion data for the current frame.

20 BY MR. SCHMIDT:

14:30:29

21 Q. But the stabilization strength metric is  
22 recalculated for each current frame. Can we agree  
23 on that?

24 A. Depending on some examples here in Zhou,  
25 the stabilization parameter can change with respect

Page 117

1 to time, but it doesn't necessarily mean that it's  
2 different in each and every frame. It can be  
3 constant for a while and then have a slight change,  
4 things of that nature.

5 Q. I asked whether or not it was recalculated  
6 for each current frame. Can we agree on that?

7 A. I will need to read my declaration and the  
8 patent to see if this is, indeed, the case. I'm  
9 not sure if I can answer the question.

10 Q. Okay. The stabilization strength metric 14:32:15  
11 is based on the calculation of the amount of blur  
12 that Zhou detects in a given image; correct?

13 MS. MAO: Objection. Form.

14 And, Patrick, we are at an hour.

15 THE WITNESS: What was the question again?

16 BY MR. SCHMIDT:

17 Q. Do you want to take a break?

18 A. If we could, yeah.

19 Q. All right.

20 (A short break was taken at 14:33:03  
21 2:33 PM to 2:46 PM.)

22 BY MR. SCHMIDT:

23 Q. Welcome back, Doctor.

24 A. Thank you.

25 Q. Before the break we were talking about the

1 low-light high-pass parameter that you claim is  
2 present in Zhou. Do you recall that?

3 A. Yes.

4 Q. Let me ask you this question: Do you  
5 agree that the stabilization strength metric, which  
6 you cite, in Zhou is not based specifically on the  
7 nature of the lighting conditions?

8 MS. MAO: Objection. Form.

9 THE WITNESS: Zhou talks extensively about  
10 low-lighting conditions and techniques for improved 14:47:19  
11 stabilization of frames captured in low-lighting  
12 conditions.

13 BY MR. SCHMIDT:

14 Q. My question was about the stabilization  
15 strength metric.

16 And the question is, isn't it true that  
17 the calculation of that value is not tied  
18 specifically to the nature of the lighting  
19 conditions?

20 MS. MAO: Same objection. 14:47:43

21 THE WITNESS: Zhou mentions in many places that  
22 the objective of his invention is to effectively  
23 stabilize low-light video, and, for example, he  
24 mentions that if the amount of blur in the image is  
25 larger, typically found in darker images with

1 longer integration times, smaller stabilization  
2 strengths may be employed.

3 So just as examples here, the main  
4 objective is to address the issues that arise in  
5 low-lighting conditions.

6 BY MR. SCHMIDT:

7 Q. I got all of that. I want to focus now on  
8 how the stabilization strength metric is  
9 calculated.

10 Isn't it true, Doctor, that the 14:50:38  
11 stabilization strength metric is not calculated on  
12 the basis of lighting conditions?

13 MS. MAO: Same objection.

14 THE WITNESS: So Zhou makes a strong connection  
15 between low-lighting conditions, amount of blur,  
16 and stabilization, strength. It's all connected in  
17 his teaching.

18 BY MR. SCHMIDT:

19 Q. Turn to column 6 of Zhou.

20 The stabilization strength metric in Zhou 14:52:02  
21 is calculated on the basis of the overall image  
22 blur metric.

23 Do you see that?

24 A. 6. What line?

25 Q. Well, the overall image blur metric is

1 mentioned in line 27 where it's "Next, the  
2 operation 100 can optionally proceed to averaging  
3 the overall image blur metric over some number, n,  
4 of consecutive frames."

5 Let me point you to one more thing.

6 Do you see Figure 5C, which is a chart  
7 translating the overall image blur metric value  
8 plotted along the X axis into a target strength  
9 plotted along the Y axis?

10 Do you see that?

14:53:12

11 A. Yes, I do.

12 Q. So isn't it true that the stabilization  
13 strength metric in Zhou is calculated on the basis  
14 of the image blur metric?

15 A. Again, Zhou makes this -- the whole patent  
16 is all about low-lighting conditions. The  
17 low-lighting condition, the objective is not to  
18 measure how low is the light. The objective is to  
19 measure what is the effect of the low-lighting  
20 conditions on the image quality, and the effect is  
21 manifesting itself via the blur. So by measuring  
22 the blur, you indirectly address the low lighting.  
23 Not indirectly. It's the main cause. It's really  
24 focusing on low-lighting conditions.

14:54:14

25 So it's crystal clear that, yeah, by

Page 121

1 measuring the amount of blur, you address this  
2 effect that the low-lighting conditions can have on  
3 quality.

4 Q. But the way that the stabilization  
5 strength metric is calculated in Zhou, isn't it  
6 true that the blur can be very high -- well, strike  
7 that.

8 Isn't it true in Zhou that the  
9 stabilization strength metric can be calculated to  
10 have a very high value even in well-lit conditions? 14:55:09

11 MS. MAO: Objection. Form.

12 THE WITNESS: I mention multiple times that  
13 blur is due to multiple reasons, and here Zhou  
14 makes a very, very clear point that wants to look  
15 at the undesirable blur effect when we have  
16 low-lighting conditions. So this is the framework  
17 of the whole teaching, and you measure the effect  
18 of the low-lighting conditions, which is the blur,  
19 and that's what we care about in deciding whether  
20 to remove it or not based on how we are going to 14:56:05  
21 smooth the motion trajectory.

22 BY MR. SCHMIDT:

23 Q. Okay. Blur can be caused by lots of  
24 different things. Low lighting being one of many  
25 causes; correct?

1           A.    We addressed that at the beginning of the  
2 deposition, that fast-moving objects or this or  
3 that can cause blur, but low-lighting conditions is  
4 a well-known situation that results in motion blur,  
5 and Zhou, line after line, talks about the  
6 connection between low-lighting conditions and the  
7 resulting blur and just addressing this blur. So  
8 it's more than clear that that's what Zhou is  
9 focusing on.

10          Q.    Blur can be caused by conditions unrelated       14:57:02  
11 to lighting conditions. Do you agree?

12          A.    Again, we covered that, but you can have  
13 the combination of things, the fast-moving object  
14 in low-lighting conditions, introducing larger blur  
15 than in high-lighting conditions and so on. So,  
16 yeah, this is very well understood. Again, Zhou is  
17 all about the blur caused by low-lighting  
18 conditions.

19          Q.    But Zhou is calculating the stabilization  
20 strength metric on the basis of blur generally, not       14:57:54  
21 on the lighting conditions in particular; isn't  
22 that right?

23          MS. MAO: Same objection.

24          THE WITNESS: Yeah, Zhou makes the connection  
25 that low-lighting conditions cause blur by

1 measuring the blur by just addressing the  
2 low-lighting conditions, just the relationship  
3 there that it is addressing.

4 BY MR. SCHMIDT:

5 Q. Take a look at the top of column 6 of  
6 Zhou. Do you see the calculation that it provides  
7 for blur?

8 A. Yes, I see the formula, the square root of  
9  $t_x$  squared plus  $t_y$  squared.

10 Q. So what Zhou is teaching is that the 14:58:59  
11 amount of blur is calculated to be simply a  
12 function of the amount the image translates in each  
13 of the horizontal and vertical directions; correct?

14 A. This is one embodiment that he teaches,  
15 yes.

16 Q. This is the only embodiment that he  
17 teaches for calculating blur; right?

18 MS. MAO: Objection. Form.

19 THE WITNESS: Well, in column 5, it says  
20 "According to some embodiments," and follows that. 14:59:27

21 And then column 6 says "Those skilled in  
22 the art will understand that other techniques could  
23 be used to approximate the amount of blur present  
24 in the image."  
25

1 BY MR. SCHMIDT:

2 Q. This calculation for blur at the top of  
3 column 6 is what is used to calculate the  
4 stabilization strength metric; correct?

5 MS. MAO: Objection. Form.

6 THE WITNESS: This is one embodiment. That's  
7 what the patent tells us.

8 BY MR. SCHMIDT:

9 Q. In this embodiment, the stabilization  
10 strength metric is a function only of the 15:00:07  
11 translation of the image in the horizontal and  
12 vertical directions; correct?

13 A. Yeah, this one embodiment out of many that  
14 Zhou mentions is based on the tx ty, yes.

15 Q. In Zhou, the stabilization strength metric  
16 is always nonzero; correct?

17 MS. MAO: Objection. Form.

18 THE WITNESS: I will need to read carefully the  
19 specification.

20 I think in form of examples or if, you 15:01:49  
21 know, figures to be depicted as a positive and  
22 nonnegative number -- anyway, but zero could be --  
23 could be a value to utilize as well.

24 BY MR. SCHMIDT:

25 Q. Well, in Figure 5C of Zhou, do you see

1       that the stabilization strength metric ranges  
2       between maximum strength 525 and minimum strength  
3       545?

4           MS. MAO:  Objection.  Form.

5           THE WITNESS:  I see that in Figure 5C, there's  
6       a minimal and maximum, but in this figure the  
7       minimum is greater than zero, and we don't know how  
8       much greater than zero it is.  These are schematic  
9       examples that can have different implementations as  
10      well.  I don't believe this says that the minimum       15:02:57  
11      strength -- I mean, could be ten to the minus five  
12      at minimum strength, which is above zero.

13      BY MR. SCHMIDT:

14           Q.  I want to turn back to Bell, which is  
15      Exhibit 9, and can you turn to claim 1, which is in  
16      column 12 of Bell?

17           A.  Okay.  I'm on there.

18           Q.  Do you see in the last two limitations of  
19      claim 1, Bell recites "damping movement of said  
20      virtual camera."  That's the second-to-last       15:04:11  
21      limitation.

22                   And then in the last limitation, it says  
23      "accelerating said movement of said virtual  
24      camera."

25                   Do you see that?

1 A. Yes, I do.

2 Q. Is that consistent with your understanding  
3 of Bell's disclosures that there's a virtual camera  
4 that's either accelerated or decelerated based on  
5 the conditions at the time?

6 MS. MAO: Objection. Form.

7 THE WITNESS: Can you please repeat your  
8 question?

9 BY MR. SCHMIDT:

10 Q. Those last two limitations of claim 1 15:05:27  
11 refer to dampening and accelerating the movement of  
12 the virtual camera. Is that consistent with the  
13 teachings of Bell that you analyzed in forming your  
14 invalidity opinions?

15 MS. MAO: Objection. Form.

16 THE WITNESS: What this tells us is how to  
17 adjust the movement based on whether this crop  
18 polygon is inside or outside the inner region.

19 So I have to look at my declaration to see  
20 where I make use of this. 15:06:26

21 BY MR. SCHMIDT:

22 Q. Well, let me just ask you some questions  
23 about the disclosure. If you turn to column 9 in  
24 Bell, do you see Relation 5 about halfway down?

25 A. Yes, I do.

1 Q. And Relation 5 is a spherical linear  
2 interpolation based on something that is called a  
3 decay factor. Do you see that?

4 A. Yes, I see that.

5 Q. And that interpolation with the decay  
6 factor would be an example of damping the virtual  
7 camera?

8 A. So we have interpolation function here.  
9 We have the condition that the crop polygon remains  
10 completely within the inner region, and then using 15:07:51  
11 a mixing weight approximately .95 -- by the way,  
12 that is my W that I use. When I do spherical  
13 interpolation, I need a T between zero and one.  
14 That was my W, the previous question.

15 So continuing here, with the 0.95, there  
16 is interpolation in delta K is close to the  
17 delta K minus one. It just changes just a little  
18 bit. So this is, again, one example -- I don't  
19 know what other examples I mention, but this is  
20 with the limitation that at some level that if the 15:08:45  
21 crop polygon is within the inner region of the said  
22 certain space, then the object of movement of the  
23 said virtual camera that I just changed the v of  
24 delta slightly.

25 Q. And a little further down in that column

1 do you see Relation 7?

2 A. Yes.

3 Q. In Relation 7 is the different spherical  
4 linear interpolation with a weighting  
5 factor of alpha? Do you see that?

6 A. Yes, I do.

7 Q. And the relationship here is an example of  
8 accelerating the virtual camera in order to avoid a  
9 collision with the edge of the frame; correct?

10 MS. MAO: Objection. Form. 15:10:05

11 THE WITNESS: This example here is when the  
12 polygon lies outside the inner region and then  
13 depending on how far -- how much it lies outside  
14 this region, I can choose alpha close to one or do  
15 nothing or close to zero whereby the virtual  
16 P prime zero orientation change --

17 THE STENOGRAPHER: You have to speak up or...

18 THE WITNESS: Yeah, I haven't analyzed this  
19 equation in my declaration and in detail, but based  
20 on the reading here, the set of equations address 15:11:52  
21 the situation where the crop polygon is inside  
22 the -- in the region or just going outside the  
23 region.

24 BY MR. SCHMIDT:

25 Q. But between these two relationships, in

1 light of claim 1, what Bell is teaching is tuning  
2 these factors to control the amount of smoothing to  
3 avoid the virtual camera going outside the visible  
4 frame; correct?

5 MS. MAO: Objection. Form.

6 THE WITNESS: Yeah, these are formulas to  
7 control the camera the crop polygon being outside  
8 the inner region.

9 BY MR. SCHMIDT:

10 Q. Let's turn to a new topic.

15:12:53

11 In the '840 patent, there is a claim  
12 limitation for -- withdrawn.

13 If you turn to column 32 -- I'm sorry.  
14 Column 30, beginning at about line 46, the claim  
15 reads "wherein the determination of the smoothed  
16 trajectory based on the look-ahead of the  
17 trajectory includes use of a temporal horizon of  
18 motion experienced by the image capture device, the  
19 temporal horizon enabling approximation of  
20 intentional motion of the image capture device  
21 while causing a delay in the determination of the  
22 smoothed trajectory."

15:14:15

23 Do you see that?

24 A. Yes, I do.

25 Q. As a person of ordinary skill in the art,

Page 130

1       what is your understanding of the phrase "enabling  
2       approximation of intentional motion of the image  
3       capture device"?

4           MS. MAO:  Objection.  Form.

5           THE WITNESS:  Can you please repeat the  
6       question?

7       BY MR. SCHMIDT:

8           Q.    As a person of ordinary skill in the art,  
9       what is your understanding of the phrase, quote,  
10      "enabling approximation of intentional motion" --       15:16:41

11          MS. MAO:  Objection.  Form.

12      BY MR. SCHMIDT:

13          Q.    -- "of the image capture device"?

14          A.    To start with, the '840 patent discloses  
15      that intentional motion may affect the motion that  
16      was intended by the user of the image capture  
17      device, such as forward motion to follow an object  
18      of interest, panning motion to shoot the wide view  
19      of the scenery and all other motion.

20                  Also talks about unintentional motion and       15:17:36  
21      therefore approximating this intentional motion  
22      means what the word implies of getting some  
23      estimate, some approximation, of what this  
24      intentional motion is.

25          Q.    Would one way to phrase it be to say that

1 enabling approximation of intentional motion means  
2 striving to allow motion where it was intended and  
3 restrict motion where it was unintended?

4 MS. MAO: Objection. Form.

5 THE WITNESS: The limitation does not mean to  
6 me of what to do with this approximated intentional  
7 motion, just saying that being able to get some  
8 estimates, some approximation, of this intentional  
9 motion.

10 BY MR. SCHMIDT:

15:19:14

11 Q. Well, if you read further up the claim  
12 says "wherein the determination of the smoothed  
13 trajectory based on the look-ahead of the  
14 trajectory includes use of a temporal horizon of  
15 motion," and it continues on from there.

16 Do you see that?

17 A. Yes, I do.

18 Q. So wouldn't you agree that the  
19 determination of a smoothed trajectory in claim 1  
20 needs to include the use of a temporal horizon,  
21 which enables approximation of intentional motion?

15:20:01

22 A. The smoothed trajectory based on the  
23 look-ahead with trajectory includes use of the  
24 temporal horizon of motion experience. So you are  
25 going to use the temporal horizon, and the temporal

Page 132

1 horizon enables approximating the intentional  
2 motion, and what one will do with this intentional  
3 motion, I guess, we talked about smoothing -- I'm  
4 just reading the words here in this limitation.

5 Q. You would agree, Doctor, that the  
6 determination of the smoothed trajectory in claim 1  
7 needs to include the use of the temporal horizon;  
8 correct?

9 A. Yes, the determination of the smoothed  
10 trajectory includes the determination of the use of 15:21:52  
11 the temporal horizon.

12 Q. Now, if there was a system that introduced  
13 movement to frames where it was not intended by the  
14 user, that would be inconsistent with the temporal  
15 horizon enabling approximation of intentional  
16 motion. Agreed?

17 MS. MAO: Objection. Form.

18 THE WITNESS: I'm sorry. I didn't follow the  
19 question.

20 BY MR. SCHMIDT: 15:22:47

21 Q. If there was a system that intentionally  
22 introduced movement to a frame where it was not  
23 intended by the user, that would be inconsistent  
24 with the temporal horizon limitation cited here;  
25 correct?

1 MS. MAO: Objection. Form.

2 THE WITNESS: So I don't get this hypothetical  
3 here, if it's a hypothetical. So the camera moves  
4 independently of the user?

5 BY MR. SCHMIDT:

6 Q. Yes.

7 The hypothetical involves a situation  
8 where the camera does not move. The user does not  
9 intend it to move, and yet the system makes the  
10 decision to add motion to that frame. That would 15:23:29  
11 be inconsistent with this claim limitation.  
12 Wouldn't you agree?

13 MS. MAO: Objection. Form.

14 THE WITNESS: I don't understand when you say  
15 "the system decides," you said, or agrees to  
16 motion?

17 I don't get the hypothetical picture.

18 BY MR. SCHMIDT:

19 Q. Imagine a stationary camera.

20 A. Okay. 15:23:56

21 Q. And during processing, the smoothing  
22 algorithm decides to move the virtual camera in  
23 that frame even though the camera was stationary  
24 intentional.

25 A. So the camera is stationary. It's

1 recording the scene and calculates a smoothed  
2 trajectory. Right?

3 Q. Yes.

4 A. But a virtual position of the camera.  
5 Okay.

6 Q. And the system calculates that the virtual  
7 camera during that frame should be moving even  
8 though the camera was stationary.

9 MS. MAO: Objection. Form.

10 BY MR. SCHMIDT: 15:24:41

11 Q. In that hypothetical, that system would be  
12 inconsistent with its temporal horizon?

13 A. But why should the system move the virtual  
14 camera? It's due to a matter or due to another  
15 assumption? What's happening?

16 Q. For whatever reason. For design choice.  
17 It's a hypothetical. So to smooth the motion  
18 across multiple frames perhaps.

19 In that hypothetical, the system would not  
20 be consistent with the temporal horizon limitation 15:25:11  
21 cited here; correct?

22 MS. MAO: Objection. Form.

23 THE WITNESS: I'm sorry. I don't -- I don't  
24 understand what's going on.

25

1 BY MR. SCHMIDT:

2 Q. What don't you understand?

3 A. Maybe it's late in the afternoon or  
4 something.

5 I have a stationary camera. I have a  
6 system that processes -- what does it process?  
7 Process the gyro data about this camera? What  
8 processing is taking place?

9 Q. Let me give you more detail on the  
10 hypothetical. So back up. Camera is stationary. 15:25:45

11 A. Okay.

12 Q. Camera is buffering frames over time.  
13 Camera remains stationary for five seconds. At  
14 second five, the camera undergoes a drastic  
15 movement. Are you with me so far?

16 A. Okay.

17 Q. During processing of video, the system  
18 makes the determination instead of having the  
19 motion become so drastic at second five, I'm going  
20 to smooth that motion out across the seconds one 15:26:19  
21 through four by introducing motion in earlier  
22 frames where it didn't otherwise exist. In this  
23 hypothetical --

24 A. So you said it was stationary. Frames one  
25 through five, the camera was stationery. Right?

Page 136

1 So no motion? Nothing?

2 Q. Yes.

3 A. Frame 6 it just goes up somewhere. Okay.

4 So then which frame am I processing now? Frame 2?

5 Q. Now you're going back and processing  
6 frame 1 because you buffered them.

7 A. Okay. So process frame 1 and try to  
8 decide how to smooth the trajectory?

9 Q. In my hypothetical, we're adding motion to  
10 frame 1 so that the motion is not so drastic at 15:27:09  
11 frame 6.

12 MS. MAO: Let me just put an objection to the  
13 entire line of questioning as to form.

14 THE WITNESS: Okay. So at frame 1, and I'm  
15 looking at frame 6 and decide to change?

16 BY MR. SCHMIDT:

17 Q. Yes.

18 A. Okay. So frame 6 and beyond, I mean, what  
19 does the horizon start with? Frame 2 or...

20 Q. Forget about the horizon for a second. 15:27:49  
21 Let's just understand the hypothetical.

22 Do you understand the hypothetical?

23 MS. MAO: Objection. Form.

24 THE WITNESS: It's a vague word. So understand  
25 the word "hypothetical."

1 BY MR. SCHMIDT:

2 Q. Do you understand the hypothetical  
3 I described?

4 A. No.

5 Q. What don't you understand about it?

6 A. Everything. Unless -- I don't know --  
7 there is a board, and we can sketch what we are  
8 doing or not doing.

9 Q. I don't think we should be sketching on  
10 boards. Let me just ask you one more time. 15:28:22

11 If a system introduces intentional motion  
12 to a frame that wasn't intended by the user, that's  
13 inconsistent with this temporal horizon claim  
14 limitation; correct?

15 MS. MAO: Same objection.

16 THE WITNESS: If the system, in smoothing the  
17 trajectory, is introducing a motion -- I need to  
18 understand more about it. What is -- I'm sorry.  
19 I cannot -- I haven't considered this hypothetical.  
20 I cannot give you an answer as we sit here right 15:29:00  
21 now.

22 BY MR. SCHMIDT:

23 Q. Okay. And you've never considered a  
24 system where a drastic motion in some future frame  
25 was spread across other frames?

1 MS. MAO: Objection. Form.

2 THE WITNESS: Frames moving forward or frames  
3 in the past?

4 BY MR. SCHMIDT:

5 Q. In the past.

6 MS. MAO: Objection. Form.

7 THE WITNESS: Yeah, it's not set forth in my  
8 declaration.

9 BY MR. SCHMIDT:

10 Q. Let's turn to Exhibit 5. That's one of 15:29:52  
11 your declarations. We are going to turn to  
12 page 65, and at page 64, Exhibit 5, you're  
13 analyzing this claim limitation, "the temporal  
14 horizon enabling approximation of intentional  
15 motion."

16 Do you see that?

17 A. Yes.

18 Q. And in paragraph 112, you cite a patent  
19 called Cai that distinguishes zero motion from  
20 video from videos with intended motion. 15:30:35

21 Do you see that?

22 A. Yes, I do.

23 Q. Okay. And then you reproduce Figures 4  
24 and 3 of Cai on the following page, page 68.

25 Do you see that?

Page 139

1 A. Yes, I do.

2 Q. And in Figure 3, for example, do you see  
3 that annotation of T between two frames?

4 A. Yes, I do.

5 Q. That's a threshold in Cai; correct?

6 A. Yes.

7 Q. And the way that Cai works is it will  
8 consider the motion zero motion until it exceeds  
9 some threshold, and then it will follow the motion  
10 from there; correct? 15:31:21

11 MS. MAO: Objection. Vague.

12 THE WITNESS: Did we get Cai or not?

13 BY MR. SCHMIDT:

14 Q. I have it here, if you want.

15 Are you able to answer the question  
16 without the patent or do you need the patent? Do  
17 you remember the question?

18 A. Can you please repeat it?

19 Q. The question is that Cai will consider  
20 motion in a given frame zero motion unless it 15:34:53  
21 exceeds the threshold?

22 MS. MAO: Objection. Form.

23 THE WITNESS: The main objective of Cai is to  
24 distinguish between zero and nonzero motion, and  
25 the zero motion is the -- and nonzero motion is the

1 intended motion, and then there are different ways  
2 to perform this distinction between zero and  
3 nonzero motion.

4 MR. SCHMIDT: Will you mark this as Exhibit 11.

5 (Whereupon, Exhibit 11 was  
6 marked for identification.)

7 BY MR. SCHMIDT:

8 Q. I placed before you the next exhibit in  
9 order, Exhibit 11, U.S. Patent 10,158,802, which  
10 we'll refer to as Cai. 15:39:04

11 Are you familiar with this document,  
12 correct, sir?

13 A. Yes, I am.

14 Q. Let me direct you to Figure 5.

15 Figure 5 is a representation of the  
16 process taught by Cai. Fair?

17 A. I'm sorry. I'm sorry. I didn't hear you.  
18 That's all.

19 Q. Figure 5 is an illustration of the process  
20 that Cai teaches and discloses. Is that fair? 15:39:38

21 MS. MAO: Objection. Form.

22 THE WITNESS: Figure 5 is an implementation of  
23 what Cai teaches.

24 BY MR. SCHMIDT:

25 Q. Do you see block 522 in the lower

1 left-hand corner labeled "zero motion detection"?

2 A. Yes, I do.

3 Q. That's where the determination between  
4 zero motion and nonzero motion is made; correct?

5 A. Yes, I see that. 522 is zero motion  
6 reduction.

7 Q. The question is that's where the  
8 determination you mentioned earlier between zero  
9 motion and nonzero motion is made in Cai; correct?

10 A. Yeah, in this block diagram, that's the 15:41:58  
11 block that reads "zero motion detection."

12 Q. The zero motion detection in block 522,  
13 that determination is made strictly on the basis of  
14 previous frames and current frame.

15 Do you see that?

16 MS. MAO: Objection. Form.

17 THE WITNESS: I can see that it is working in  
18 previous frames and current frame.

19 BY MR. SCHMIDT:

20 Q. And the consideration of the raw 15:42:38  
21 trajectory of future frames 524 comes after the  
22 zero motion detection block.

23 Do you see that?

24 MS. MAO: Objection. Form.

25 THE WITNESS: 522 is performing zero motion

1 detection, and according to the specification, it  
2 "may be performed in a variety of different ways.  
3 In the example of Figure 2, the low-pass filter  
4 predicted trajectory frames are compared to a  
5 stable planned trajectory." If the difference is  
6 small and within a threshold, then the video  
7 sequence may be declared to have a zero motion  
8 trajectory. "This determination would" -- "may be  
9 combined with a detection of transitions as  
10 described in Figure 3 a false detection test as 15:44:20  
11 described in Figure 4 and so on.

12 So it's not only past frames that are  
13 needed to determine if it's zero motion.

14 BY MR. SCHMIDT:

15 Q. Where are you reading from?

16 A. 7, 40.

17 Q. Column 7, line 40.

18 "In the example of Figure 2, the low-pass  
19 filter predicted trajectory frames are compared to  
20 a stable planned trajectory." 15:45:19

21 In that implementation what's happening is  
22 that the low-pass filtered frames at any given  
23 moment are compared to the stable planned  
24 trajectory frame at that same moment; correct?

25 A. This is one implementation that can be

1 compared with the actual trajectory data.

2 Q. But what I said is correct; correct?

3 MS. MAO: Objection. Form.

4 THE WITNESS: Yeah, the way it's here, you read  
5 this particular sentence, that's how it reads, but,  
6 that's, again, one implementation.

7 BY MR. SCHMIDT:

8 Q. And in the embodiment in Figure 3, the  
9 comparison being made is also between a low-pass  
10 filtered frame at a given time and the planned 15:46:31  
11 trajectory frame at that same time; correct?

12 MS. MAO: Objection. Form.

13 BY MR. SCHMIDT:

14 Q. Actually, let me withdraw the question.

15 In Figure 3, what's happening is that the  
16 displacement between a low-pass filter frame and a  
17 previous low-pass filter frame is being measured;  
18 correct?

19 A. This is one of the implementations.

20 Cai mentions multiple ways to do this determination 15:47:43  
21 compared to the theta data, the theta data to the  
22 hypothesis there, or you can compare it to the real  
23 data or you can compare the real data to a  
24 hypothesis. This is everything understood by Cai's  
25 disclosure.

1 Q. I want to break it down figure by figure.

2 In Figure 3, what Cai is comparing is the  
3 motion between a current frame and a previous  
4 frame; correct?

5 MS. MAO: Objection. Form.

6 THE WITNESS: Or a current frame and a future  
7 frame.

8 BY MR. SCHMIDT:

9 Q. But what Figure 4 is considering is the  
10 displacement between two successive frames. 15:49:06  
11 Agreed?

12 MS. MAO: Objection. Form.

13 THE WITNESS: Figure 4, that seems to be the  
14 difference between the white circle and the shaded  
15 circle, the low bus Figure and the proposed method.

16 BY MR. SCHMIDT:

17 Q. I said Figure 4. My apologies. I meant  
18 Figure 3.

19 The question was in Figure 3 the  
20 comparison is between two successive frames; 15:49:53  
21 correct?

22 MS. MAO: Objection. Form.

23 Patrick, I think we've been going for over  
24 an hour now.

25 THE WITNESS: Take a break.

1 BY MR. SCHMIDT:

2 Q. Let me wrap this up. There's a question  
3 pending.

4 The comparison in Figure 3 is between two  
5 successive frames; correct?

6 MS. MAO: Objection. Form.

7 THE WITNESS: Again, three is just an example,  
8 but what I see in three is the difference between  
9 two successive, but the success can be the current  
10 and the future frame so it will be in the future. 15:50:43

11 BY MR. SCHMIDT:

12 Q. But Figure 5 tells us that zero motion  
13 detection is based only on previous frames and  
14 current frame. Do you see that?

15 MS. MAO: Objection. Form.

16 THE WITNESS: This is just an embodiment and  
17 implementation in the specification that says  
18 otherwise.

19 BY MR. SCHMIDT:

20 Q. Where does it say that in the 15:51:09  
21 specification?

22 A. Well, we were looking at there were many  
23 ways to implement 5, 22.

24 Q. Can you identify for me where in the  
25 specification Cai discloses zero motion detection

1 based on a look-ahead of frames in the future?

2 A. Yeah, in 7, 40-41. First of all, it says  
3 "The first part includes zero motion detection 522  
4 which may be performed in a variety of different  
5 ways."

6 Q. Okay. Anything else?

7 A. And then it mentions Figure 2.

8 And then further down, in 46, "This  
9 determination may be combined with a detection of  
10 transitions as described in the context of 15:52:05  
11 Figure 3," which means looking into the future,  
12 looking at the next frame, "and a false detection  
13 test as described in the context of Figure 4."

14 And this is just examples, one of the many  
15 implementations that he's talking about.

16 Q. You mentioned a false detection test in  
17 Figure 4. Can you turn to Figure 4, please?

18 A. Yes.

19 Q. What's happening in Figure 4 is that the  
20 system -- the -- strike that. 15:52:39

21 What's happening in Figure 4 is that the  
22 system is treating the motion as zero motion up  
23 until a certain point. Do you see that?

24 MS. MAO: Objection to form.

25 THE WITNESS: Yes, I see that.

1 BY MR. SCHMIDT:

2 Q. And at the vertical line in the chart in  
3 Figure 4, the system makes a determination that the  
4 zero motion determination that it made was a false  
5 detection; correct?

6 A. Yeah, the meaning of Figure 4 is that  
7 although there's no zero motion throughout this  
8 motion trajectory, a certain part was detected the  
9 zero motion but the part from the left of the  
10 center vertical line in photo 4 and that's the 15:53:43  
11 false detection part.

12 Q. And the reason why, at the beginning of  
13 the trajectory, it was registering as zero motion  
14 is because the displacement between any two  
15 successive frames in the low-pass filter trajectory  
16 was small; correct?

17 MS. MAO: Objection. Form.

18 THE WITNESS: That could be one reason, but  
19 like in every method, you can have false results  
20 based on a number of reasons. 15:54:22

21 BY MR. SCHMIDT:

22 Q. And the system was only able to determine  
23 that it had falsely detected zero motion after  
24 those small displacements accumulated into a large  
25 displacement. That's what Figure 4 is teaching;

Page 148

1 correct?

2 MS. MAO: Objection. Form.

3 THE WITNESS: Figure 4 is an example of a false  
4 detection, and it's an example that teaches that  
5 you can avoid this false detection if, instead of  
6 comparing each frame individually against each  
7 other, the trajectories may be compared. So it  
8 teaches that if you use one of the many methods  
9 that the patent teaches, if you use the difference  
10 in the trajectory, the difference between

15:56:08

11 successive frames, you might have false detection.  
12 Therefore, compare against the original trajectory,  
13 and that would be a better way to avoid this false  
14 detection. So it does two things, demonstrates  
15 where one of those can fail but also recommends a  
16 remedy for that failure.

17 BY MR. SCHMIDT:

18 Q. Figure 4, the trajectory with the shaded  
19 dots is the trajectory from the proposed method.

20 Do you see that?

15:56:41

21 A. Yes, that's what the label says.

22 Q. Okay. And there is a lag in when that  
23 trajectory from the proposed method is able to  
24 track the intentional motion; correct?

25 MS. MAO: Objection. Form.

Page 149

1 THE WITNESS: Yeah. We have a full detection  
2 of the zero motion, zero motion, yes.

3 MR. SCHMIDT: Why don't we take a break?

4 And I think I just have a few more  
5 questions. So why don't we take a short one, and  
6 we could probably wrap up.

7 THE WITNESS: Okay.

8 (A short break was taken at  
9 3:57 PM to 4:08 PM.)

10 BY MR. SCHMIDT: 16:08:32

11 Q. Just a few more questions, Doctor.

12 Sticking with Cai for a moment,  
13 Exhibit 11, I want to direct you to column 2 and  
14 line 35, the disclosure reads "The movement of the  
15 scene in a video sequence is referred to as the  
16 trajectory. The movement of the camera can be  
17 estimated by analyzing the movement of the scene."

18 Do you see that?

19 A. Yes, I do.

20 Q. Does that indicate to you that Cai is 16:08:59  
21 describing an approach where the motion estimation  
22 is done based on an optical analysis of the image  
23 itself as opposed to an image sensor?

24 MS. MAO: Objection. Form.

25 THE WITNESS: Cai discloses in column 10, 23-24

Page 150

1 that a global positioning system device,  
2 accelerometer, gyroscopes, and so on can also be  
3 used in implementing his teachings.

4 BY MR. SCHMIDT:

5 Q. Column 10 just has a laundry list of  
6 features that may be in a video device 100; right?

7 A. Lists other devices that could be used  
8 with the disclosed invention.

9 Q. Like the crypto processor? Could that be  
10 used with the invention in Cai? 16:11:06

11 MS. MAO: Objection. Form.

12 THE WITNESS: Yeah, what I focus on is the  
13 accelerometer, the gyroscope, that can provide this  
14 motion information.

15 BY MR. SCHMIDT:

16 Q. But you agree that Cai has absolutely no  
17 disclosure of using the accelerometer or gyroscope  
18 in order to estimate the trajectory of the camera;  
19 correct?

20 MS. MAO: Objection. Form. 16:11:36

21 THE WITNESS: Cai teaches a method to process  
22 camera data to process -- I'm sorry -- to process  
23 camera trajectory data and just decide if the zero  
24 motion or intentional motion, and where this  
25 trajectory data comes from is secondary in the

1 sense that the method doesn't focus on how to  
2 obtain the trajectory data but how to process the  
3 trajectory data. So, therefore, using gyro data,  
4 for example, would be just -- is taught by Cai. He  
5 says if you have gyro data, I used them, and the  
6 method will not change the total.

7 BY MR. SCHMIDT:

8 Q. Go back to column 2. At line 40, Cai  
9 writes "Because it is not always knowing which  
10 elements in a scene are moving and which elements 16:13:00  
11 in a scene appear to move because of the camera's  
12 motion, trajectory smoothing is based on an  
13 estimate of the actual unknown trajectory."

14 Do you see that?

15 A. Yes.

16 Q. The estimate is based on an actual unknown  
17 trajectory because Cai is only contemplating an  
18 optical analysis in the image itself for image  
19 estimation; isn't that right?

20 MS. MAO: Objection. Form. 16:13:34

21 THE WITNESS: This is something that changes if  
22 I have gyro data available. So it's a general  
23 statement that he makes here.

24 BY MR. SCHMIDT:

25 Q. But it sounds like we are in agreement

1 that this statement indicates Cai was not  
2 contemplating an approach that would use gyro or  
3 accelerometer data to estimate the motion  
4 trajectory; correct?

5 MS. MAO: Objection. Form.

6 THE WITNESS: But he mentions that such data  
7 can be used with his invention. It's an exclusive  
8 statement with that and applying the teachings to  
9 gyro acceleration data would be -- is  
10 straightforward. 16:15:23

11 BY MR. SCHMIDT:

12 Q. You're referring to the disclosure in  
13 column 10?

14 A. Yes.

15 Q. Where the gyro and the accelerometer are  
16 mentioned, amongst such things as a speaker, a  
17 global positioning system, a crypto processor, a  
18 compact disk drive, a digital versatile disk;  
19 right?

20 A. Yeah, this is one mention. I'm not sure 16:15:45  
21 or not if there's an additional mention somewhere  
22 else in the specification, but that's specific  
23 that, if these are available, they can be used.

24 Q. Okay. Turn to Zhou, which is Exhibit 6.

25 Actually, before we go there, let me just

1 ask you this: Would you agree that there are  
2 drawbacks to buffering more frames and having a  
3 longer temporal horizon?

4 MS. MAO: Objection. Form.

5 THE WITNESS: Are you referring to something  
6 specific in the patent or my declaration?

7 BY MR. SCHMIDT:

8 Q. Not right now. This is just a general  
9 statement.

10 As a general matter, would you agree there 16:17:11  
11 are some drawbacks to having a longer temporal  
12 horizon which involves buffering more frames?

13 MS. MAO: Objection. Form.

14 THE WITNESS: Like a lot of other things, it's  
15 an engineering tradeoff that is involved here.  
16 Buffering more future data would require a larger  
17 buffer, could introduce a larger delay, but at the  
18 same time, it would allow us to have a better look  
19 at the future, and that's invaluable. If you can  
20 look further into the future, you can tell a lot 16:17:50  
21 about what's going to happen. So it's just an  
22 engineering tradeoff as to how long such a buffer  
23 should be. There are a lot of considerations  
24 involved in making the choice.

25 BY MR. SCHMIDT:

1 Q. But it sounds like you agree that  
2 buffering more frames would come at the expense of  
3 consuming memory with a larger buffer, more  
4 processing time to handle those frames. Is that  
5 fair?

6 A. At the benefit of doing a better job  
7 determining the intent of the camera and a lot of  
8 other things. So it's a tradeoff. You lose some;  
9 you gain some.

10 Q. I need to ask the question again because 16:18:40  
11 you didn't clearly answer it. I understand the  
12 benefits.

13 Would you agree that buffering more frames  
14 comes at the expense of consuming memory with a  
15 larger buffer and more processing time to handle  
16 those frames? Do you agree?

17 MS. MAO: Same objection.

18 THE WITNESS: I mean, it sounds like a previous  
19 statement if we don't consider the tradeoff; right?  
20 So in three units that's more than two. So three 16:19:17  
21 delay time versus two delay time. Yeah, three is  
22 greater than two, but the consideration of interest  
23 is to consider all the trade-offs involved.

24 BY MR. SCHMIDT:

25 Q. Do you agree with my statement that larger

1 buffer consumes more memory, takes longer time to  
2 process and those are drawbacks?

3 MS. MAO: Same objection.

4 BY MR. SCHMIDT:

5 Q. Or do you disagree?

6 A. The longer time to process may or may not  
7 be the case. The storing part, I would agree.

8 Q. Okay. So a longer buffer is not  
9 necessarily going to result in longer processing  
10 time? Is that what you're telling me? 16:20:12

11 A. It depends how I access the data in the  
12 buffer, I would think.

13 Q. Okay. So if you wanted to show that a  
14 larger temporal horizon was creating more of a  
15 delay in processing, you would have to find  
16 something specific in the prior art that taught  
17 that; right?

18 MS. MAO: Objection. Form.

19 THE WITNESS: The delay is not necessarily to  
20 the processing. The delay is due to the fact that 16:20:40  
21 I have to look further into the future, and,  
22 therefore, it generates a greater delay. The delay  
23 is clearly proportional to how many frames I store.  
24 But referring to the processing time, that may or  
25 may not be in related to the number of elements

1 I store.

2 BY MR. SCHMIDT:

3 Q. Okay. Doctor, last question. Do you have  
4 any other opinions that are not expressed in your  
5 declarations that you haven't discussed here today  
6 regarding the two patents that we've been  
7 discussing today?

8 A. Not thinking right now, but this does not  
9 exclude having additional opinions based on other  
10 documents that I might be asked to look at, things 16:21:41  
11 of that nature.

12 Q. But sitting here right now, you don't have  
13 any other opinions beyond what are set forth in  
14 your declarations with regard to these two patents;  
15 correct?

16 MS. MAO: Same objection. Asked and answered.

17 THE WITNESS: I didn't give it much thought  
18 before coming here.

19 MR. SCHMIDT: Okay. Thanks for your time.

20 THE WITNESS: Thank you. 16:22:08

21 MR. SCHMIDT: Pass the witness.

22 MS. MAO: Let's take a five-minute break.

23 (A short break was taken at 4:22  
24 PM to 4:25 PM.)

25 MS. MAO: We have no further questions.

Page 157

MR. SCHMIDT: Off the record.

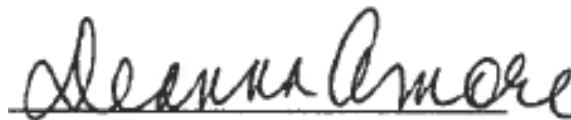
C E R T I F I C A T E

I, DEANNA AMORE, a Shorthand Reporter and  
notary public, within and for the State of  
Illinois, County of DuPage, do hereby certify:

That AGGELOS K. KATSAGGELOS, the witness  
whose examination is hereinbefore set forth, was  
first duly sworn by me and that this transcript of  
said testimony is a true record of the testimony  
given by said witness.

I further certify that I am not related to  
any of the parties to this action by blood or  
marriage, and that I am in no way interested in the  
outcome of this matter.

IN WITNESS WHEREOF, I have hereunto set my  
hand this 9th day of April 2025.



Deanna M. Amore, CRR, RPR, CSR

1 STELLA MAO

2 smao@mofo.com

3 April 10, 2025

4 RE: Arashi Vision Inc. v. Gopro Inc.

5 4/4/2025, Aggelos Katsaggelos, (#7277891).

6 The above-referenced transcript has been  
7 completed by Veritext Legal Solutions and  
8 review of the transcript is being handled as follows:

9 \_\_\_ Per CA State Code (CCP 2025.520 (a)-(e)) - Contact Veritext  
10 to schedule a time to review the original transcript at  
11 a Veritext office.

12 \_XX\_ Per CA State Code (CCP 2025.520 (a)-(e)) - Locked .PDF  
13 Transcript - The witness should review the transcript and  
14 make any necessary corrections on the errata pages included  
15 below, notating the page and line number of the corrections.  
16 The witness should then sign and date the errata and penalty  
17 of perjury pages and return the completed pages to all  
18 appearing counsel within the period of time determined at  
19 the deposition or provided by the Code of Civil Procedure.  
20 Contact Veritext when the sealed original is required.

21 \_\_\_ Waiving the CA Code of Civil Procedure per Stipulation of  
22 Counsel - Original transcript to be released for signature  
23 as determined at the deposition.

24 \_\_\_ Signature Waived - Reading & Signature was waived at the  
25 time of the deposition.

Page 160

1     \_\_\_ Federal R&S Requested (FRCP 30(e)(1)(B)) - Locked .PDF  
2         Transcript - The witness should review the transcript and  
3         make any necessary corrections on the errata pages included  
4         below, notating the page and line number of the corrections.  
5         The witness should then sign and date the errata and penalty  
6         of perjury pages and return the completed pages to all  
7         appearing counsel within the period of time determined at  
8         the deposition or provided by the Federal Rules.  
9     \_\_\_ Federal R&S Not Requested - Reading & Signature was not  
10        requested before the completion of the deposition.

Arashi Vision Inc. v. Gopro Inc.

Aggelos Katsaggelos (#7277891)

E R R A T A S H E E T

PAGE\_\_\_\_\_ LINE\_\_\_\_\_ CHANGE\_\_\_\_\_

\_\_\_\_\_

REASON\_\_\_\_\_

PAGE\_\_\_\_\_ LINE\_\_\_\_\_ CHANGE\_\_\_\_\_

\_\_\_\_\_

REASON\_\_\_\_\_

PAGE\_\_\_\_\_ LINE\_\_\_\_\_ CHANGE\_\_\_\_\_

\_\_\_\_\_

REASON\_\_\_\_\_

PAGE\_\_\_\_\_ LINE\_\_\_\_\_ CHANGE\_\_\_\_\_

\_\_\_\_\_

REASON\_\_\_\_\_

PAGE\_\_\_\_\_ LINE\_\_\_\_\_ CHANGE\_\_\_\_\_

\_\_\_\_\_

REASON\_\_\_\_\_

PAGE\_\_\_\_\_ LINE\_\_\_\_\_ CHANGE\_\_\_\_\_

\_\_\_\_\_

REASON\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(Aggelos Katsaggelos)

Date

1 Arashi Vision Inc. v. Gopro Inc.

2 Aggelos Katsaggelos (#7277891)

3 ACKNOWLEDGEMENT OF DEPONENT

4 I, Aggelos Katsaggelos, do hereby declare that I  
5 have read the foregoing transcript, I have made any  
6 corrections, additions, or changes I deemed necessary as  
7 noted above to be appended hereto, and that the same is  
8 a true, correct and complete transcript of the testimony  
9 given by me.

10

11

\_\_\_\_\_

\_\_\_\_\_

12

Aggelos Katsaggelos

Date

13

\*If notary is required

14

SUBSCRIBED AND SWORN TO BEFORE ME THIS

15

\_\_\_\_\_ DAY OF \_\_\_\_\_, 20\_\_\_\_.

16

17

18

\_\_\_\_\_

19

NOTARY PUBLIC

20

21

22

23

24

25

[& - 23-24]

|                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&amp;</b>                                                                                                                                                                                                                                                                                                                                                          | 90:23 99:19,25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>117</b> 31:11,13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>19</b> 4:3 69:5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>&amp;</b> 2:3,8,12<br>160:24 161:9                                                                                                                                                                                                                                                                                                                                 | 100:2,4,9<br>150:25 151:5<br>153:13 160:3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 32:14 33:10,14<br>33:19                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>1:29</b> 91:8<br><b>1it</b> 48:22                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>0</b>                                                                                                                                                                                                                                                                                                                                                              | <b>10,027,893</b> 4:5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>11:11</b> 62:25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>0</b> 54:9 55:22<br>63:22 68:9<br>114:20,21<br>115:3,14,18<br><b>0.95</b> 128:15<br><b>084-003999</b><br>1:24                                                                                                                                                                                                                                                      | 46:1<br><b>10,158,802</b> 4:9<br>141:9<br><b>10,462,370</b> 4:7<br>99:23<br><b>10,574,894</b> 3:7<br><b>10,958,840</b> 3:9<br><b>100</b> 65:14<br>66:19 71:20<br>121:2 151:6<br><b>10016</b> 2:14<br><b>105</b> 79:22<br><b>106</b> 85:22<br><b>108</b> 53:2,3 73:1<br>73:2,4<br><b>10:09</b> 31:4<br><b>10th</b> 2:10<br><b>11</b> 4:9 73:15,23<br>74:13 75:4<br>86:23 87:3,8<br>90:12,20 99:23<br>141:4,5,9<br>150:13<br><b>112</b> 99:10<br>139:18<br><b>113</b> 99:8,12<br><b>116</b> 6:19<br><b>1164</b> 6:15,20<br><b>1165</b> 7:3 | <b>11:26</b> 62:25<br><b>12</b> 126:16<br><b>12384</b> 159:20<br><b>12:30</b> 87:15<br><b>12:35</b> 91:8<br><b>13</b> 32:7,17<br>35:15,16 37:2<br>53:13 54:23<br>56:18 58:6,6<br>61:11 66:16<br><b>13-32</b> 28:11<br><b>1300</b> 32:22<br>33:2 35:8,24<br>36:5,5,9,22<br><b>14</b> 63:11 66:17<br><b>141</b> 4:9<br><b>15</b> 34:3<br><b>150</b> 15:20<br><b>16</b> 28:11 30:15<br>109:7<br><b>17</b> 24:21,22<br>26:3 27:4 76:1<br>76:5,17 77:23<br>88:19 110:11<br><b>17-19</b> 28:8<br><b>18</b> 3:24 24:25<br>78:1,13 100:3<br>100:4,8,15<br>102:21 108:10<br>108:12 | <b>2</b> 3:8 5:21 6:1<br>34:10,13,17,20<br>35:1,4,7,18<br>36:1,6,18 37:2<br>61:13 101:7,7<br>137:4,19 143:3<br>143:18 147:7<br>150:13 152:8<br><b>20</b> 26:3 38:21<br>163:15<br><b>200</b> 34:16,22<br><b>2000</b> 39:10<br><b>2014</b> 10:12<br><b>2015</b> 39:10<br><b>2018</b> 38:21<br>39:2,10,12<br>40:18<br><b>202</b> 34:21 36:2<br><b>2024-01186</b><br>3:12<br><b>2025</b> 1:15<br>159:17 160:3<br><b>2025.520</b> 160:9<br>160:12<br><b>206</b> 35:6<br><b>2100</b> 1:19<br><b>22</b> 63:11<br>146:23<br><b>23</b> 79:17,18<br><b>23-24</b> 150:25 |
| <b>1</b>                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>1</b> 3:6 5:14,17<br>7:23,25 12:19<br>14:1,5 28:8<br>34:10,13 36:18<br>50:6 60:14<br>61:12 63:22<br>65:14,14 66:19<br>79:19,23,24<br>80:16,22 81:2<br>82:9 83:1,23<br>85:3,20 114:6<br>114:12,20,21<br>115:3,14,18<br>126:15,19<br>127:10 130:1<br>132:19 133:6<br>137:6,7,10,14<br>161:1<br><b>10</b> 4:7 66:19<br>73:15 85:22,25<br>86:1,6,17,24<br>88:19 90:3,7 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

|                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>26</b> 32:8,17,20<br>32:24 33:1,4<br>34:3 36:12,12<br><b>27</b> 121:1<br><b>29</b> 7:25<br><b>295</b> 2:13<br><b>2:33</b> 118:21<br><b>2:46</b> 118:21<br><b>2d</b> 50:21 52:4<br>52:19,21 74:19<br>77:17 78:7                                                                                                                                                                                       | <b>4</b><br><b>4</b> 1:15 3:14<br>6:13,17,19<br>79:15 99:10,10<br>110:12 139:23<br>143:11 145:9<br>145:13,17<br>147:13,17,17<br>147:19,21<br>148:3,6,10,25<br>149:3,18<br><b>4/4/2025</b> 160:5<br><b>40</b> 70:24<br>143:16,17<br>152:8<br><b>40-41</b> 147:2<br><b>406</b> 58:7,9<br><b>41</b> 48:17 109:8<br><b>44</b> 66:17<br><b>45</b> 4:5 22:9<br>46:23<br><b>46</b> 130:14<br>147:8<br><b>47</b> 22:4,10,11<br>50:4<br><b>48</b> 77:3<br><b>4:08</b> 150:9<br><b>4:25</b> 157:24 | 139:10,12<br>141:14,15,19<br>141:22 146:12<br>146:23<br><b>50</b> 71:12 72:3<br><b>500</b> 63:20 64:4<br>64:9,23 65:16<br><b>502</b> 64:5,9<br>65:13 71:21<br>72:13<br><b>503</b> 64:23<br><b>52</b> 53:13<br><b>522</b> 141:25<br>142:5,12,25<br>147:3<br><b>524</b> 142:21<br><b>525</b> 126:2<br><b>54</b> 57:4 78:1<br><b>545</b> 126:3<br><b>56</b> 78:1<br><b>57</b> 83:17 84:20<br><b>58</b> 73:19,23<br>74:13<br><b>5a</b> 63:6,11,15<br>63:19 64:8<br>66:1<br><b>5b</b> 63:6 64:15<br><b>5c</b> 63:6 64:24<br>66:1 70:19<br>121:6 125:25<br>126:5<br><b>5d</b> 63:6,12 65:2<br>65:8,12,17,22<br>65:25 66:6,9<br>66:18,20,23 | 67:10,21 70:22<br>71:12 72:3,16<br><b>5th</b> 2:13                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                  |
| <b>3</b><br><b>3</b> 3:10 6:5,8<br>11:13 20:9,12<br>31:9 52:23,25<br>72:25 139:24<br>140:2 143:10<br>144:8,15 145:2<br>145:18,19<br>146:4 147:11<br><b>30</b> 63:19 108:7<br>130:14 161:1<br><b>308</b> 48:17<br><b>31</b> 108:7,12<br><b>32</b> 130:13<br><b>321</b> 100:6<br><b>35</b> 150:14<br><b>38</b> 77:3<br><b>3:57</b> 150:9<br><b>3d</b> 50:21 52:3,8<br>52:20 74:19<br>78:8,11,13<br>79:7,9 | <b>5</b><br><b>5</b> 3:4,6,18 7:1,6<br>22:4,9,10<br>53:16 63:5<br>71:4,6 99:5<br>116:12 124:19<br>127:24 128:1                                                                                                                                                                                                                                                                                                                                                                           | <b>6</b><br><b>6</b> 3:8,10,14,22<br>7:10,13,22<br>46:23 53:18<br>120:19,24<br>124:5,21 125:3<br>137:3,11,15,18<br>153:24<br><b>60</b> 19:15<br><b>61/407,630</b><br>3:25 18:18<br>19:19<br><b>62</b> 47:5<br><b>63</b> 81:1 82:24<br><b>64</b> 85:19<br>139:12<br><b>65</b> 139:12<br><b>68</b> 139:24                                                                                                                                                                                                                                                                                                                              | <b>7</b><br><b>7</b> 3:18,22,24<br>13:6 18:11,12<br>18:16 19:22<br>20:7 56:10,21<br>58:5 61:4,5<br>62:10 72:23<br>76:17 86:17<br>129:1,3 143:16<br>143:17 147:2<br><b>7,674,438</b> 3:22<br>7:11 |
|                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                  |

[7-8 - addressing]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>7-8</b> 76:5<br/> <b>70</b> 11:13,15<br/> <b>707</b> 2:5<br/> <b>7277891</b> 2:19<br/> 160:5 162:2<br/> 163:2<br/> <b>74</b> 13:13<br/> <b>78</b> 13:15</p>                                                                                                                                                                                                                                                                               | <p><b>9</b></p> <p><b>9</b> 4:5 45:20,22<br/> 45:25 48:16<br/> 50:4 73:15<br/> 79:13 82:12<br/> 84:19 100:4,8<br/> 126:15 127:23<br/> <b>90017</b> 2:5,10<br/> <b>95</b> 128:11<br/> <b>99</b> 4:7<br/> <b>9:01</b> 1:16 5:2<br/> <b>9:57</b> 31:4<br/> <b>9th</b> 2:13 159:17</p>                                                                                                                                                                                              | <p>129:8<br/> <b>acceleration</b><br/> 30:9 59:3<br/> 60:17 61:19,25<br/> 62:14,20 67:20<br/> 68:1,8 69:10<br/> 69:13,22 70:13<br/> 82:16 153:9</p>                                                                                                                                                                                                                                                                                                                                                                     | <p><b>action</b> 159:12<br/> <b>actual</b> 51:12<br/> 86:21 87:9,11<br/> 88:2,2,11,25<br/> 89:10,14,24<br/> 90:5,9,20,21,24<br/> 101:19 144:1<br/> 152:13,16</p>                                                                                                                                                                                                                                                                                                                 |
| <p><b>8</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p><b>95</b> 128:11</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p><b>accelerometer</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p><b>actually</b> 20:9</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>8</b> 4:3 19:1,2,6<br/> 22:3 24:21<br/> 32:21 34:4<br/> 48:14 53:12<br/> 63:5 76:17<br/> 84:20,20<br/> <b>8,531,535</b> 4:3<br/> 19:7<br/> <b>84</b> 116:13,14<br/> <b>840</b> 3:16,20<br/> 5:22 6:14,23<br/> 7:2 79:16 99:7<br/> 99:15 112:23<br/> 116:15 130:11<br/> 131:14<br/> <b>865</b> 2:9<br/> <b>894</b> 3:12 5:15<br/> 6:7 12:19 13:5<br/> 60:10 61:14<br/> 67:12,15<br/> <b>8a</b> 68:11,12,17<br/> 69:2,8,11,19<br/> 70:9</p> | <p><b>9th</b> 2:13 159:17</p> <p><b>a</b></p> <p><b>abc</b> 70:3<br/> <b>abcs</b> 70:4<br/> <b>ability</b> 33:19<br/> <b>able</b> 21:24 28:2<br/> 33:22 38:9,16<br/> 79:9 132:7<br/> 140:15 148:22<br/> 149:23<br/> <b>above</b> 53:15<br/> 126:12 160:6<br/> 163:7<br/> <b>abrupt</b> 64:18<br/> <b>absolutely</b><br/> 27:15 66:22<br/> 72:20 111:9<br/> 151:16<br/> <b>abstract</b> 46:21<br/> <b>accelerated</b><br/> 127:4<br/> <b>accelerating</b><br/> 126:23 127:11</p> | <p>151:2,13,17<br/> 153:3,15<br/> <b>accelerometers</b><br/> 11:17 13:3<br/> 41:21<br/> <b>access</b> 156:11<br/> <b>accomplish</b><br/> 116:2<br/> <b>accomplished</b><br/> 29:7<br/> <b>accordance</b><br/> 35:17 88:20<br/> <b>account</b> 110:19<br/> <b>accumulated</b><br/> 148:24<br/> <b>accuracy</b> 45:3<br/> 45:4 72:7<br/> <b>accurate</b> 45:9<br/> <b>acknowledge</b><br/> 81:22<br/> <b>acknowledge...</b><br/> 163:3<br/> <b>acquire</b> 48:4<br/> 93:17<br/> <b>acquired</b> 54:2<br/> 93:12 95:20</p> | <p>20:10,19 37:7<br/> 76:24 79:14<br/> 95:6 108:7,23<br/> 115:20 144:14<br/> 153:25<br/> <b>add</b> 49:21<br/> 134:10<br/> <b>added</b> 115:19<br/> <b>adding</b> 47:13<br/> 137:9<br/> <b>addition</b> 40:1<br/> 109:8 117:15<br/> <b>additional</b><br/> 75:24 153:21<br/> 157:9<br/> <b>additions</b> 42:25<br/> 163:6<br/> <b>address</b> 16:24<br/> 120:4 121:22<br/> 122:1 129:20<br/> <b>addressed</b><br/> 123:1<br/> <b>addressing</b><br/> 13:4 123:7<br/> 124:1,3</p> |

[adjust - appear]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>adjust</b> 115:7,22<br>117:6 127:17<br><b>adjustable</b> 70:4<br><b>adjustment</b><br>20:23<br><b>advanced</b> 39:1<br><b>advantages</b><br>47:1<br><b>affect</b> 96:16<br>131:15<br><b>affine</b> 22:6,13<br>24:2,15 49:11<br>49:13,15,19,25<br>50:17,18 73:15<br>74:24<br><b>afternoon</b><br>91:11 136:3<br><b>aggelos</b> 1:13<br>3:3,11,15,19<br>5:3 159:6<br>160:5 162:2,24<br>163:2,4,12<br><b>agree</b> 8:7 14:3<br>14:13 22:19<br>23:24 26:6<br>38:3 39:5<br>40:25 42:4<br>43:12,14 45:19<br>57:2,16 60:5<br>61:21 62:15<br>68:25 70:9<br>72:2 74:21<br>82:15 83:8<br>84:3 103:6,22<br>104:12 117:22 | 118:6 119:5<br>123:11 132:18<br>133:5 134:12<br>151:16 154:1<br>154:10 155:1<br>155:13,16,25<br>156:7<br><b>agreed</b> 37:22<br>76:19 81:7<br>133:16 145:11<br><b>agreement</b><br>152:25<br><b>agrees</b> 134:15<br><b>ahead</b> 56:10<br>80:1 83:4<br>84:15,15 85:21<br>86:8,16 130:16<br>132:13,23<br>147:1<br><b>algorithm</b><br>20:21 39:14<br>107:22 134:22<br><b>allow</b> 45:9<br>132:2 154:18<br><b>allowed</b> 94:14<br><b>allowing</b> 29:24<br><b>allows</b> 94:1,7<br>95:23<br><b>alpha</b> 86:19<br>88:6 89:9<br>129:5,14<br><b>alternative</b><br>14:12 81:6<br><b>amore</b> 1:24<br>159:3,21 | <b>amount</b> 28:18<br>112:8,15,16<br>113:3 115:9,24<br>117:5,12<br>118:11 119:24<br>120:15 122:1<br>124:11,12,23<br>130:2<br><b>analysis</b> 13:8<br>18:2,7 38:25<br>39:20 43:13<br>46:15 82:17<br>92:23 102:21<br>150:22 152:18<br><b>analyze</b> 20:5<br>24:12 26:8<br>77:22 85:19<br>93:11,22<br><b>analyzed</b> 21:12<br>77:14 127:13<br>129:18<br><b>analyzing</b> 14:7<br>41:8 47:9,24<br>48:2 79:24<br>139:13 150:17<br><b>anchor</b> 8:3,14<br><b>angeles</b> 2:5,10<br><b>angle</b> 25:1<br>78:11,20 79:8<br><b>angular</b> 24:14<br>28:10,15 30:8<br>78:4 79:2 85:2<br>85:3<br><b>annotation</b><br>140:3 | <b>anomalies</b> 96:1<br><b>answer</b> 15:19<br>15:22 16:18<br>17:9 21:24<br>24:5 28:2<br>33:22 38:7,9<br>38:16,20 39:2<br>42:14 44:7<br>46:14 54:10<br>61:9 68:3<br>71:25 80:10<br>82:21 105:13<br>105:14 111:12<br>118:9 138:20<br>140:15 155:11<br><b>answered</b> 42:9<br>105:25 106:17<br>107:20 157:16<br><b>answering</b><br>105:15<br><b>answers</b> 105:16<br><b>anticipated</b><br>104:10<br><b>anymore</b> 21:2<br><b>anyway</b> 125:22<br><b>aperture</b> 92:25<br><b>apologies</b><br>145:17<br><b>appeal</b> 1:1<br><b>appealing</b><br>41:19<br><b>appear</b> 52:15<br>115:4,20<br>152:11 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[appearances - background]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>appearances</b><br>2:1<br><b>appeared</b> 13:16<br><b>appearing</b> 51:1<br>160:18 161:7<br><b>appears</b> 71:22<br>72:6<br><b>appended</b><br>163:7<br><b>applicable</b><br>12:14 61:3<br><b>application</b><br>3:24 18:17<br>19:16,18,21<br>20:1,5,8 41:2<br>41:24 42:10<br>48:10<br><b>applications</b><br>36:25 43:10,11<br>44:9 48:7<br><b>applied</b> 27:23<br>59:25 61:5<br>77:1 103:2<br>107:23 113:3<br><b>applies</b> 101:15<br><b>apply</b> 26:25<br>61:1 62:19<br>90:20<br><b>applying</b> 91:16<br>101:18 102:13<br>153:8<br><b>approach</b> 8:8<br>8:16 9:9,20<br>10:4,9 14:6,8<br>14:18 37:10 | 40:10,12 43:20<br>44:15 60:20<br>61:10 106:4<br>150:21 153:2<br><b>approaches</b><br>10:1 14:16,22<br>17:21 21:19,20<br>41:4,17 44:19<br><b>approximate</b><br>124:23<br><b>approximated</b><br>70:6 132:6<br><b>approximately</b><br>71:12 128:11<br><b>approximating</b><br>131:21 133:1<br><b>approximation</b><br>52:7 130:19<br>131:2,10,23<br>132:1,8,21<br>133:15 139:14<br><b>april</b> 1:15<br>159:17 160:3<br><b>arashi</b> 1:3 2:2<br>160:4 162:1<br>163:1<br><b>architecture</b><br>11:25 34:14<br><b>area</b> 17:19<br><b>arjomand</b> 2:4<br><b>art</b> 18:2 39:18<br>40:19 46:12<br>47:7 91:13<br>115:13 124:22<br>130:25 131:8 | 156:16<br><b>articulate</b><br>88:10<br><b>articulating</b><br>88:14<br><b>aside</b> 33:16<br><b>asked</b> 30:12<br>54:22 105:24<br>106:16 107:20<br>118:5 157:10<br>157:16<br><b>asking</b> 11:6<br>12:6 17:11<br>29:16 44:2<br>71:11 104:24<br>106:9 110:7<br><b>aspect</b> 112:15<br><b>assertion</b> 32:15<br>33:5<br><b>assessed</b> 110:15<br><b>assign</b> 115:17<br><b>assignee</b> 116:4<br><b>associated</b> 32:7<br><b>assume</b> 51:16<br><b>assuming</b> 93:13<br><b>assumption</b><br>135:15<br><b>attention</b> 19:13<br>105:1<br><b>attenuated</b><br>94:14 114:12<br><b>attenuating</b><br>94:3,9<br><b>automatically</b><br>9:17 10:2,23 | <b>available</b> 15:2<br>15:4 39:24<br>41:3,21,23<br>152:22 153:23<br><b>avenue</b> 2:13<br><b>average</b> 115:12<br><b>averaging</b><br>121:2<br><b>avoid</b> 71:16<br>129:8 130:3<br>149:5,13<br><b>aware</b> 12:21<br>33:17 38:22<br>46:18<br><b>axis</b> 46:24<br>47:17 70:24<br>71:13 72:3<br>121:8,9 |
| <b>b</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                            |
| <b>b</b> 1:4 2:2 25:4<br>25:15,18 54:13<br>63:22 65:14<br>66:19 161:1<br><b>back</b> 20:7 31:6<br>48:13 63:2<br>70:22 79:12<br>80:25 82:11,24<br>83:15 85:18<br>91:10 109:7<br>118:23 126:14<br>136:10 137:5<br>152:8<br><b>background</b><br>14:5 52:16                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                            |

**[balance - brings]**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>balance</b> 80:2,12<br>80:21 81:9,17<br>81:19,23 82:6<br>82:10<br><b>based</b> 13:9 14:8<br>14:9 21:16<br>23:16 24:7<br>25:15 34:25<br>35:1,7 37:7,11<br>37:13,25 38:23<br>39:4 41:17<br>42:25 43:3,5,9<br>43:12 44:18,21<br>46:19 47:15<br>80:1 81:6 83:4<br>83:9 84:14<br>85:21 86:7,15<br>90:19 99:13<br>100:17,21<br>101:24 102:11<br>102:20 108:6<br>111:3 112:10<br>113:14 114:2<br>115:6,9,23<br>118:11 119:6<br>122:20 125:14<br>127:4,17 128:2<br>129:19 130:16<br>132:13,22<br>146:13 147:1<br>148:20 150:22<br>152:12,16<br>157:9<br><b>basis</b> 75:20<br>100:12 120:12 | 120:21 121:13<br>123:20 142:13<br><b>becoming</b><br>96:13,14<br><b>beginning</b> 7:25<br>34:3 58:6 66:6<br>70:23 123:1<br>130:14 148:12<br><b>begins</b> 20:15<br>22:12<br><b>behalf</b> 2:2,7<br><b>believe</b> 48:14<br>126:10<br><b>bell</b> 4:6 46:2,18<br>46:21,24 47:6<br>47:8,20 79:12<br>79:13,19 80:8<br>80:12,15,21,23<br>81:12,16,20,22<br>82:5,9,11,15,20<br>84:19,21 85:8<br>86:16,17 90:3<br>95:12 126:14<br>126:16,19<br>127:13,24<br>130:1<br><b>bell's</b> 127:3<br><b>belong</b> 16:19<br><b>belongs</b> 16:13<br><b>benefit</b> 155:6<br><b>benefits</b> 155:12<br><b>better</b> 70:17<br>149:13 154:18<br>155:6 | <b>beyond</b> 137:18<br>157:13<br><b>big</b> 112:6,19<br><b>bit</b> 93:2,22<br>128:18<br><b>black</b> 42:14<br><b>block</b> 48:17<br>58:7,9 141:25<br>142:10,11,12<br>142:22<br><b>blood</b> 159:12<br><b>blur</b> 92:11,19<br>93:1 99:13<br>100:6,11,16,17<br>101:3,12,22,24<br>102:10,19<br>103:4,7,11,15<br>103:19,23<br>104:2,4,6,8,12<br>104:17,22<br>105:4,23 106:4<br>106:6,10,14,23<br>106:25 107:3,6<br>107:9,12,15,23<br>108:1,3,6<br>111:3,22 112:1<br>112:8,11,15<br>113:4,15 114:2<br>114:5 115:7,9<br>115:24,25<br>117:6,13<br>118:11 119:24<br>120:15,22,25<br>121:3,7,14,21<br>121:22 122:1,6 | 122:13,15,18<br>122:23 123:3,4<br>123:7,7,10,14<br>123:17,20,25<br>124:1,7,11,17<br>124:23 125:2<br><b>blurred</b> 92:17<br><b>blurring</b> 93:4,6<br>93:9 97:20<br>98:1,5,5,9,20<br>98:22 99:3<br><b>board</b> 1:1 11:1<br>11:8 13:10,19<br>13:24 40:21<br>41:7 42:4,23<br>45:8 46:19,24<br>138:7<br><b>boards</b> 138:10<br><b>bottom</b> 20:12<br><b>boulevard</b> 2:5<br><b>bound</b> 29:16,21<br>30:2,3,14<br><b>boundaries</b><br>16:20,21 60:3<br><b>bounds</b> 29:25<br><b>break</b> 30:25<br>31:1,3,6 62:23<br>62:24 67:18<br>91:6,7 118:17<br>118:20,25<br>145:1,25 150:3<br>150:8 157:22<br>157:23<br><b>brings</b> 22:24 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[buffer - cases]

|                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>buffer</b> 90:14,25<br>93:19 110:20<br>154:17,22<br>155:3,15 156:1<br>156:8,12<br><b>buffered</b> 137:6<br><b>buffering</b> 90:3<br>136:12 154:2<br>154:12,16<br>155:2,13<br><b>bundle</b> 20:23<br><b>bus</b> 145:15                                                                                                                                          | <b>calculated</b><br>42:24 100:12<br>100:18,21<br>103:7,23<br>106:14 117:1<br>120:9,11,21<br>121:13 122:5,9<br>124:11<br><b>calculates</b><br>101:14 107:11<br>135:1,6<br><b>calculating</b><br>123:19 124:17<br><b>calculation</b><br>117:18 118:11<br>119:17 124:6<br>125:2<br><b>calculations</b><br>31:20,25 32:1<br><b>california</b> 2:5<br>2:10<br><b>call</b> 6:15 7:3<br>50:1 55:24<br>57:8 98:5<br><b>called</b> 5:4 19:15<br>95:15 128:2<br>139:19<br><b>calling</b> 24:3<br><b>calls</b> 24:15<br>26:19,20 50:16<br>54:5 107:12<br><b>camera</b> 11:2<br>16:10,13 22:7<br>22:15 23:18<br>25:7 28:10 | 34:20 35:5,19<br>36:2 38:23<br>39:3 41:10<br>42:6 51:13,19<br>51:24 52:3,8<br>52:11,14,17<br>53:3,7,14,21<br>55:14 56:19<br>57:1,4,18<br>58:11,14,19<br>63:16,20 64:2<br>64:16,20 66:11<br>66:18 72:22<br>73:5,6,11 78:2<br>78:9,10,18,23<br>79:7,8 84:21<br>85:16 86:25<br>87:6,9,21,22<br>88:2,11,16<br>89:6,13,14<br>90:4,5,10,14,15<br>93:20 95:15<br>96:7,11 97:1<br>103:13 109:9<br>109:22 110:3<br>110:12 111:16<br>113:7,8,25<br>114:14 115:8<br>126:20,24<br>127:3,12 128:7<br>128:23 129:8<br>130:3,7 134:3<br>134:8,19,22,23<br>134:25 135:4,7<br>135:8,14 136:5 | 136:7,10,12,13<br>136:14,25<br>150:16 151:18<br>151:22,23<br>155:7<br><b>camera's</b><br>152:11<br><b>cancel</b> 8:3,14<br><b>capable</b> 38:18<br>38:23 39:12<br><b>capture</b> 11:21<br>12:21 14:23,24<br>73:7 78:10<br>79:9 84:2<br>102:18 130:18<br>130:20 131:3<br>131:13,16<br><b>captured</b> 60:15<br>119:11<br><b>captures</b> 78:18<br><b>care</b> 122:19<br><b>carefully</b><br>125:18<br><b>carried</b> 12:20<br><b>carry</b> 86:22<br><b>case</b> 10:10<br>42:11,20,20<br>61:6 62:9<br>69:24 80:20<br>82:1 102:25<br>118:8 156:7<br><b>cases</b> 10:19<br>42:11,19 47:14<br>107:4 |
| <b>c</b>                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>c</b> 53:15 54:5,8<br>55:4,14,22<br>63:22 65:14<br>66:19 68:9<br>159:1,1<br><b>ca</b> 160:9,12,21<br><b>cai</b> 4:10 139:19<br>139:24 140:5,7<br>140:12,19,23<br>141:10,16,20<br>141:23 142:9<br>144:20 145:2<br>146:25 150:12<br>150:20,25<br>151:10,16,21<br>152:4,8,17<br>153:1<br><b>cai's</b> 144:24<br><b>calculate</b><br>105:22 106:13<br>106:23 125:3 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

[categorical - column]

|                                                                                |                                                                     |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>categorical</b><br>42:16                                                    | 152:6 162:4,7<br>162:10,13,16                                       | <b>cited</b> 33:19<br>80:22 107:17<br>133:24 135:21                                                                                                                                                                                                  | <b>client</b> 34:8,14<br>35:4,10,17,18<br>35:25 36:1,6,7<br>36:16                                                                                                                                                                            |
| <b>cause</b> 96:2<br>98:18,24 104:8<br>104:17 121:23<br>123:3,25               | <b>changed</b><br>128:23                                            | <b>citing</b> 13:17                                                                                                                                                                                                                                  | <b>close</b> 87:15<br>114:9 128:16<br>129:14,15                                                                                                                                                                                              |
| <b>caused</b> 98:8<br>101:12 122:23<br>123:10,17                               | <b>changes</b> 64:18<br>85:3 101:12<br>117:9 128:17<br>152:21 163:6 | <b>civil</b> 160:19,21                                                                                                                                                                                                                               | <b>closer</b> 52:10<br>58:4                                                                                                                                                                                                                  |
| <b>causes</b> 122:25                                                           | <b>characterizati...</b><br>46:11                                   | <b>claim</b> 12:19,25<br>13:11 60:9,12<br>60:14 61:14,17<br>61:21 62:12<br>67:15 70:10<br>79:24 80:22<br>81:1,4 83:11<br>83:14,16,23<br>84:13,17 85:19<br>119:1 126:15<br>126:19 127:10<br>130:1,11,14<br>132:11,19<br>133:6 134:11<br>138:13 139:13 | <b>code</b> 160:9,12<br>160:19,21                                                                                                                                                                                                            |
| <b>causing</b> 130:21                                                          | <b>characterize</b><br>39:23                                        |                                                                                                                                                                                                                                                      | <b>coefficient</b><br>99:13 100:17<br>108:5,8,13<br>111:3 112:10<br>113:14 114:2,5<br>114:11,19<br>115:2,6,17                                                                                                                                |
| <b>ccp</b> 160:9,12                                                            | <b>characterizing</b><br>101:3                                      |                                                                                                                                                                                                                                                      | <b>collect</b> 84:5                                                                                                                                                                                                                          |
| <b>cell</b> 39:1                                                               | <b>chart</b> 121:6<br>148:2                                         |                                                                                                                                                                                                                                                      | <b>collision</b> 129:9                                                                                                                                                                                                                       |
| <b>cellular</b> 34:6<br>36:14                                                  | <b>check</b> 86:19                                                  |                                                                                                                                                                                                                                                      | <b>column</b> 7:23,25<br>14:1,5 19:14<br>22:4 24:21<br>27:4 30:15<br>32:8,17,20,24<br>33:1,4 34:3<br>36:12,12 46:23<br>48:16 50:4<br>53:13 54:23<br>56:18 58:6<br>61:11 63:11<br>66:16,17 69:5<br>73:23 75:4<br>76:17 77:23<br>78:1,13 84:20 |
| <b>center</b> 95:9<br>101:17 148:10                                            | <b>chicago</b> 1:20                                                 |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
| <b>centers</b> 13:2                                                            | <b>choice</b> 135:16<br>154:24                                      |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
| <b>central</b> 1:16                                                            | <b>choose</b> 68:6<br>129:14                                        |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
| <b>certain</b> 29:25<br>33:11 43:10<br>67:2 128:22<br>147:23 148:8             | <b>chooses</b> 103:3                                                |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
| <b>certainly</b> 23:5<br>67:25 117:17                                          | <b>chosen</b> 63:21<br>66:19 102:6                                  |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
| <b>certify</b> 159:5,11                                                        | <b>circle</b> 145:14<br>145:15                                      |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
| <b>chance</b> 71:25<br>106:6 107:2                                             | <b>citation</b> 28:6<br>32:6,16                                     |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
| <b>chances</b> 97:1,8<br>103:18 104:4                                          | <b>cite</b> 13:8 27:21<br>35:25 38:4<br>77:25 85:22<br>119:6 139:18 |                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                              |
| <b>change</b> 28:12<br>95:5 96:10<br>112:7,20<br>117:25 118:3<br>129:16 137:15 |                                                                     | <b>clarification</b><br>83:20<br><b>clarify</b> 116:3<br><b>clear</b> 16:12,20<br>17:9,18 41:22<br>54:16 55:6,12<br>55:23 57:7<br>66:9 70:18<br>78:22 80:25<br>107:7 116:1<br>121:25 122:14<br>123:8<br><b>clearly</b> 77:15<br>155:11 156:23        |                                                                                                                                                                                                                                              |

**[column - confirm]**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 84:20 90:3,23<br>100:3,4,15<br>102:21 108:10<br>108:12 109:7<br>110:11 120:19<br>124:5,19,21<br>125:3 126:16<br>127:23 128:25<br>130:13,14<br>143:17 150:13<br>150:25 151:5<br>152:8 153:13<br><b>combination</b><br>34:9 36:16<br>41:5 60:16<br>61:18,24 62:4<br>62:14 65:25<br>67:18,24 69:12<br>69:21 70:1,12<br>76:6 80:7,11<br>80:20 123:13<br><b>combinations</b><br>114:22<br><b>combined</b><br>14:17 65:18<br>80:15 81:20<br>143:9 147:9<br><b>combining</b> 15:6<br>37:2 80:23<br>82:2<br><b>come</b> 155:2<br><b>comes</b> 142:21<br>151:25 155:14<br><b>coming</b> 157:18 | <b>commentary</b><br>25:17<br><b>common</b> 98:17<br>115:11<br><b>communicating</b><br>34:15<br><b>communication</b><br>61:3<br><b>compact</b><br>153:18<br><b>comparable</b><br>47:15<br><b>compare</b> 88:22<br>101:3 144:22<br>144:23 149:12<br><b>compared</b><br>143:4,19,23<br>144:1,21 149:7<br><b>comparing</b><br>47:9 89:12<br>145:2 149:6<br><b>comparison</b><br>41:10 42:6<br>87:10,12,20,20<br>87:25 88:15<br>89:2,4,4,9,22<br>144:9 145:20<br>146:4<br><b>comparisons</b><br>90:8<br><b>compatible</b><br>36:9 37:3 43:6<br><b>compensate</b><br>28:9 | <b>compensation</b><br>113:5<br><b>competing</b><br>100:5<br><b>complete</b><br>111:18 112:12<br>163:8<br><b>completed</b><br>160:7,17 161:6<br><b>completely</b><br>40:25 44:16<br>112:2 128:10<br><b>completion</b><br>161:10<br><b>complex</b> 21:3<br><b>complexity</b><br>44:18 51:16<br><b>complicate</b><br>97:4<br><b>complicated</b><br>51:17,18<br><b>components</b><br>11:22 31:15<br>32:16 34:9<br>36:17 101:4,7<br><b>compressed</b><br>96:14<br><b>comprise</b> 11:16<br><b>computation</b><br>47:16<br><b>computational</b><br>42:12 43:20<br>44:4,18<br><b>computational...</b><br>39:6,9 41:18 | <b>computer</b> 34:5<br>36:13<br><b>computes</b> 49:2<br><b>computing</b><br>32:22 33:2<br>34:5 35:24<br>36:21 101:14<br>109:8 110:2<br><b>concatenation</b><br>21:2 65:17<br><b>condition</b><br>121:17 128:9<br><b>conditions</b> 59:8<br>59:20,25 74:7<br>74:8 96:16,20<br>96:24 97:7,17<br>97:21,25 98:1<br>98:3,13,18<br>103:9,12,16,17<br>103:24 104:3,5<br>104:14,18<br>105:5,23 106:2<br>106:5,11,15,24<br>107:2,5,8,19,24<br>107:25 119:7<br>119:10,12,19<br>120:5,12,15<br>121:16,20,24<br>122:2,10,16,18<br>123:3,6,10,11<br>123:14,15,18<br>123:21,25<br>124:2 127:5<br><b>confirm</b> 80:19 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[connected - corrections]

|                                     |                                      |                                   |                        |
|-------------------------------------|--------------------------------------|-----------------------------------|------------------------|
| <b>connected</b><br>25:20 120:16    | 70:7 118:3                           | <b>continues</b><br>20:16 22:8,16 | 70:13 71:2,14          |
| <b>connection</b><br>96:19 120:14   | <b>constrain</b> 23:9<br>26:22       | 83:5 88:7                         | 74:16,22,25            |
| 123:6,24                            | <b>constrained</b><br>23:20 24:18    | 132:15                            | 80:13 81:10,14         |
| <b>consecutive</b><br>51:2,7 121:4  | <b>constraining</b><br>25:4,17       | <b>continuing</b><br>100:4 128:15 | 81:15 82:8             |
| <b>consider</b> 50:14               | <b>constraint</b><br>25:20,21 26:4   | <b>continuous</b><br>53:14 59:22  | 84:17 87:2,6,7         |
| 52:9 78:11,13                       | 26:14 27:5,16                        | <b>continuously</b><br>114:19     | 87:23 89:6             |
| 78:17 92:22                         | 27:22 28:6,18                        | <b>control</b> 130:2,7            | 90:15,17 99:15         |
| 140:8,19                            | 29:2,8,8,11,15                       | <b>controls</b> 113:2             | 100:13,23              |
| 155:19,23                           | 30:2,13                              | <b>conventional</b><br>40:19      | 104:14 107:12          |
| <b>consideration</b><br>39:10 83:10 | <b>constraints</b><br>25:6 26:19     | <b>corner</b> 142:1               | 108:21,22,25           |
| 142:20 155:22                       | 29:16,21 30:3                        | <b>correct</b> 6:24,25            | 109:15 110:8           |
| <b>considerations</b><br>154:23     | 30:14                                | 7:19 11:3,9,23                    | 110:20,23,24           |
| <b>considered</b><br>18:3 23:19     | <b>consume</b> 41:9                  | 12:10,22 13:3                     | 111:4 113:1,17         |
| 78:24 79:2                          | <b>consumes</b><br>156:1             | 13:10 14:6                        | 113:18 115:21          |
| 97:14 112:11                        | <b>consuming</b><br>155:3,14         | 16:11 19:11,12                    | 116:7,16,17,21         |
| 138:19,23                           | <b>contact</b> 160:9<br>160:20       | 20:2 27:24                        | 117:2,9 118:12         |
| <b>considering</b><br>17:14 50:23   | <b>contains</b> 24:16                | 29:4,18 30:15                     | 122:25 124:13          |
| 88:10 145:9                         | <b>contemplating</b><br>152:17 153:2 | 33:7,20 34:25                     | 125:4,12,16            |
| <b>consistent</b> 54:5              | <b>contend</b> 86:6                  | 35:19 36:2                        | 129:9 130:4            |
| 55:19 94:12                         | <b>contending</b><br>80:11,20 86:14  | 37:19 38:5                        | 133:8,25               |
| 127:2,12                            | <b>content</b> 8:17                  | 39:6,21 46:5,8                    | 135:21 138:14          |
| 135:20                              | 9:4,11,22,25                         | 46:9,20 48:3                      | 140:5,10               |
| <b>consists</b> 93:14               | 10:5,15,21                           | 49:4 50:11                        | 141:12 142:4,9         |
| <b>constant</b> 58:13               | <b>context</b> 37:9                  | 51:4 53:7,22                      | 143:24 144:2,2         |
| 58:24 59:3                          | 63:9 147:10,13                       | 57:1,19 59:9                      | 144:11,18              |
| 63:16,20 65:17                      |                                      | 59:22 60:10,23                    | 145:4,21 146:5         |
| 68:19 69:9,9                        |                                      | 61:15 63:16                       | 148:5,16 149:1         |
| 69:10,10,12                         |                                      | 64:3,21,25                        | 149:24 151:19          |
|                                     |                                      | 65:1,3 66:13                      | 153:4 157:15           |
|                                     |                                      | 67:2,3 69:13                      | 163:8                  |
|                                     |                                      |                                   | <b>correction</b> 45:9 |
|                                     |                                      |                                   | 112:1                  |
|                                     |                                      |                                   | <b>corrections</b>     |
|                                     |                                      |                                   | 160:14,15              |
|                                     |                                      |                                   | 161:3,4 163:6          |

[correspond - delay]

|                               |                           |                             |                              |
|-------------------------------|---------------------------|-----------------------------|------------------------------|
| <b>correspond</b><br>51:12,23 | 117:22 118:6<br>142:14,18 | 152:2,3,3,5,22<br>153:3,6,9 | 77:15,24 79:15<br>82:7,21,24 |
| <b>corresponding</b><br>101:9 | 145:3,6 146:9<br>146:14   | 154:16 156:11               | 85:18 88:5                   |
| <b>cost</b> 56:20 58:9        | <b>curve</b> 95:11,12     | <b>date</b> 160:16          | 107:17 116:6                 |
| <b>counsel</b> 2:1            | 95:12                     | 161:5 162:24                | 116:13,18                    |
| 160:18,22                     | <b>cut</b> 16:12,20       | 163:12                      | 118:7 127:19                 |
| 161:7                         | 17:9 41:22                | <b>day</b> 159:17           | 129:19 139:8                 |
| <b>counting</b> 109:3         | <b>cutoff</b> 29:12       | 163:15                      | 154:6                        |
| <b>county</b> 159:5           | <b>d</b>                  | <b>deal</b> 43:7            | <b>declarations</b>          |
| <b>course</b> 60:2            | <b>d</b> 1:4 2:2 3:1      | <b>deanna</b> 1:24          | 15:17 27:24                  |
| 61:5 77:8                     | 54:9 55:22                | 159:3,21                    | 79:16 92:4                   |
| 107:7                         | 70:19                     | <b>decay</b> 128:3,5        | 97:14 99:6                   |
| <b>cover</b> 79:6,7,8         | <b>dampening</b>          | <b>decelerated</b>          | 139:11 157:5                 |
| <b>covered</b> 123:12         | 127:11                    | 127:4                       | 157:14                       |
| <b>create</b> 106:3           | <b>damping</b>            | <b>decide</b> 86:21         | <b>declare</b> 163:4         |
| <b>created</b> 23:16          | 126:19 128:6              | 137:8,15                    | <b>declared</b> 143:7        |
| 71:5,6                        | <b>darker</b> 119:25      | 151:23                      | <b>deemed</b> 163:6          |
| <b>creating</b> 111:7         | <b>data</b> 12:14,15      | <b>decides</b> 134:15       | <b>define</b> 25:14          |
| 156:14                        | 25:1 37:15,25             | 134:22                      | 41:3 93:2,6,20               |
| <b>critical</b> 103:4         | 39:25 40:2,2,7            | <b>deciding</b>             | <b>defined</b> 24:17         |
| <b>crop</b> 88:6 89:22        | 41:9,11,14,15             | 122:19                      | 25:16,16                     |
| 127:17 128:9                  | 42:7,13,13                | <b>decision</b> 87:11       | <b>definitely</b> 11:24      |
| 128:21 129:21                 | 43:6,8,13 44:3            | 134:10                      | 39:2                         |
| 130:7                         | 44:12,14 48:5             | <b>declaration</b>          | <b>definition</b> 49:7       |
| <b>cropping</b> 16:23         | 51:17 72:13               | 3:10,14,18 6:5              | 49:10,16,20,25               |
| <b>crr</b> 1:24 159:21        | 84:5 86:21                | 6:13 7:1 13:5               | 94:13 95:8                   |
| <b>crypto</b> 151:9           | 87:9,9,11,13              | 15:20 16:17                 | <b>definitions</b>           |
| 153:17                        | 88:1,11 90:21             | 17:7 18:8 28:2              | 49:19 92:8,14                |
| <b>crystal</b> 54:16          | 101:11 103:19             | 28:7 30:18                  | <b>degrees</b> 73:17         |
| 66:9 70:18                    | 111:23 112:18             | 31:10 32:12                 | 75:13,15,16,16               |
| 107:7 121:25                  | 117:14,15,19              | 33:10,12,17,23              | 75:17                        |
| <b>csr</b> 1:24 159:21        | 136:7 144:1,21            | 38:9,16,19                  | <b>delay</b> 130:21          |
| <b>current</b> 90:14          | 144:21,23,23              | 39:1 45:15                  | 154:17 155:21                |
| 117:6,13,16,19                | 151:22,23,25              | 52:23,24 73:1               | 155:21 156:15                |
|                               |                           | 73:13 75:24                 | 156:19,20,22                 |

[delay - devices]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>156:22<br/> <b>delta</b> 85:4,5,9<br/> 85:12 128:16<br/> 128:17,24<br/> <b>demonstrates</b><br/> 149:14<br/> <b>depending</b><br/> 17:19 45:5<br/> 52:6 70:16<br/> 102:6 114:4<br/> 117:24 129:13<br/> <b>depends</b> 39:13<br/> 39:16 41:1,23<br/> 42:10 43:16<br/> 45:4 48:10<br/> 51:15 156:11<br/> <b>depict</b> 44:17<br/> <b>depicted</b> 35:14<br/> 125:21<br/> <b>deponent</b> 163:3<br/> <b>deposition</b> 1:12<br/> 5:11,14 7:12<br/> 19:8 26:10<br/> 123:2 160:19<br/> 160:23,25<br/> 161:8,10<br/> <b>derbanne</b> 3:7<br/> <b>derivation</b><br/> 26:23<br/> <b>derivative</b> 23:8<br/> 23:12,22 53:25<br/> 55:11,20,21<br/> 56:15 57:9,17<br/> 57:24 58:1,2<br/> 58:25 59:2,4</p> | <p>60:6,8,21,22<br/> 61:11,12 64:5<br/> 64:9,20,23,25<br/> 65:13,19 66:13<br/> 67:5 68:2,24<br/> 71:19,20,21<br/> 72:11,12,13<br/> <b>derivatives</b><br/> 30:10 56:6,11<br/> 56:24,24 61:1<br/> 61:4 67:7<br/> 72:18 78:3<br/> <b>derive</b> 85:12<br/> <b>derived</b> 13:9,18<br/> <b>described</b> 8:22<br/> 13:25 21:8<br/> 34:10 36:17,22<br/> 51:21 56:25<br/> 57:3 61:11<br/> 69:3 71:19<br/> 78:12 138:3<br/> 143:10,11<br/> 147:10,13<br/> <b>describes</b> 54:23<br/> 63:10 66:10<br/> 108:12 115:5<br/> <b>describing</b><br/> 59:18 70:10,17<br/> 72:17 150:21<br/> <b>description</b> 4:2<br/> 48:17 63:11<br/> 71:5<br/> <b>design</b> 135:16<br/> <b>desired</b> 53:16<br/> 54:23 55:3,15</p> | <p>57:5,6<br/> <b>detail</b> 77:15,23<br/> 93:22 129:19<br/> 136:9<br/> <b>details</b> 15:23<br/> 89:21<br/> <b>detected</b> 148:8<br/> 148:23<br/> <b>detection</b> 142:1<br/> 142:11,12,22<br/> 143:1,9,10<br/> 146:13,25<br/> 147:3,9,12,16<br/> 148:5,11 149:4<br/> 149:5,11,14<br/> 150:1<br/> <b>detects</b> 118:12<br/> <b>determination</b><br/> 81:5 83:8 86:7<br/> 86:15 112:25<br/> 130:15,21<br/> 132:12,19<br/> 133:6,9,10<br/> 136:18 142:3,8<br/> 142:13 143:8<br/> 144:20 147:9<br/> 148:3,4<br/> <b>determine</b><br/> 30:22 56:19<br/> 79:25 83:3,21<br/> 84:5,9,13<br/> 85:20 109:9<br/> 110:2 143:13<br/> 148:22</p> | <p><b>determined</b><br/> 60:15 84:16<br/> 101:8 115:9,23<br/> 160:18,23<br/> 161:7<br/> <b>determining</b><br/> 84:6,10 155:7<br/> <b>developing</b><br/> 23:20<br/> <b>deviate</b> 25:8<br/> <b>deviations</b><br/> 29:25<br/> <b>device</b> 11:22,25<br/> 12:21 13:5,21<br/> 14:9,23 15:1,3<br/> 28:11 31:15,21<br/> 32:2,16,22<br/> 33:2,7,20 34:5<br/> 34:6,8 35:8,13<br/> 35:14,17,18,24<br/> 35:25 36:1,4,5<br/> 36:5,9,10,14,16<br/> 36:22,22 37:1<br/> 37:5 38:4,12<br/> 38:22 39:21<br/> 40:20 46:25<br/> 109:10 110:4<br/> 110:14,15<br/> 115:8 130:18<br/> 130:20 131:3<br/> 131:13,17<br/> 151:1,6<br/> <b>devices</b> 34:15<br/> 35:3,4 39:11<br/> 151:7</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[diagram - distortions]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>diagram</b><br>142:10<br><b>difference</b> 29:1<br>95:2 143:5<br>145:14 146:8<br>149:9,10<br><b>different</b> 13:25<br>14:16 16:1<br>23:12 26:21<br>28:19 29:7<br>39:10 49:18<br>59:7,19 60:1,1<br>60:7,8 62:5<br>65:3,9 66:12<br>66:21 69:18<br>82:23 86:13<br>96:7,8,9 98:8<br>101:4 102:11<br>102:14,15,15<br>102:19 104:2<br>111:7 118:2<br>122:24 126:9<br>129:3 141:1<br>143:2 147:4<br><b>digital</b> 153:18<br><b>dimension</b><br>73:20 74:15<br>75:8,12,18,18<br>77:17<br><b>dimensional</b><br>52:1,9,10,13<br>73:18 74:1,3,9<br>74:11,18 75:19<br>75:19,21 76:10<br>76:10,19,19 | 78:19,21,23<br>79:3,5<br><b>dimensionality</b><br>76:14<br><b>dimensions</b><br>73:5,5,6,11<br>74:22,25 75:1<br>75:5,14 76:12<br>76:25 77:2,11<br>77:11,19<br><b>diminish</b> 78:3<br><b>direct</b> 7:23<br>19:13 20:8,19<br>31:9 58:5 63:5<br>63:9 68:11<br>79:14 99:7<br>100:3 141:14<br>150:13<br><b>directed</b> 17:3<br><b>directions</b> 15:1<br>124:13 125:12<br><b>directly</b> 26:14<br>27:16<br><b>disagree</b> 9:19<br>42:16 46:11<br>47:6 156:5<br><b>disagreeing</b><br>44:16<br><b>disclose</b> 31:14<br>80:12,21,23<br>81:13,16,23<br>82:6<br><b>disclosed</b> 11:8<br>40:22 77:1<br>90:3 117:12 | 151:8<br><b>discloses</b> 12:12<br>13:6,22 32:15<br>35:1 46:21<br>73:4 75:21<br>115:6,22<br>116:10,15,23<br>117:3,11<br>131:14 141:20<br>146:25 150:25<br><b>disclosing</b><br>38:12 82:9<br><b>disclosure</b> 13:1<br>16:24 26:15<br>27:15,22 34:4<br>67:1 73:10<br>76:25 115:21<br>116:7 127:23<br>144:25 150:14<br>151:17 153:12<br><b>disclosures</b><br>17:3,13,14<br>127:3<br><b>discouraging</b><br>25:11<br><b>discrete</b> 85:3<br><b>discuss</b> 80:8<br>116:14<br><b>discussed</b> 11:24<br>61:6 97:25<br>103:11 104:17<br>116:22 157:5<br><b>discusses</b> 108:7<br>108:24 | <b>discussing</b><br>48:20 61:15<br>98:15 103:14<br>116:17 157:7<br><b>discussion</b><br>27:14 32:8,17<br>32:21 33:4<br>37:19 47:4,12<br>90:24<br><b>discussions</b><br>31:7<br><b>disk</b> 153:18,18<br><b>displacement</b><br>144:16 145:10<br>148:14,25<br><b>displacements</b><br>148:24<br><b>displayed</b><br>93:14<br><b>distinct</b> 14:22<br><b>distinction</b><br>17:17 141:2<br><b>distinguish</b><br>140:24<br><b>distinguished</b><br>14:16<br><b>distinguishes</b><br>139:19<br><b>distortion</b><br>45:11 94:15<br>96:4 97:8 98:6<br><b>distortions</b><br>96:1 98:22<br>99:3 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[distribution - equation]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>distribution</b><br>95:1,8,10<br><b>doctor</b> 5:8<br>11:12 12:2<br>18:15 24:23<br>27:3 31:6<br>42:22 44:21<br>45:24 50:25<br>54:22 55:16<br>60:19 63:2<br>77:6 82:13<br>86:11 91:10<br>99:22 105:3,21<br>107:19 118:23<br>120:10 133:5<br>150:11 157:3<br><b>document</b><br>18:10,21,22,24<br>18:25 20:4,9<br>20:11 21:12<br>46:4,7,10<br>141:11<br><b>documents</b><br>7:19 20:10<br>157:10<br><b>doing</b> 9:14<br>14:13 26:9<br>39:3,12 114:17<br>117:18 138:8,8<br>155:6<br><b>dots</b> 149:19<br><b>douady</b> 3:9<br><b>dp</b> 55:10,25<br>56:2 57:13 | <b>dr</b> 3:11,15,19<br>106:19<br><b>drag</b> 43:18<br><b>drastic</b> 136:14<br>136:19 137:10<br>138:24<br><b>drawbacks</b><br>154:2,11 156:2<br><b>drive</b> 153:18<br><b>dt</b> 54:9 55:10<br>55:22,22 56:2<br>57:13<br><b>due</b> 92:19 96:8<br>96:10 97:8<br>98:6 103:12,12<br>103:15 104:2<br>107:2 108:1<br>122:13 135:14<br>135:14 156:20<br><b>duly</b> 5:2,4<br>159:8<br><b>dupage</b> 159:5<br><b>duration</b> 84:2<br>101:6<br><br><b>e</b><br><br><b>e</b> 3:1 101:6,7,7<br>159:1,1 160:9<br>160:12 161:1<br>162:3,3,3<br><b>e.g.</b> 22:5,13<br>117:13<br><b>earlier</b> 57:1<br>76:15 77:20<br>136:21 142:8 | <b>easy</b> 57:11<br><b>edge</b> 129:9<br><b>effect</b> 25:21<br>97:6 113:20,22<br>121:19,20<br>122:2,15,17<br><b>effectively</b><br>117:4 119:22<br><b>effects</b> 98:14<br><b>eight</b> 73:17<br><b>eis</b> 15:8,10<br>16:13,16 17:3<br>17:8,13,18<br>18:2,7<br><b>either</b> 55:20<br>76:22,23<br>117:14 127:4<br><b>elaborating</b><br>115:24<br><b>electronic</b><br>15:10,23<br><b>elements</b> 16:3,6<br>16:25 37:1<br>43:2 152:10,10<br>156:25<br><b>emanuel</b> 2:8,12<br><b>embodiment</b><br>10:25 67:11<br>124:14,16<br>125:6,9,13<br>144:8 146:16<br><b>embodiments</b><br>18:2 88:20<br>124:20 | <b>employed</b><br>120:2<br><b>enables</b> 132:21<br>133:1<br><b>enabling</b><br>130:19 131:1<br>131:10 132:1<br>133:15 139:14<br><b>encompasses</b><br>23:3<br><b>energy</b> 96:22<br><b>engineering</b><br>41:13 43:8<br>47:18 154:15<br>154:22<br><b>enlarged</b> 96:14<br><b>ensure</b> 25:8<br><b>entire</b> 72:18<br>137:13<br><b>entirely</b> 86:25<br>87:5<br><b>equal</b> 55:11,20<br>55:22,22 56:2<br>56:16 57:9,13<br>57:25 59:1<br>60:6,8 61:1<br>64:5,9,20,25<br>71:21 72:13<br><b>equation</b> 24:22<br>24:25 53:16,18<br>54:20 56:1,10<br>56:21 57:22<br>58:5,15 61:4<br>62:8,10 72:23<br>86:2 129:19 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[equations - explain]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>equations</b><br>25:14 28:12<br>55:13 62:9<br>129:20<br><b>errata</b> 160:14<br>160:16 161:3,5<br><b>estimate</b> 11:2<br>20:21 22:7,14<br>37:25 41:10<br>42:6 45:11<br>86:18,20<br>101:21 107:15<br>108:2 131:23<br>151:18 152:13<br>152:16 153:3<br><b>estimated</b> 25:7<br>37:15 45:3<br>73:11 150:17<br><b>estimates</b> 37:10<br>37:13 42:23<br>46:19 73:19<br>100:5 132:8<br><b>estimating</b><br>14:23 38:23<br>73:4 107:22<br>117:5,12<br><b>estimation</b> 11:7<br>20:15 37:22<br>39:3 40:20<br>43:3,5,12,19,21<br>44:22 111:21<br>150:21 152:19<br><b>evaluating</b><br>110:15 | <b>event</b> 102:19<br><b>exacerbate</b><br>97:5<br><b>exact</b> 71:4<br><b>exactly</b> 11:4<br>27:9 66:23<br>71:6,23 72:8<br>74:9 78:9 93:2<br>93:21<br><b>examination</b><br>3:2,4 5:6 159:7<br><b>examined</b> 5:5<br><b>example</b> 8:18<br>8:25 9:5,6,14<br>9:15,24 10:10<br>10:19 13:13,15<br>16:8,9 22:24<br>22:25 25:19,23<br>30:10 32:21<br>33:2,9,11,14<br>35:24 36:21<br>37:24 38:1<br>43:4 44:10<br>50:15 52:2,13<br>53:15 58:10,23<br>58:24 59:4,6<br>59:18 60:25<br>61:2,13 62:7<br>63:15 64:1,15<br>64:19,22,24<br>65:2,8 69:25<br>70:15,18 73:6<br>73:14 74:14,15<br>75:11,14,23<br>78:2 86:4 | 100:16,20<br>101:5 102:4,24<br>107:13,16,17<br>107:21 108:18<br>111:7,14,21<br>112:4,14 113:6<br>115:5 119:23<br>128:6,18 129:7<br>129:11 140:2<br>143:3,18 146:7<br>149:3,4 152:4<br><b>examples</b> 13:17<br>26:21 30:17,19<br>33:13 35:9,9<br>36:19 50:14,22<br>74:17 75:25<br>76:13 77:17<br>102:22 107:14<br>117:24 120:3<br>125:20 126:9<br>128:19 147:14<br><b>exceeds</b> 140:8<br>140:21<br><b>exclude</b> 23:6<br>43:9 102:22<br>157:9<br><b>excluded</b> 27:11<br><b>excluding</b><br>103:14<br><b>exclusive</b> 153:7<br><b>exclusively</b><br>15:4 16:19<br><b>excuse</b> 68:13<br><b>exercise</b> 39:6 | <b>exhibit</b> 3:6,8,10<br>3:14,18,22,24<br>4:3,5,7,9 5:14<br>5:17,21 6:1,5,8<br>6:13,17 7:1,6<br>7:10,13,22<br>11:13 18:12,16<br>18:16 19:2,6,6<br>19:22 20:7<br>22:3 24:21<br>31:9 32:21<br>34:4 45:20,22<br>45:25,25 48:14<br>52:23,25 53:12<br>63:5 72:25<br>79:13,15 82:12<br>84:19 99:5,10<br>99:10,18,19,22<br>99:23,25 100:2<br>116:12 126:15<br>139:10,12<br>141:4,5,8,9<br>150:13 153:24<br><b>exhibits</b> 3:5 4:1<br>5:11 93:3<br><b>exist</b> 136:22<br><b>expense</b> 42:12<br>155:2,14<br><b>experience</b> 37:7<br>100:22 132:24<br><b>experienced</b><br>101:25 130:18<br><b>expert</b> 17:12<br><b>explain</b> 57:21 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[explicitly - filtering]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>explicitly</b> 93:11<br><b>exposed</b> 95:21<br>95:24 96:9<br><b>exposure</b> 92:16<br>96:21,24,25<br>97:4,7 98:4,4,9<br>98:14 99:2<br>100:13,22<br>101:6 102:1<br><b>exposures</b><br>107:3<br><b>express</b> 116:6<br><b>expressed</b><br>53:17 86:25<br>157:4<br><b>expresses</b> 22:20<br><b>expression</b><br>50:18<br><b>extensively</b><br>119:9<br><b>extent</b> 15:5<br>51:19 113:4<br>115:9,23<br><b>extract</b> 10:22<br><b>extremely</b><br>39:12 | <b>factor</b> 82:16<br>128:3,6 129:5<br><b>factors</b> 39:16<br>45:4 130:2<br><b>fail</b> 44:22<br>149:15<br><b>failure</b> 45:1<br>149:16<br><b>fair</b> 10:16<br>13:19 14:24<br>43:14 48:6<br>75:5 76:10<br>77:12 80:9<br>81:17 84:12<br>85:16 102:2,21<br>114:14 141:16<br>141:20 155:5<br><b>false</b> 143:10<br>147:12,16<br>148:4,11,19<br>149:3,5,11,13<br><b>falsely</b> 148:23<br><b>familiar</b> 7:18<br>15:8 19:10<br>46:4 82:12<br>95:14,16 97:10<br>141:11<br><b>far</b> 129:13<br>136:15<br><b>fashion</b> 23:14<br><b>fast</b> 21:4<br>103:12 104:20<br>123:2,13<br><b>favoring</b> 21:18 | <b>feature</b> 8:2,13<br>9:3 10:14,21<br>10:22 43:3,17<br>43:18 44:3,10<br>44:11,11,13<br>49:2,3 50:6,10<br>51:3,11 78:3<br>87:17 100:21<br><b>features</b> 9:10<br>9:17,21 10:2<br>14:2 22:7,14<br>37:11,14,16<br>38:24 39:4<br>40:9,13,14<br>43:4 44:22<br>50:20 51:1,6<br>151:6<br><b>federal</b> 161:1,8<br>161:9<br><b>feel</b> 28:5<br><b>field</b> 24:8 38:22<br>104:19<br><b>figueroa</b> 2:9<br><b>figure</b> 13:6<br>32:7,17 34:17<br>34:20 35:1,4,7<br>35:15,16,18<br>36:1,6 37:2,2<br>63:5,15,19<br>64:8,12,13,15<br>64:24 65:2,8<br>65:17,22,25<br>66:1,18,20<br>67:10,21 68:5<br>68:11,12,17 | 69:2,8,11,19<br>70:9,19,22<br>71:4,6,12 72:3<br>72:16 93:12<br>121:6 125:25<br>126:5,6 140:2<br>141:14,15,19<br>141:22 143:3<br>143:10,11,18<br>144:8,15 145:1<br>145:1,2,9,13,15<br>145:17,18,19<br>146:4,12 147:7<br>147:11,13,17<br>147:17,19,21<br>148:3,6,25<br>149:3,18<br><b>figures</b> 34:10<br>34:13 36:18<br>125:21 139:23<br><b>filed</b> 10:13 20:2<br><b>filing</b> 8:7<br><b>filter</b> 93:24<br>94:1,17,19,22<br>110:9,10 143:3<br>143:19 144:16<br>144:17 148:15<br><b>filtered</b> 143:22<br>144:10<br><b>filtering</b> 41:8<br>47:23 48:1<br>91:14 109:10<br>109:16,16,17<br>109:18 110:3 |
| <b>f</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>f</b> 52:5,6 159:1<br><b>fact</b> 17:8 23:21<br>41:11 42:7<br>57:8 70:3<br>76:23 77:9<br>105:16 115:2<br>156:20                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

[finalize - formulas]

|                         |                       |                |                       |
|-------------------------|-----------------------|----------------|-----------------------|
| <b>finalize</b> 43:22   | 120:7 151:12          | 30:6,9,16      | 105:24 106:16         |
| <b>find</b> 43:20       | 152:1                 | 31:22 32:10    | 109:1 111:5           |
| 156:15                  | <b>focused</b> 47:20  | 33:8,21 35:20  | 112:13 113:10         |
| <b>finding</b> 102:15   | <b>focuses</b> 12:16  | 36:3 37:23     | 113:21 114:15         |
| <b>fine</b> 15:23       | 47:10                 | 38:6,14 39:7   | 117:10 118:13         |
| 38:18 104:25            | <b>focusing</b>       | 40:11,24 41:12 | 119:8 122:11          |
| <b>finish</b> 12:6      | 121:24 123:9          | 42:18 43:15    | 124:18 125:5          |
| 59:13 76:3              | <b>foerster</b> 2:3   | 44:25 45:13    | 125:17,20             |
| 105:13,17               | <b>follow</b> 51:18   | 46:13 48:9     | 126:4 127:6,15        |
| <b>finished</b> 76:4    | 90:9 131:17           | 49:5,17 50:12  | 129:10 130:5          |
| <b>first</b> 5:4 6:22   | 133:18 140:9          | 51:5,14,25     | 131:4,11 132:4        |
| 11:14 18:25             | <b>followed</b> 101:1 | 52:18 53:8,23  | 133:17 134:1          |
| 19:14 23:7,11           | 112:6                 | 56:8,14 57:20  | 134:13 135:9          |
| 23:21 27:10             | <b>following</b>      | 58:22 59:10,23 | 135:22 137:13         |
| 53:25 57:17             | 139:24                | 60:11,24 61:16 | 137:23 139:1,6        |
| 58:25 60:21             | <b>follows</b> 5:5    | 61:23 63:17    | 140:22 141:21         |
| 61:6,11 65:13           | 27:14 47:5            | 64:7 65:4,11   | 142:16,24             |
| 71:19 72:11             | 124:20 160:8          | 65:20 66:2,14  | 144:3,12 145:5        |
| 86:1 94:13              | <b>foregoing</b>      | 67:13 69:1,14  | 145:12,22             |
| 101:9 102:24            | 163:5                 | 69:23 70:14    | 146:6,15              |
| 109:9,21 110:3          | <b>foreground</b>     | 71:3 74:2 75:6 | 147:24 148:17         |
| 110:25 111:22           | 44:24 52:15           | 77:13 78:16    | 149:2,25              |
| 111:22 112:2            | <b>forget</b> 137:20  | 79:4 80:14     | 150:24 151:11         |
| 147:2,3 159:8           | <b>form</b> 8:10 9:13 | 81:18,25 82:18 | 151:20 152:20         |
| <b>fit</b> 22:6,14 50:9 | 9:23 10:17            | 85:10 86:9     | 153:5 154:4,13        |
| 50:25 51:18             | 11:10 12:5,11         | 87:14,24 88:12 | 156:18                |
| <b>five</b> 126:11      | 13:2 14:4,14          | 88:18 91:15,21 | <b>formed</b> 17:12   |
| 136:13,14,19            | 15:14,21 17:5         | 92:2,12 93:5   | <b>forming</b> 19:25  |
| 136:25 157:22           | 17:16 18:5,23         | 93:25 94:11,18 | 46:7 60:5             |
| <b>flip</b> 18:20       | 20:3 21:10,21         | 96:3,18 97:12  | 127:13                |
| <b>floor</b> 2:10,13    | 22:22 23:15           | 98:2,11,25     | <b>formula</b> 53:17  |
| <b>fly</b> 21:13        | 24:1,11 25:13         | 100:14,24      | 85:25 115:16          |
| <b>focal</b> 101:12     | 26:17 27:25           | 102:3,12       | 124:8                 |
| <b>focus</b> 47:11      | 28:21 29:5,12         | 103:10,25      | <b>formulas</b> 130:6 |
| 71:10 76:16             | 29:14,17,22,23        | 104:15 105:6   |                       |

[forth - given]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>forth</b> 41:3<br>50:15 53:17<br>56:21 79:18<br>102:21 139:7<br>157:13 159:7<br><b>forward</b> 88:15<br>88:21 89:5<br>131:17 139:2<br><b>found</b> 53:15<br>119:25<br><b>four</b> 136:21<br><b>fragile</b> 86:18<br><b>frame</b> 20:16<br>39:4,4 40:19<br>48:22 49:2,4<br>50:11,20 51:7<br>51:7,7 84:22<br>85:3,3 92:21<br>92:24 101:5,6<br>101:10 102:7,7<br>102:25 103:1<br>111:22 117:2,6<br>117:9,9,13,16<br>117:19,22<br>118:2,6 129:9<br>130:4 133:22<br>134:10,23<br>135:7 137:3,4<br>137:4,6,7,10,11<br>137:14,15,18<br>137:19 138:12<br>138:24 140:20<br>142:14,18<br>143:24 144:10<br>144:11,16,17 | 145:3,4,6,7<br>146:10,14<br>147:12 149:6<br><b>frames</b> 20:22<br>22:8,15 45:10<br>45:12 51:4,11<br>51:22 86:19<br>87:17 88:6<br>92:20 93:1,4,7<br>93:15 110:20<br>117:15,18<br>119:11 121:4<br>133:13 135:18<br>136:12,22,24<br>138:25 139:2,2<br>140:3 142:14<br>142:18,21<br>143:4,12,19,22<br>145:10,20<br>146:5,13 147:1<br>148:15 149:11<br>154:2,12 155:2<br>155:4,13,16<br>156:23<br><b>framework</b><br>122:16<br><b>franklin</b> 1:19<br><b>frcp</b> 161:1<br><b>free</b> 28:5<br><b>freedom</b> 73:17<br>75:13,15,16,17<br>75:17<br><b>frequencies</b><br>91:23 92:6<br>94:2,8 114:12 | <b>frequency</b> 94:4<br>94:10 113:9,20<br>113:22<br><b>front</b> 5:12<br>18:16<br><b>ft</b> 50:5,16 51:21<br><b>full</b> 150:1<br><b>fully</b> 106:20<br><b>function</b> 53:6<br>54:24 56:16,20<br>57:14,14,15,23<br>57:25 58:9<br>124:12 125:10<br>128:8<br><b>further</b> 56:3<br>57:23 128:25<br>132:11 147:8<br>154:20 156:21<br>157:25 159:11<br><b>future</b> 86:19<br>88:6,22,24<br>89:6,13,17<br>90:4 110:15,20<br>117:15,18<br>138:24 142:21<br>145:6 146:10<br>146:10 147:1<br>147:11 154:16<br>154:19,20<br>156:21<br><b>fuzzy</b> 16:20 | <b>gain</b> 155:9<br><b>game</b> 34:6<br>36:14<br><b>gaussian</b> 94:17<br>94:20,24,25<br>95:4,8,11,12<br><b>general</b> 28:17<br>29:15 30:7,9<br>30:20 41:1<br>43:7 44:2 45:1<br>47:8,12 50:19<br>62:8 91:12<br>152:22 154:8<br>154:10<br><b>generalization</b><br>61:6<br><b>generally</b> 21:16<br>123:20<br><b>generate</b> 26:25<br>113:3<br><b>generated</b><br>101:11 110:13<br><b>generates</b><br>156:22<br><b>getting</b> 43:24<br>45:16 131:22<br><b>give</b> 49:8 54:14<br>54:15,18 55:23<br>71:25 115:14<br>136:9 138:20<br>157:17<br><b>given</b> 17:8<br>52:16 53:14<br>62:3,21 76:23<br>87:22 100:22 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[given - housing]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 102:18 118:12<br>140:20 143:22<br>144:10 159:10<br>163:9<br><b>gives</b> 30:20<br>44:13 62:8<br>100:16 107:21<br><b>glasses</b> 106:19<br><b>global</b> 34:7<br>36:15 97:10<br>151:1 153:17<br><b>gloss</b> 115:19<br><b>go</b> 5:13 30:21<br>52:10 54:1<br>76:25 94:2,8<br>94:14 115:25<br>152:8 153:25<br><b>goal</b> 50:9<br><b>goes</b> 8:16 21:1<br>50:13 54:13<br>85:1 137:3<br><b>going</b> 5:13<br>18:11,21 23:17<br>26:23 42:2<br>43:23 51:12<br>52:15 57:7,12<br>58:4 73:13<br>74:10,14,16,17<br>74:18 75:7,11<br>75:12,15 76:5<br>79:14 86:20<br>91:12 105:20<br>107:9 112:9<br>122:20 129:22<br>130:3 132:25 | 135:24 136:19<br>137:5 139:11<br>145:23 154:21<br>156:9<br><b>good</b> 5:8,9 27:6<br>30:25 51:18<br>52:7,7<br><b>gopro</b> 1:7<br>160:4 162:1<br>163:1<br><b>greater</b> 126:7,8<br>155:22 156:22<br><b>ground</b> 79:19<br>79:23 80:16<br><b>guess</b> 70:24<br>133:3<br><b>guided</b> 76:24<br><b>gyro</b> 39:25<br>41:20 42:13<br>136:7 152:3,5<br>152:22 153:2,9<br>153:15<br><b>gyroscope</b><br>151:13,17<br><b>gyroscopes</b><br>11:17 13:2<br>14:10 151:2 | <b>handled</b> 160:8<br><b>happen</b> 154:21<br><b>happened</b><br>96:10<br><b>happening</b><br>135:15 143:21<br>144:15 147:19<br>147:21<br><b>happens</b> 93:12<br>106:3 114:21<br><b>happy</b> 105:16<br><b>harassing</b><br>106:17<br><b>harder</b> 93:2<br><b>hat</b> 54:11 55:23<br><b>head</b> 82:19<br><b>hear</b> 141:17<br><b>heavy</b> 39:15<br>68:16<br><b>height</b> 96:13<br><b>help</b> 11:12<br><b>hereinbefore</b><br>159:7<br><b>hereto</b> 163:7<br><b>hereunto</b><br>159:16<br><b>high</b> 15:22<br>74:10 80:3,8<br>81:9,13 91:22<br>92:5 94:4,6,8<br>99:14 103:24<br>109:17 112:24<br>113:2,9,20,22<br>114:12 116:16<br>116:21,24 | 119:1 122:6,10<br>123:15<br><b>higher</b> 45:5<br>73:20 74:9,15<br>74:18 75:8,9<br>75:12,17 76:25<br>77:16<br><b>highest</b> 44:13<br><b>hitting</b> 93:17<br>95:21 96:22<br><b>homography</b><br>73:17,18,21,25<br>74:8,16,21<br>75:13<br><b>horizon</b> 130:17<br>130:19 132:14<br>132:20,24,25<br>133:1,7,11,15<br>133:24 135:12<br>135:20 137:19<br>137:20 138:13<br>139:14 154:3<br>154:12 156:14<br><b>horizontal</b> 49:1<br>49:2 124:13<br>125:11<br><b>host</b> 35:7<br><b>hosting</b> 34:15<br>34:21<br><b>hour</b> 30:24<br>59:11 118:14<br>145:24<br><b>housing</b> 12:20<br>60:18 80:1<br>83:4,19,22 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>h</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>h</b> 162:3<br><b>halfway</b> 127:24<br><b>hand</b> 19:14<br>43:21 114:8<br>142:1 159:17<br><b>handle</b> 155:4<br>155:15                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

[housing - indicate]

|                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 84:1,14 85:21<br><b>hundred</b> 72:12<br><b>hypothesis</b><br>144:22,24<br><b>hypothetical</b><br>134:2,3,7,17<br>135:11,17,19<br>136:10,23<br>137:9,21,22,25<br>138:2,19                                                                                                                                                                                                                                                | 10:23 11:21<br>12:21 14:8,23<br>15:6,10,11,13<br>16:10 28:8<br>37:11,15,25<br>38:24 39:5,20<br>40:1,14,22<br>41:11,17 42:7<br>42:13,25 43:4<br>43:6,9,13,17,22<br>44:18,21 47:15<br>51:17 92:15,24<br>93:12,17 96:2<br>96:9 98:14<br>101:17 102:14<br>102:16,18,19<br>102:20 118:12<br>119:24 120:21<br>120:25 121:3,7<br>121:14,20<br>124:12,24<br>125:11 130:18<br>130:20 131:2<br>131:13,16<br>150:22,23<br>152:18,18<br><b>image's</b> 8:17<br>9:4,11,21 10:5<br>10:15<br><b>images</b> 12:16<br>14:8 15:2 51:2<br>51:22 52:14,16<br>95:19 119:25<br><b>imagine</b> 111:25<br>134:19 | <b>imaging</b> 28:10<br><b>imitation</b> 13:4<br><b>implement</b><br>33:19 146:23<br><b>implementati...</b><br>35:7,12 39:15<br>39:15 40:15<br>43:25 44:15<br>141:22 143:21<br>143:25 144:6<br>146:17<br><b>implementati...</b><br>31:24 35:11<br>41:4 47:11,21<br>126:9 144:19<br>147:15<br><b>implemented</b><br>33:7 34:7<br>35:10,17,25<br>36:15 39:14<br>48:8,11 111:24<br><b>implementer</b><br>39:25<br><b>implementing</b><br>39:19 151:3<br><b>implements</b><br>103:5<br><b>implies</b> 131:22<br><b>importance</b><br>67:6<br><b>important</b> 67:8<br>112:15<br><b>impose</b> 26:18<br><b>imposed</b> 30:13 | <b>imposing</b> 25:5<br>26:3,13 27:5<br><b>improved</b><br>119:10<br><b>impulse</b> 94:19<br>94:22,24<br><b>include</b> 60:16<br>67:23 113:9<br>132:20 133:7<br><b>included</b><br>160:14 161:3<br><b>includes</b> 49:11<br>130:17 132:14<br>132:23 133:10<br>147:3<br><b>including</b> 43:10<br>63:20<br><b>inconsistent</b><br>57:10 133:14<br>133:23 134:11<br>135:12 138:13<br><b>increase</b> 97:2,7<br>97:7 98:3,13<br>103:17 104:3<br>106:6 107:2<br><b>increased</b> 98:4<br><b>increasing</b><br>76:14<br><b>independent</b><br>104:7<br><b>independently</b><br>17:23 104:16<br>112:2 134:4<br><b>indicate</b> 150:20 |
| <b>i</b>                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>i.e.</b> 58:14<br><b>idea</b> 27:6 50:21<br><b>identification</b><br>5:12,18 6:2,9<br>6:18 7:7,14<br>18:13 19:3<br>45:21 99:20<br>141:6<br><b>identified</b><br>115:10,24<br><b>identify</b> 8:18<br>146:24<br><b>identifying</b><br>99:12<br><b>iii</b> 2:12<br><b>illinois</b> 1:20<br>159:5<br><b>illustrates</b><br>63:19 66:18<br>69:8<br><b>illustration</b><br>141:19<br><b>image</b> 8:2,14<br>9:9,17 10:1,20 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>indicated</b> 23:21</p> <p><b>indicates</b> 153:1</p> <p><b>indication</b><br/>72:20 78:22</p> <p><b>indirectly</b><br/>121:22,23</p> <p><b>individual</b><br/>45:10 117:2</p> <p><b>individually</b><br/>149:6</p> <p><b>influence</b> 14:18</p> <p><b>information</b><br/>11:18,23 13:9<br/>13:18,21,24<br/>14:6,7,9,22<br/>15:3,5,6 25:15<br/>47:19 52:21<br/>93:18 94:2,3,7<br/>94:9 110:13<br/>151:14</p> <p><b>inner</b> 87:18<br/>88:7,16 89:23<br/>127:18 128:10<br/>128:21 129:12<br/>130:8</p> <p><b>inputs</b> 49:8</p> <p><b>inside</b> 89:23<br/>127:18 129:21</p> <p><b>insta360</b> 1:4<br/>2:2</p> <p><b>integrate</b> 96:21</p> <p><b>integration</b><br/>120:1</p> <p><b>intend</b> 134:9</p> | <p><b>intended</b><br/>131:16 132:2<br/>133:13,23<br/>138:12 139:20<br/>141:1</p> <p><b>intensive</b> 39:6,9</p> <p><b>intent</b> 155:7</p> <p><b>intentional</b><br/>130:20 131:2<br/>131:10,15,21<br/>131:24 132:1,6<br/>132:8,21 133:1<br/>133:2,15<br/>134:24 138:11<br/>139:14 149:24<br/>151:24</p> <p><b>intentionally</b><br/>133:21</p> <p><b>inter</b> 1:4</p> <p><b>interact</b> 35:5</p> <p><b>interaction</b><br/>14:19</p> <p><b>interest</b> 131:18<br/>155:22</p> <p><b>interested</b><br/>159:13</p> <p><b>interframe</b><br/>93:9,13,20</p> <p><b>interpolation</b><br/>86:22 87:4,5<br/>90:13,13 108:9<br/>108:14,19,20<br/>111:16 113:8<br/>113:16,19<br/>114:3,13,17,23</p> | <p>116:11 128:2,5<br/>128:8,13,16<br/>129:4</p> <p><b>interpret</b> 62:3<br/>66:20 71:7<br/>106:1</p> <p><b>interpretation</b><br/>54:19 57:22<br/>58:18 62:18,22</p> <p><b>interpreting</b><br/>71:17</p> <p><b>intraframe</b><br/>93:10</p> <p><b>introduce</b><br/>154:17</p> <p><b>introduced</b><br/>133:12,22</p> <p><b>introduces</b><br/>138:11</p> <p><b>introducing</b><br/>123:14 136:21<br/>138:17</p> <p><b>invalidity</b> 12:3<br/>12:10,24 13:8<br/>16:15 17:2<br/>19:25 46:8<br/>127:14</p> <p><b>invaluable</b><br/>154:19</p> <p><b>invention</b> 67:12<br/>88:21 119:22<br/>151:8,10 153:7</p> <p><b>inventor</b> 71:6<br/>72:10</p> | <p><b>inventors</b> 20:2</p> <p><b>involve</b> 44:3<br/>90:9</p> <p><b>involved</b> 14:2<br/>15:13 41:18<br/>43:23 154:15<br/>154:24 155:23</p> <p><b>involves</b> 24:3<br/>87:11 90:7,20<br/>134:7 154:12</p> <p><b>involving</b> 6:23<br/>23:25 24:9<br/>87:5</p> <p><b>ipr</b> 3:12</p> <p><b>ipr2024-01164</b><br/>1:5 3:16</p> <p><b>ipr2024-01165</b><br/>1:7 3:20</p> <p><b>ipr2024-01186</b><br/>1:6</p> <p><b>issue</b> 93:4<br/>95:18 96:2,17<br/>97:5,16,24</p> <p><b>issues</b> 60:2,3<br/>98:8,12 120:4</p> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p><b>j</b></p> <p><b>jerks</b> 64:17</p> <p><b>jitter</b> 92:1,6</p> <p><b>job</b> 2:19 155:6</p> <p><b>jointly</b> 20:22</p> <p><b>joseph</b> 2:12</p> <p><b>josephmilowic</b><br/>2:14</p>                                                                                                                                                                                                                                                                                                                            |

**[k - limitation]**

|                       |                      |                         |                         |
|-----------------------|----------------------|-------------------------|-------------------------|
| <b>k</b>              | 29:24 55:6           | 60:25 62:8              | <b>lies</b> 129:12,13   |
| <b>k</b> 1:13 3:3 5:3 | 71:22 72:8           | 63:4 68:13              | <b>light</b> 39:15      |
| 84:22,23,23           | 89:22 90:19          | 73:4,10 75:21           | 43:19 80:3,8            |
| 85:3,3,4,5,8,9        | 105:12 112:17        | 81:20 82:2              | 81:9,13 97:20           |
| 85:11,12,12,13        | 115:16 125:21        | <b>kwatra's</b> 33:13   | 97:25 98:1,3            |
| 85:16 88:1            | 126:7 128:19         | 33:20                   | 98:18 99:14             |
| 89:9 90:24            | 138:6                | <b>l</b>                | 106:10 112:24           |
| 128:16,17             | <b>knowing</b> 152:9 | <b>l</b> 110:16         | 113:2 116:16            |
| 159:6                 | <b>knowledge</b>     | <b>label</b> 149:21     | 116:20,24               |
| <b>katsaggelos</b>    | 8:17 9:4,6,11        | <b>labeled</b> 68:19    | 119:1,23                |
| 1:13 3:3,11,15        | 9:16,21 10:5         | 142:1                   | 121:18 130:1            |
| 3:19 5:3              | 10:15 24:7           | <b>lag</b> 149:22       | <b>lighter</b> 41:18    |
| 106:19 159:6          | <b>known</b> 95:11   | <b>language</b> 60:9    | <b>lighting</b> 96:16   |
| 160:5 162:2,24        | 107:2 115:13         | 60:19 61:22             | 96:20,24 97:6           |
| 163:2,4,12            | 123:4                | 83:11                   | 97:17 98:13             |
| <b>keeps</b> 115:24   | <b>kwatra</b> 4:4    | <b>large</b> 15:5,24    | 103:8,12,16,17          |
| <b>kept</b> 86:20     | 19:8,10 20:2         | 44:23 95:4              | 104:3,5,14,18           |
| <b>kernel</b> 99:14   | 21:17,18,23,24       | 148:24                  | 105:5 106:2,5           |
| 100:6,11,17           | 22:3,19,24           | <b>larger</b> 29:24     | 106:24 107:1,5          |
| 101:24 102:10         | 23:3,7 24:2,15       | 67:4 96:21              | 107:8,19,24,24          |
| 102:19 103:7          | 24:17,21 25:3        | 119:25 123:14           | 119:7,10,11,18          |
| 103:23 104:12         | 26:2,10,13,18        | 154:16,17               | 120:5,12,15             |
| 105:4,23              | 27:22 28:8           | 155:3,15,25             | 121:16,17,19            |
| 106:14 107:12         | 30:4,7,13,18,20      | 156:14                  | 121:22,24               |
| 107:15 108:6          | 31:7,14,20,23        | <b>late</b> 105:23      | 122:2,16,18,24          |
| 111:3 112:11          | 32:7,15,20           | 136:3                   | 123:3,6,11,14           |
| 113:15 114:2          | 33:5,6,24 34:4       | <b>laundry</b> 151:5    | 123:15,17,21            |
| 115:7                 | 34:14 35:12          | <b>left</b> 19:14 142:1 | 123:25 124:2            |
| <b>kernels</b> 102:15 | 37:21,24 38:3        | 148:9                   | <b>limit</b> 18:1 28:12 |
| 103:4                 | 38:8,11 40:23        | <b>legal</b> 160:7      | <b>limitation</b>       |
| <b>kind</b> 26:24     | 48:13,20 49:25       | <b>length</b> 101:12    | 12:25 14:18             |
| 42:14 84:9            | 50:9,13,23           | <b>lens</b> 16:7        | 61:14,17 62:12          |
| 112:19                | 53:6,12,13,22        | 101:12                  | 67:17,22,23             |
| <b>know</b> 9:25      | 54:23 55:15          | <b>level</b> 15:22      | 68:10 70:11             |
| 10:19,21 18:24        | 56:25 59:18          | 47:12 128:20            | 79:24 80:9,22           |

[limitation - low]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 81:1,4 82:25<br>83:14,17,19<br>84:17 85:19<br>126:21,22<br>128:20 130:12<br>132:5 133:4,24<br>134:11 135:20<br>138:14 139:13<br><b>limitations</b><br>126:18 127:10<br><b>limited</b> 28:16<br><b>line</b> 7:25 19:15<br>22:4 26:3 34:3<br>46:23 47:5<br>48:17 50:4<br>53:13 56:1<br>57:4 58:6<br>59:13 63:11,19<br>65:16 66:17<br>70:7,7 71:22<br>72:6 73:14,23<br>84:20 96:9,9<br>100:4 108:7,7<br>108:12 109:8<br>109:24 110:1<br>110:12 120:24<br>121:1 123:5,5<br>130:14 137:13<br>143:17 148:2<br>148:10 150:14<br>152:8 160:15<br>161:4 162:4,7<br>162:10,13,16<br>162:19 | <b>linear</b> 21:2,18<br>22:5,12,20,25<br>23:9,14,17<br>24:3,13,15,18<br>48:21,25 49:6<br>49:7 50:1,5,10<br>50:16,25 52:1<br>64:16 68:20<br>128:1 129:4<br><b>linearity</b> 49:10<br><b>linearly</b> 24:10<br><b>lined</b> 68:16<br><b>lines</b> 56:25 58:6<br>74:7,7 76:17<br>77:3 78:1<br>96:13<br><b>link</b> 59:8,21<br><b>links</b> 60:23<br><b>list</b> 151:5<br><b>listed</b> 74:8<br><b>listen</b> 106:11<br><b>lists</b> 151:7<br><b>lit</b> 103:24<br>106:14 122:10<br><b>literature</b><br>14:15<br><b>little</b> 70:24<br>114:9 128:17<br>128:25<br><b>llc</b> 1:4 2:2<br><b>located</b> 87:22<br><b>location</b> 88:16<br>89:14<br><b>locked</b> 160:12<br>161:1 | <b>logic</b> 105:7,10<br><b>logical</b> 106:4<br><b>long</b> 98:9<br>104:20 107:3<br>108:1 154:22<br><b>longer</b> 96:22,24<br>96:25 97:4<br>99:2 120:1<br>154:3,11 156:1<br>156:6,8,9<br><b>look</b> 15:15<br>16:17 18:10<br>28:1 31:10<br>38:8,8,15<br>46:23 53:12<br>58:4 79:15<br>80:1 82:7,20<br>83:4 84:15,15<br>84:20 85:21<br>86:8,16 88:9<br>88:10 89:20<br>92:17 99:5,17<br>111:8 114:20<br>122:14 124:5<br>127:19 130:16<br>132:13,23<br>147:1 154:18<br>154:20 156:21<br>157:10<br><b>looked</b> 19:22<br>79:12<br><b>looking</b> 17:12<br>21:13 23:5<br>33:23 64:11,13<br>82:25 111:14 | 137:15 146:22<br>147:11,12<br><b>looks</b> 55:7<br><b>loose</b> 57:11<br><b>los</b> 2:5,10<br><b>lose</b> 52:20<br>155:8<br><b>lot</b> 10:1 39:12<br>40:3,4,8 41:14<br>45:4 111:19<br>114:6 115:25<br>154:14,20,23<br>155:7<br><b>lots</b> 40:7<br>122:23<br><b>low</b> 74:10 80:3<br>80:8 81:9,13<br>92:5 93:24<br>94:2,9,17<br>96:20,24 97:6<br>97:17,20,25<br>98:1,3,13,18<br>99:14 103:16<br>103:17 104:3,5<br>104:13,18<br>105:4,22 106:2<br>106:5,10,13,24<br>107:1,5,8,24<br>109:16 112:24<br>113:2 116:16<br>116:20,24<br>119:1,10,11,23<br>120:5,15<br>121:16,17,18<br>121:19,22,24 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[low - marked]

|                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 122:2,16,18,24<br>123:3,6,14,17<br>123:25 124:2<br>143:3,18,22<br>144:9,16,17<br>145:15 148:15<br><b>lower</b> 45:5<br>73:20 74:14,17<br>75:8,11,16<br>141:25<br><b>lunch</b> 91:5,7                                                                                                                                                                                                                            | 122:14 123:24<br>134:9 136:18<br>148:3 152:23<br><b>making</b> 154:24<br><b>manage</b> 43:5<br><b>manifesting</b><br>121:21<br><b>manifests</b><br>93:21<br><b>manipulate</b><br>16:2,5<br><b>mao</b> 2:4 8:10<br>9:13,23 10:7<br>10:17 11:10<br>12:5,11 14:4<br>14:14,25 15:14<br>15:21 17:5,16<br>18:5 20:3<br>21:10,21 22:22<br>23:15 24:1,11<br>25:13 26:7,17<br>27:8,18,25<br>28:21 29:5,14<br>30:6,16,24<br>31:2,22 32:10<br>33:8,21 35:20<br>36:3 37:23<br>38:6,14 39:7<br>39:22 40:11,24<br>41:12 42:8,18<br>43:15 44:6,25<br>45:13 46:13<br>48:9 49:5,17<br>50:12 51:5,14<br>51:25 52:18 | 53:8,23 54:25<br>55:17 56:8,14<br>57:20 58:22<br>59:10,23 60:11<br>60:24 61:16,23<br>62:16 63:17<br>64:7 65:4,11<br>65:20 66:2,14<br>67:13 69:1,14<br>69:23 70:14<br>71:3,15 72:5<br>74:2 75:6 76:3<br>76:20 77:13<br>78:16 79:4<br>80:14 81:18,25<br>82:18 85:10<br>86:9 87:14,24<br>88:12,18 89:7<br>89:15,18 90:6<br>90:16 91:1,15<br>91:21 92:2,12<br>93:5,25 94:11<br>94:18 96:3,18<br>97:12 98:2,11<br>98:25 100:14<br>100:24 102:3<br>102:12 103:10<br>103:25 104:15<br>105:6,13,15,24<br>106:16 107:20<br>109:1 111:5<br>112:13 113:10<br>113:21 114:15<br>117:10 118:13<br>119:8,20 | 120:13 122:11<br>123:23 124:18<br>125:5,17 126:4<br>127:6,15<br>129:10 130:5<br>131:4,11 132:4<br>133:17 134:1<br>134:13 135:9<br>135:22 137:12<br>137:23 138:15<br>139:1,6 140:11<br>140:22 141:21<br>142:16,24<br>144:3,12 145:5<br>145:12,22<br>146:6,15<br>147:24 148:17<br>149:2,25<br>150:24 151:11<br>151:20 152:20<br>153:5 154:4,13<br>155:17 156:3<br>156:18 157:16<br>157:22,25<br>160:1<br><b>map</b> 12:25<br>13:13,16<br><b>mapping</b> 50:19<br>73:18 74:1<br><b>maps</b> 51:6<br><b>marjomand</b> 2:6<br><b>mark</b> 50:17<br>59:12 141:4<br><b>marked</b> 5:11<br>5:18 6:2,5,9,18 |
| <b>m</b>                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>m</b> 159:21<br><b>machine</b> 72:8<br><b>made</b> 42:17<br>82:1 142:4,9<br>142:13 144:9<br>148:4 163:5<br><b>magnitude</b><br>101:20 108:2<br><b>main</b> 68:5<br>112:20 120:3<br>121:23 140:23<br><b>make</b> 17:7 36:6<br>37:5 41:14<br>49:23 54:7<br>55:10,19 57:16<br>67:3 70:2 82:8<br>89:12 102:5<br>127:20 160:14<br>161:3<br><b>makes</b> 41:8,19<br>47:8 56:6,12<br>70:5,16 72:16<br>120:14 121:15 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

[marked - misinterpreted]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7:7,14 18:13<br>19:3 45:21,24<br>99:20 141:6<br><b>marriage</b><br>159:13<br><b>math</b> 54:10<br><b>mathematical</b><br>25:23 49:7<br>57:11 115:16<br><b>mathematically</b><br>72:9<br><b>matrices</b> 101:8<br>101:11,15<br><b>matrix</b> 49:21<br>101:4,7<br><b>matter</b> 17:1<br>39:24 45:6<br>51:8 54:19<br>55:5 82:5<br>94:13 105:10<br>106:3,3 135:14<br>154:10 159:14<br><b>maximum</b><br>126:2,6<br><b>mean</b> 9:2 16:6<br>44:9 61:24<br>84:4 90:2<br>94:25 95:3,4<br>95:13 107:8<br>115:17 118:1<br>126:11 132:5<br>137:18 155:18<br><b>meaning</b> 91:20<br>91:25 92:10<br>93:23 148:6 | <b>meaningful</b><br>57:25 71:8<br><b>means</b> 16:1<br>39:9 48:25<br>71:23 93:7<br>95:20 114:6<br>131:22 132:1<br>147:11<br><b>meant</b> 145:17<br><b>measure</b><br>121:18,19<br>122:17<br><b>measured</b><br>144:17<br><b>measurements</b><br>47:10,24<br><b>measuring</b><br>121:21 122:1<br>124:1<br><b>mechanism</b><br>87:11<br><b>meet</b> 60:9<br>61:14,21<br><b>meets</b> 70:10<br><b>mehran</b> 2:4<br><b>memory</b> 36:24<br>155:3,14 156:1<br><b>mention</b> 33:9<br>33:11 49:10<br>50:5 53:3<br>107:1 122:12<br>128:19 153:20<br>153:21<br><b>mentioned</b><br>13:20 17:19 | 21:11 22:25<br>30:17 33:14<br>43:16 47:20<br>59:24 72:10<br>87:4 90:18<br>91:3 96:23<br>114:3 121:1<br>142:8 147:16<br>153:16<br><b>mentions</b> 8:24<br>21:23 28:8,11<br>117:17 119:21<br>119:24 125:14<br>144:20 147:7<br>153:6<br><b>method</b> 13:23<br>13:25 21:4<br>45:5 90:18<br>102:13 104:7<br>145:15 148:19<br>149:19,23<br>151:21 152:1,6<br><b>methodology</b><br>17:11 30:21<br><b>methods</b> 42:25<br>43:9 44:22<br>47:15,16 149:8<br><b>metric</b> 117:1,7<br>117:8,21<br>118:10 119:5<br>119:15 120:8<br>120:11,20,22<br>120:25 121:3,7<br>121:13,14<br>122:5,9 123:20 | 125:4,10,15<br>126:1<br><b>micromotion</b><br>43:18<br><b>millions</b> 43:1<br><b>milowic</b> 2:12<br><b>mind</b> 16:12,16<br>67:11<br><b>minimal</b> 126:6<br><b>minimization</b><br>58:10 62:13<br>67:18 69:21<br>70:11 72:17<br><b>minimize</b> 61:18<br>62:1 67:23<br><b>minimized</b><br>23:22 28:16<br>57:18 61:12,13<br>66:12<br><b>minimizes</b><br>60:16,20,21<br>67:25 68:2<br><b>minimizing</b><br>23:7,11 30:10<br>30:22 56:20<br>65:12 68:24<br>72:22<br><b>minimum</b><br>126:2,7,10,12<br><b>minus</b> 126:11<br>128:17<br><b>minute</b> 157:22<br><b>misinterpreted</b><br>106:8 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[missed - movement]

|                       |                        |                |                    |
|-----------------------|------------------------|----------------|--------------------|
| <b>missed</b> 28:4    | 75:8,12 79:5           | 74:11,15,18,22 | 136:20,21          |
| <b>mixing</b> 128:11  | <b>mofo.com</b> 2:6,6  | 74:24 75:8     | 137:1,9,10         |
| <b>mobile</b> 31:15   | 160:2                  | 78:3,23 88:11  | 138:11,17,24       |
| 31:21 32:2,16         | <b>moment</b> 18:20    | 92:19,20,23    | 139:15,19,20       |
| 33:7,20 34:5          | 87:22 143:23           | 93:9,10,21     | 140:8,8,9,20,20    |
| 35:3,13,14            | 143:24 150:12          | 96:11,11,12    | 140:24,25,25       |
| 36:13 38:4,12         | <b>momentum</b>        | 99:13 100:6,11 | 141:1,3 142:1      |
| 38:22 39:11,20        | 28:10                  | 100:12,17,21   | 142:4,4,5,9,9      |
| 40:20 43:11           | <b>morning</b> 5:8,9   | 101:24,25      | 142:11,12,22       |
| 46:25                 | <b>morning's</b> 5:10  | 102:1,10,15    | 142:25 143:7       |
| <b>model</b> 22:13,25 | <b>morrison</b> 2:3    | 103:7,11,12,15 | 143:13 145:3       |
| 23:10,17,19,25        | <b>motion</b> 11:2,7,8 | 103:18,23      | 146:12,25          |
| 24:2,3,10,15,16       | 11:16,17,21,22         | 104:1,4,6,8,12 | 147:3,22,22        |
| 24:19 25:12           | 12:13,15 13:1          | 104:17,22      | 148:4,7,8,9,13     |
| 48:21 49:1,6,7        | 13:9,18 14:7,9         | 105:3,22 106:3 | 148:23 149:24      |
| 49:11,13,15,19        | 14:21,23 15:3          | 106:6,10,13,22 | 150:2,2,21         |
| 49:22,25 50:5         | 15:25 22:5,7           | 106:25 107:3,6 | 151:14,24,24       |
| 50:10,16,17,18        | 22:13,15,20,21         | 107:9,12,15,22 | 152:12 153:3       |
| 50:23 51:1,2,6        | 23:4,17 24:3           | 107:23 108:6   | <b>motivated</b>   |
| 51:15,16,17,21        | 24:10,15 25:12         | 110:15 111:3   | 76:24              |
| 52:2,5,6,9,10         | 30:8,9 37:11           | 112:11 113:4   | <b>mouth</b> 18:1  |
| 52:14,19,21           | 37:13,14,22            | 113:15,20,23   | <b>move</b> 38:20  |
| 74:15,19,19,22        | 38:23 39:3             | 114:2,5,6,9    | 44:23 52:15        |
| 74:24 75:22           | 40:2,6,20 41:9         | 115:7 117:6,13 | 101:18 134:8,9     |
| 78:11,14,17,19        | 42:23 43:3,5           | 117:14,15,19   | 134:22 135:13      |
| 78:21,23 79:3         | 43:12,20 44:22         | 122:21 123:4   | 152:11             |
| 79:9                  | 45:3,11 46:19          | 130:18,20      | <b>moved</b> 51:24 |
| <b>modeled</b> 23:13  | 46:24 47:1,9           | 131:2,10,15,15 | <b>movement</b>    |
| <b>modeling</b> 23:24 | 47:17,24 48:2          | 131:17,18,19   | 16:10 28:15        |
| 24:9 50:5 74:4        | 48:21 50:5,6           | 131:20,21,24   | 110:14 126:19      |
| <b>models</b> 20:16   | 50:10 51:1,2,3         | 132:1,2,3,7,9  | 126:23 127:11      |
| 22:5,20,21            | 51:10,12,19,22         | 132:15,21,24   | 127:17 128:22      |
| 23:4,6 24:13          | 52:2,3,8,11,17         | 133:2,3,16     | 133:13,22          |
| 50:14 51:18           | 53:14 54:3             | 134:10,16      | 136:15 150:14      |
| 73:20 74:11,18        | 60:2 73:6,20           | 135:17 136:19  | 150:16,17          |

[moves - objection]

|                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>moves</b> 92:16,25<br>93:20 97:1,1<br>134:3<br><b>moving</b> 16:6,9<br>16:13 96:6,7<br>99:2 104:20<br>123:2,13 135:7<br>139:2 152:10<br><b>multi</b> 46:24<br>47:17<br><b>multiple</b> 16:21<br>20:10 73:12<br>92:14 98:14<br>100:25 103:4<br>104:21,21<br>122:12,13<br>135:18 144:20<br><b>multiplications</b><br>42:24<br><b>multiplied</b><br>49:20 | <b>necessary</b><br>160:14 161:3<br>163:6<br><b>need</b> 21:23 26:8<br>28:4 38:8,15<br>41:20 43:21<br>44:12 61:25<br>62:21 68:8<br>78:17 79:8<br>82:20 84:8<br>86:21 89:24<br>91:2 93:6,22<br>96:20,21 99:1<br>101:1 118:7<br>125:18 128:13<br>138:17 140:16<br>155:10<br><b>needed</b> 111:10<br>143:13<br><b>needing</b> 45:11<br><b>needs</b> 83:9<br>84:15 111:24<br>112:5,24<br>132:20 133:7<br><b>network</b> 35:6<br><b>never</b> 26:13<br>138:23<br><b>nevertheless</b><br>33:13<br><b>new</b> 2:14,14<br>18:10 57:14,14<br>114:7 130:10<br><b>nicely</b> 70:6<br><b>noise</b> 112:18 | <b>non</b> 48:4,7<br><b>noncontinuous</b><br>63:21<br><b>nonlinear</b> 21:3<br>21:19 22:21<br>23:4,6,9,14,17<br>23:25 24:10,13<br>24:18 25:7,12<br>26:4,11,15<br>27:6,10 49:13<br>49:16,24<br><b>nonmoving</b><br>96:6<br><b>nonnegative</b><br>125:22<br><b>nonzero</b> 125:16<br>140:24,25<br>141:3 142:4,9<br><b>normal</b> 95:1,3<br>107:24<br><b>normalization</b><br>115:15 116:4<br><b>normalize</b><br>115:12<br><b>north</b> 1:19<br><b>notary</b> 159:4<br>163:13,19<br><b>notating</b><br>160:15 161:4<br><b>notation</b> 54:4<br>57:11,22<br><b>noted</b> 163:7<br><b>notions</b> 92:22<br><b>number</b> 2:19<br>3:6,8,25 4:2 | 7:11 18:18<br>19:19,21 39:16<br>47:1 50:13<br>75:16,17 86:1<br>121:3 125:22<br>148:20 156:25<br>160:15 161:4<br><b>o</b><br><b>object</b> 8:19,25<br>8:25 9:8 92:16<br>92:16,19,20,25<br>96:6,14 97:1<br>100:12 123:13<br>128:22 131:17<br><b>objection</b> 8:10<br>9:13,23 10:7<br>10:17 11:10,10<br>12:5,11 14:4<br>14:14,25 15:14<br>15:21 17:5,16<br>18:5 20:3<br>21:10,21 22:22<br>23:15 24:1,11<br>25:13 26:7,17<br>27:8,18,25<br>28:21 29:5,14<br>30:6,16 31:22<br>32:10 33:8,21<br>35:20 36:3<br>37:23 38:6,14<br>39:7,22 40:11<br>40:24 41:12<br>42:8,18 43:15<br>44:6,25 45:13<br>46:13 48:9 |
| <b>n</b>                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>n</b> 3:1 121:3<br><b>name</b> 54:15,15<br><b>named</b> 116:5<br><b>nature</b> 103:8<br>107:18 118:4<br>119:7,18<br>157:11<br><b>near</b> 59:11<br><b>necessarily</b><br>51:11,23 74:6<br>112:5 118:1<br>156:9,19                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**[objection - opinion]**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 49:5,17 50:12<br>51:5,14,25<br>52:18 53:8,23<br>54:25 55:17<br>56:8,14 57:20<br>58:22 59:10,23<br>60:11,24 61:16<br>61:23 62:16<br>63:17 64:7<br>65:4,11,20<br>66:2,14 67:13<br>69:1,14,23<br>70:14 71:3,15<br>72:5 74:2 75:6<br>76:20 77:13<br>78:16 79:4<br>80:14 81:18,25<br>82:18 85:10<br>86:9 87:14,24<br>88:12,18 89:7<br>89:15,18 90:6<br>90:16 91:1,15<br>91:21 92:2,12<br>93:5,25 94:11<br>94:18 96:3,18<br>97:12 98:2,11<br>98:25,25<br>100:14,24<br>102:3,12<br>103:10,25<br>104:15 105:6<br>105:24 106:16<br>107:20 109:1<br>111:5 112:13<br>113:10,21 | 114:15 117:10<br>118:13 119:8<br>119:20 120:13<br>122:11 123:23<br>124:18 125:5<br>125:17 126:4<br>127:6,15<br>129:10 130:5<br>131:4,11 132:4<br>133:17 134:1<br>134:13 135:9<br>135:22 137:12<br>137:23 138:15<br>139:1,6 140:11<br>140:22 141:21<br>142:16,24<br>144:3,12 145:5<br>145:12,22<br>146:6,15<br>147:24 148:17<br>149:2,25<br>150:24 151:11<br>151:20 152:20<br>153:5 154:4,13<br>155:17 156:3<br>156:18 157:16<br><b>objectionable</b> 103:18<br><b>objective</b> 119:22 120:4<br>121:17,18<br>140:23<br><b>objects</b> 44:23<br>96:12 99:2<br>103:13 104:20 | 123:2<br><b>obtain</b> 14:7,9<br>15:3 152:2<br><b>obtained</b> 12:15<br>12:15 15:25<br>17:23 66:9,24<br><b>obtaining</b> 13:23 14:21<br><b>obvious</b> 82:10<br><b>occur</b> 92:19<br>100:13 106:10<br><b>occurring</b> 109:11 110:4<br>110:16<br><b>offer</b> 21:12<br><b>offered</b> 15:16<br><b>office</b> 160:11<br><b>offs</b> 41:13<br>155:23<br><b>offset</b> 16:10<br>101:19,20<br><b>oh</b> 6:19 53:1<br>109:19<br><b>ois</b> 15:9,11<br>16:13,16 17:3<br>17:8,14,18<br>18:3,7 101:11<br><b>okay</b> 13:23<br>18:10 19:8<br>20:13 22:11<br>27:14 31:2<br>38:11,18 42:22<br>48:13,15 50:25<br>52:13 61:8<br>62:23 63:13 | 64:15 72:25<br>74:21 75:20<br>76:16 77:3,25<br>80:25 82:11<br>83:14 84:12<br>90:23 91:5<br>95:14 97:16<br>99:5,11 102:18<br>104:10 109:19<br>116:12 118:10<br>122:23 126:17<br>134:20 135:5<br>136:11,16<br>137:3,7,14,18<br>138:23 139:23<br>147:6 149:22<br>150:7 153:24<br>156:8,13 157:3<br>157:19<br><b>once</b> 110:25<br><b>ones</b> 22:25<br>98:15<br><b>open</b> 92:25<br><b>operation</b> 56:13,16 91:16<br>109:14 112:17<br>121:2<br><b>operations</b> 112:18<br><b>opine</b> 80:7<br><b>opined</b> 5:15,22<br><b>opining</b> 75:21<br><b>opinion</b> 11:7<br>12:2,4,25<br>15:16 21:13 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[opinion - part]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 32:4 82:4<br>116:15<br><b>opinions</b> 6:6<br>11:6,20 12:10<br>16:15 17:2,12<br>19:25 46:8<br>79:18 127:14<br>157:4,9,13<br><b>opposed</b> 22:21<br>31:21 48:1<br>72:18 75:5<br>93:10 150:23<br><b>optical</b> 15:11<br>15:13 16:2,2,5<br>39:20 150:22<br>152:18<br><b>optimal</b> 20:21<br>58:11,19 63:20<br>64:16 66:11,18<br>72:22<br><b>optimization</b><br>21:3 29:9 54:1<br>54:6,8,12,18<br>55:4,5,8,24,25<br>56:19<br><b>optimize</b> 54:3<br>54:17 55:7,9<br><b>optimized</b> 64:2<br><b>optionally</b><br>121:2<br><b>order</b> 19:6<br>23:12 45:25<br>57:17 65:18<br>67:7 87:8<br>129:8 141:9 | 151:18<br><b>ordinary</b> 91:13<br>91:19,25 92:10<br>93:23 130:25<br>131:8<br><b>orientation</b><br>85:16 88:21,22<br>88:24,25 89:3<br>89:10 129:16<br><b>orientations</b><br>84:22<br><b>origin</b> 101:16<br>101:19,21<br><b>original</b> 53:14<br>54:3,6,17<br>55:14 72:13<br>83:10,13 84:2<br>84:4,7 87:12<br>111:23 149:12<br>160:10,20,22<br><b>outcome</b><br>159:14<br><b>output</b> 13:14<br>16:23 49:9<br>110:7,22<br><b>outside</b> 87:18<br>88:7 127:18<br>129:12,13,22<br>130:3,7<br><b>overall</b> 108:24<br>120:21,25<br>121:3,7<br><b>overlaid</b> 68:17<br><b>overlap</b> 17:19 | <b>owner</b> 1:8 2:7<br><b>p</b><br><b>p</b> 26:20 53:4,6<br>53:9,16,21,24<br>54:2,6,7,8,9,11<br>54:24 55:5,15<br>55:22,23,23,25<br>55:25 56:11,20<br>56:25 57:3,8<br>58:11 84:23<br>85:4,8,9,11,12<br>85:12,13 88:1<br>90:24 95:5<br>129:16<br><b>page</b> 4:2 15:20<br>18:16 19:14<br>20:9,11 79:17<br>79:18 81:1<br>82:24 83:17<br>85:19 109:7<br>139:12,12,24<br>139:24 160:15<br>161:4 162:4,7<br>162:10,13,16<br>162:19<br><b>pages</b> 160:14<br>160:17,17<br>161:3,6,6<br><b>pair</b> 48:22<br><b>pan</b> 28:9 52:14<br><b>panning</b> 131:18<br><b>paper</b> 24:17<br><b>parabolic</b><br>68:20 70:7 | <b>paragraph</b><br>11:13,15 13:13<br>13:15 20:15,20<br>23:5 25:3<br>31:11,13 32:13<br>32:14 33:10,19<br>53:2,3 63:24<br>73:1,4 79:22<br>85:22 99:8,10<br>99:12 116:13<br>116:14 139:18<br><b>parameter</b><br>26:20 28:20<br>29:2,3,6,17,22<br>54:13 80:2,3,4<br>80:9,13,21,24<br>81:13,17,19,24<br>82:6,10 99:14<br>107:22,23<br>112:24,25<br>113:2 114:1<br>115:14 116:16<br>116:20,21,23<br>116:24 117:25<br>119:1<br><b>parameters</b><br>20:22 21:2<br>25:15,20,22,24<br>27:16 81:6<br>87:5 101:13<br>115:11<br><b>part</b> 13:7 17:20<br>34:21 62:19<br>66:6 71:7 72:9<br>77:14 102:7 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[part - perturbations]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>116:18 147:3<br/>148:8,9,11<br/>156:7<br/><b>partes</b> 1:4<br/><b>participating</b><br/>6:23<br/><b>particular</b><br/>101:10 102:4,8<br/>102:25 123:21<br/>144:5<br/><b>parties</b> 159:12<br/><b>partitioned</b><br/>58:12<br/><b>partitioning</b><br/>58:19 66:11<br/><b>partitions</b><br/>66:21<br/><b>parts</b> 46:22<br/>60:1 62:5<br/>95:24 96:7,8<br/>102:14,16,20<br/><b>pass</b> 49:22 80:3<br/>80:8 81:9,13<br/>93:24 94:6,17<br/>99:14 109:16<br/>109:17 112:24<br/>113:2 116:16<br/>116:21,24<br/>119:1 143:3,18<br/>143:22 144:9<br/>144:16,17<br/>148:15 157:21<br/><b>passage</b> 27:3<br/>48:21 74:20</p> | <p><b>past</b> 117:14,17<br/>139:3,5 143:12<br/><b>patent</b> 1:1,8 2:7<br/>3:6,8,13,17,21<br/>3:22,24 4:3,5,7<br/>4:9 5:15,22 6:7<br/>6:14,23 7:2,11<br/>7:22 11:5<br/>12:19 18:17<br/>19:7,11 27:12<br/>33:13,24 46:1<br/>46:2,16 60:10<br/>61:15 77:19<br/>79:13,17 82:12<br/>99:7,15,23<br/>112:7,20,23<br/>116:15 118:8<br/>121:15 125:7<br/>130:11 131:14<br/>139:18 140:16<br/>140:16 141:9<br/>149:9 154:6<br/><b>patents</b> 45:15<br/>157:6,14<br/><b>path</b> 23:8,12,13<br/>23:16,20,22,24<br/>24:9 25:7<br/>26:20,23,24<br/>27:1 30:22<br/>34:20 35:5,19<br/>36:2 53:3,7,9<br/>53:14,21,24<br/>54:2,2,3,17,18<br/>54:24 55:3,11<br/>55:14,15 56:3</p> | <p>56:20 57:1,4,5<br/>57:6,18 58:11<br/>58:13,19,25<br/>59:2,7,19,22<br/>60:2,6,7,9,16<br/>61:13 62:1,2,4<br/>62:5,15,19,19<br/>62:21 63:15,20<br/>63:21 64:2,16<br/>65:9,18,18<br/>66:5,11,18,20<br/>68:24 69:8,9<br/>69:12,20 70:4<br/>70:6,23,25<br/>71:2,12,13,18<br/>71:23 72:2,4<br/>72:18,19,22,24<br/>111:17 113:7,8<br/>113:25 114:14<br/><b>path's</b> 64:20<br/><b>paths</b> 60:1<br/>64:17 65:3<br/><b>patrick</b> 2:9<br/>59:11 87:15<br/>105:13 118:14<br/>145:23<br/><b>patrickschmidt</b><br/>2:11<br/><b>pay</b> 105:1<br/><b>pdf</b> 160:12<br/>161:1<br/><b>penalty</b> 160:16<br/>161:5<br/><b>pending</b> 146:3</p> | <p><b>perfectly</b> 38:18<br/><b>perform</b> 16:3<br/>48:5 111:2,21<br/>112:9 113:7<br/>141:2<br/><b>performance</b><br/>21:5 45:6<br/><b>performances</b><br/>47:16<br/><b>performed</b><br/>38:25 58:10<br/>73:21 111:17<br/>113:19 143:2<br/>147:4<br/><b>performing</b><br/>117:3 142:25<br/><b>period</b> 89:17<br/>160:18 161:7<br/><b>perjury</b> 160:17<br/>161:6<br/><b>permutations</b><br/>13:20<br/><b>person</b> 8:18,24<br/>9:7 10:20<br/>91:13 130:25<br/>131:8<br/><b>personal</b> 34:5<br/>36:13<br/><b>pertaining</b> 6:7<br/>18:2<br/><b>perturbation</b><br/>24:13<br/><b>perturbations</b><br/>8:3,15 87:16</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>petitioner</b> 1:5<br/>2:2</p> <p><b>phenomenon</b><br/>95:14 103:17</p> <p><b>phone</b> 34:6<br/>36:14 46:25</p> <p><b>phones</b> 39:1</p> <p><b>photo</b> 148:10</p> <p><b>photons</b> 93:17<br/>95:20,22,25<br/>96:22</p> <p><b>phrase</b> 131:1,9<br/>131:25</p> <p><b>physical</b> 51:13<br/>51:24 84:21<br/>85:1</p> <p><b>physically</b> 16:6<br/>16:9</p> <p><b>picture</b> 43:1<br/>107:5 134:17</p> <p><b>pit</b> 101:7,7</p> <p><b>pixel</b> 43:22</p> <p><b>place</b> 84:6,10<br/>111:1 115:15<br/>136:8</p> <p><b>placed</b> 18:15<br/>19:5 27:16<br/>28:7 99:22<br/>141:8</p> <p><b>places</b> 37:4<br/>119:21</p> <p><b>placing</b> 28:18<br/>29:1,8,11,16,21</p> <p><b>plain</b> 91:19,25<br/>92:10 93:23</p> | <p><b>planned</b> 143:5<br/>143:20,23<br/>144:10</p> <p><b>planning</b> 16:22</p> <p><b>please</b> 27:19<br/>28:23 35:22<br/>76:16 80:17<br/>105:1,17<br/>106:18 127:7<br/>131:5 140:18<br/>147:17</p> <p><b>plotted</b> 121:8,9</p> <p><b>plus</b> 71:19,20<br/>72:11,12 73:16<br/>89:9 124:9</p> <p><b>pm</b> 91:8,8<br/>118:21,21<br/>150:9,9 157:24<br/>157:24</p> <p><b>point</b> 8:3,14<br/>13:11 17:6<br/>21:22 28:5<br/>67:3 68:5 70:2<br/>70:6,16 78:3<br/>101:16,17,19<br/>101:21 104:25<br/>116:19 121:5<br/>122:14 147:23</p> <p><b>pointed</b> 30:14</p> <p><b>pointing</b><br/>106:18</p> <p><b>points</b> 50:6,10<br/>70:3 102:5,6<br/>102:11,14<br/>103:2</p> | <p><b>polygon</b> 87:17<br/>88:6 89:22<br/>127:18 128:9<br/>128:21 129:12<br/>129:21 130:7</p> <p><b>poor</b> 104:13<br/>105:5</p> <p><b>poorly</b> 105:23<br/>106:14</p> <p><b>portion</b> 34:9<br/>36:17 60:9<br/>70:23,25 71:13</p> <p><b>portions</b> 13:8<br/>16:14 69:8</p> <p><b>posita</b> 57:7<br/>77:18</p> <p><b>position</b> 11:1<br/>12:20 13:1,10<br/>13:14,19,24<br/>23:18 24:17<br/>26:24 38:4,12<br/>40:21 41:8<br/>42:5 45:8<br/>46:19 49:1,3<br/>63:16 86:19<br/>101:11 109:10<br/>109:22 110:3,4<br/>110:12 114:7,8<br/>114:10 115:8<br/>135:4</p> <p><b>positioning</b><br/>34:7 36:15<br/>151:1 153:17</p> <p><b>positions</b> 90:4<br/>90:5,8,10</p> | <p>101:5 108:14<br/>109:10 110:16<br/>111:8 113:16<br/>114:4,21</p> <p><b>positive</b> 125:21</p> <p><b>possibilities</b><br/>36:20</p> <p><b>possibility</b><br/>37:14</p> <p><b>possible</b> 8:8</p> <p><b>post</b> 48:2,7</p> <p><b>potentially</b><br/>60:3 103:3</p> <p><b>power</b> 41:9<br/>42:5 47:25</p> <p><b>powerful</b> 39:12</p> <p><b>predicted</b><br/>143:4,19</p> <p><b>preference</b><br/>22:20</p> <p><b>present</b> 58:13<br/>58:21 66:13<br/>88:20 119:2<br/>124:23</p> <p><b>previous</b><br/>128:14 142:14<br/>142:18 144:17<br/>145:3 146:13<br/>155:18</p> <p><b>previously</b><br/>79:13</p> <p><b>prime</b> 55:23<br/>129:16</p> <p><b>printing</b> 72:8</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>prior</b> 9:16 18:2<br/>39:18 46:12<br/>84:17 156:16<br/><b>priori</b> 8:17 9:3<br/>9:11,21 10:5<br/>10:15,22<br/><b>probable</b> 97:18<br/><b>probably</b> 150:6<br/><b>problem</b> 29:9<br/>97:19,20 98:1<br/>98:20,20 106:5<br/>114:23<br/><b>procedure</b><br/>160:19,21<br/><b>proceed</b> 121:2<br/><b>proceeding</b><br/>5:23 6:15 7:3,4<br/><b>proceedings</b><br/>6:22<br/><b>process</b> 17:20<br/>40:15 44:12<br/>108:25 110:22<br/>136:6,7 137:7<br/>141:16,19<br/>151:21,22,22<br/>152:2 156:2,6<br/><b>processes</b> 84:6<br/>136:6<br/><b>processing</b><br/>21:19,19 41:9<br/>42:5 43:1<br/>47:25 48:3,5,7<br/>84:10 112:19<br/>134:21 136:8<br/>136:17 137:4,5</p> | <p>155:4,15 156:9<br/>156:15,20,24<br/><b>processor</b><br/>36:24 151:9<br/>153:17<br/><b>project</b> 86:18<br/>88:21<br/><b>projected</b><br/>89:13 101:18<br/>101:20<br/><b>projection</b> 52:3<br/>52:20 87:16,21<br/>88:5,15 89:2,5<br/>89:8,21 90:9<br/>101:4,6,8,10,15<br/><b>proportional</b><br/>156:23<br/><b>proposed</b><br/>145:15 149:19<br/>149:23<br/><b>provide</b> 11:17<br/>11:22 15:12<br/>18:7 32:6<br/>104:21 151:13<br/><b>provided</b> 6:6<br/>6:14 7:2 11:8<br/>13:21 100:20<br/>160:19 161:8<br/><b>provides</b> 26:21<br/>124:6<br/><b>provisional</b><br/>19:15,18 20:1<br/>20:8<br/><b>public</b> 159:4<br/>163:19</p> | <p><b>publications</b><br/>40:4,8<br/><b>pull</b> 9:16 10:1<br/><b>pulling</b> 40:2,6<br/><b>purposes</b> 12:9<br/>12:24<br/><b>put</b> 12:11 17:25<br/>20:10 104:25<br/>116:8 137:12</p> <p><b>q</b></p> <p><b>qualitatively</b><br/>66:8<br/><b>quality</b> 121:20<br/>122:3<br/><b>quantities</b><br/>26:21 28:14<br/>30:8,10,22<br/><b>quantity</b> 79:9<br/><b>quaternions</b><br/>84:23<br/><b>question</b> 12:7<br/>15:19 16:18<br/>17:9 18:21<br/>21:24 22:19<br/>23:13 24:7,23<br/>28:2,17,22<br/>29:20 32:25<br/>33:1,23 35:21<br/>38:7,9,16,20<br/>39:2,8,11 42:2<br/>42:9 44:8<br/>46:14 50:1,17<br/>54:22 59:16<br/>60:19 61:8,9<br/>61:10 65:6,7</p> | <p>65:24 69:16,18<br/>71:10 72:1<br/>76:16 77:6<br/>80:17 82:21,23<br/>86:11,13 93:16<br/>97:22 104:11<br/>104:25 105:2,8<br/>105:11,20<br/>106:1,8,9,11,21<br/>106:22,23<br/>113:11 114:17<br/>118:9,15 119:4<br/>119:14,16<br/>127:8 128:14<br/>131:6 133:19<br/>140:15,17,19<br/>142:7 144:14<br/>145:19 146:2<br/>155:10 157:3<br/><b>questioning</b><br/>59:14 137:13<br/><b>questions</b> 91:12<br/>105:14,15<br/>127:22 150:5<br/>150:11 157:25<br/><b>quinn</b> 2:8,12<br/><b>quinnemanue...</b><br/>2:11,14<br/><b>quite</b> 39:1<br/><b>quote</b> 117:13<br/>131:9</p> <p><b>r</b></p> <p><b>r</b> 108:14 109:10<br/>110:4 113:8,16<br/>114:4,18,18,24</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[r - relationships]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>115:8,23 116:1<br/>116:11 159:1<br/>162:3,3<br/><b>r&amp;s</b> 161:1,9<br/><b>range</b> 28:12,19<br/>29:2,3,12<br/>44:17 52:16<br/>115:12<br/><b>ranges</b> 115:3<br/>126:1<br/><b>rather</b> 40:21<br/>70:19<br/><b>raw</b> 142:20<br/><b>read</b> 21:23<br/>22:23 27:4,9<br/>47:4 50:22<br/>61:3 93:18<br/>101:1 108:17<br/>111:6,20 118:7<br/>125:18 132:11<br/>144:4 163:5<br/><b>reading</b> 15:20<br/>27:19 32:24<br/>38:19 64:14<br/>66:17 70:1<br/>78:21 129:20<br/>133:4 143:15<br/>160:24 161:9<br/><b>reads</b> 8:1 20:20<br/>25:3 34:4<br/>61:17 67:23<br/>78:1 84:21<br/>130:15 142:11<br/>144:5 150:14</p> | <p><b>real</b> 21:4 47:11<br/>47:21,25 48:4<br/>48:7 108:21<br/>109:10 110:3<br/>111:16 113:8<br/>113:25 114:8<br/>114:14 115:8<br/>144:22,23<br/><b>really</b> 25:22<br/>54:20 121:23<br/><b>reason</b> 66:22<br/>104:21 135:16<br/>148:12,18<br/>162:6,9,12,15<br/>162:18,21<br/><b>reasonable</b><br/>62:17 74:19<br/><b>reasons</b> 104:2<br/>122:13 148:20<br/><b>recalculated</b><br/>117:22 118:5<br/><b>recall</b> 21:22<br/>37:12,19 38:13<br/>82:19 83:18<br/>119:2<br/><b>received</b> 58:9<br/><b>receiving</b> 58:18<br/><b>recited</b> 80:9<br/>83:16<br/><b>recites</b> 84:13<br/>126:19<br/><b>recommends</b><br/>149:15<br/><b>record</b> 5:13,21<br/>7:10 18:15</p> | <p>19:6 45:24<br/>158:1 159:9<br/><b>recording</b><br/>110:14 135:1<br/><b>reducing</b> 30:21<br/>91:22<br/><b>reduction</b><br/>142:6<br/><b>refer</b> 7:11 19:7<br/>46:1 127:11<br/>141:10<br/><b>reference</b> 22:4<br/>79:19<br/><b>referenced</b><br/>160:6<br/><b>references</b><br/>73:12<br/><b>referred</b> 76:18<br/>77:11 150:15<br/><b>referring</b> 11:4<br/>17:21 32:12<br/>40:9 45:14,18<br/>47:21 60:12,14<br/>65:22 67:14<br/>73:23 83:15,22<br/>87:13 153:12<br/>154:5 156:24<br/><b>refers</b> 33:2<br/>60:14 83:15<br/>88:25 92:23<br/>103:1<br/><b>reflected</b><br/>101:13<br/><b>refrain</b> 106:18</p> | <p><b>regard</b> 14:21<br/>157:14<br/><b>regarding</b> 6:6<br/>6:14 7:2 11:20<br/>13:12 46:15<br/>99:7 157:6<br/><b>region</b> 87:18<br/>88:7,16 89:23<br/>127:18 128:10<br/>128:21 129:12<br/>129:14,22,23<br/>130:8<br/><b>registering</b><br/>148:13<br/><b>relate</b> 16:15<br/>97:17,25<br/><b>related</b> 26:22<br/>98:12 156:25<br/>159:11<br/><b>relating</b> 17:13<br/>17:14<br/><b>relation</b> 85:22<br/>85:24,25 86:6<br/>86:17,23,24<br/>87:3,8 90:7,12<br/>90:20 98:19<br/>127:24 128:1<br/>129:1,3<br/><b>relationship</b><br/>25:24 124:2<br/>129:7<br/><b>relationships</b><br/>26:9 77:4,10<br/>129:25</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[relative - rotation]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>relative</b> 8:4<br>39:8 42:24<br>67:6<br><b>relatively</b><br>103:24 104:13<br>105:4,22<br>106:13<br><b>released</b> 160:22<br><b>relevant</b> 17:4<br><b>relied</b> 38:11<br><b>relies</b> 9:10 11:1<br>15:2,24<br><b>rely</b> 10:25 15:4<br>16:14<br><b>relying</b> 11:21<br>12:3,9 66:25<br>79:19 81:12<br><b>remain</b> 25:5,18<br><b>remaining</b> 13:7<br><b>remains</b> 114:10<br>128:9 136:13<br><b>remedy</b> 149:16<br><b>remember</b><br>86:11 140:17<br><b>remove</b> 112:18<br>122:20<br><b>removing</b><br>30:21<br><b>render</b> 82:9<br><b>rendered</b> 82:4<br><b>repeat</b> 28:22<br>35:21 69:15<br>80:17 86:12<br>97:22 113:11<br>127:7 131:5 | 140:18<br><b>reported</b> 1:23<br><b>reporter</b> 159:3<br><b>represent</b><br>67:21 69:20<br><b>representation</b><br>141:15<br><b>represented</b><br>84:22 85:2,4<br><b>representing</b><br>51:3 58:14<br>67:11 101:8,17<br><b>reproduce</b><br>139:23<br><b>requested</b><br>161:1,9,10<br><b>require</b> 9:10,25<br>10:14 42:25<br>62:12 88:1<br>154:16<br><b>required</b> 43:24<br>70:11 160:20<br>163:13<br><b>requires</b> 8:17<br>9:3,21 10:5,9<br>12:19 23:25<br>24:9 41:24<br>42:5 43:13<br>44:4 47:25<br>81:4<br><b>requiring</b> 9:16<br>21:3<br><b>resolution</b> 72:7<br><b>resources</b> 44:4 | <b>respect</b> 57:9<br>117:25<br><b>response</b> 94:24<br><b>responses</b> 49:9<br><b>responsive</b> 42:3<br><b>restrict</b> 132:3<br><b>restricting</b><br>52:21<br><b>result</b> 54:1,6,8<br>54:11,14,17<br>55:8,24,25<br>64:4 65:12<br>93:9 107:3<br>110:10 114:13<br>156:9<br><b>resulting</b><br>101:16 104:21<br>113:9 123:7<br><b>results</b> 55:4<br>98:4 109:21<br>123:4 148:19<br><b>return</b> 160:17<br>161:6<br><b>review</b> 1:4 20:1<br>160:8,10,13<br>161:2<br><b>reviewed</b> 39:19<br><b>right</b> 8:12 12:2<br>16:7 18:4<br>23:14 26:16<br>27:17 31:1<br>34:17 35:6<br>36:18 37:17<br>51:24 52:17<br>54:7,10,12,19 | 54:24 55:12,16<br>56:4 57:12,15<br>62:22 65:10<br>68:13 74:6<br>75:2,13 81:24<br>82:12 83:23<br>84:18 85:9<br>86:3 87:1<br>88:17 99:25<br>100:1 107:19<br>110:5,6,9<br>115:4 118:19<br>123:22 124:17<br>135:2 136:25<br>138:20 151:6<br>152:19 153:19<br>154:8 155:19<br>156:17 157:8<br>157:12<br><b>rolling</b> 45:10<br>95:15,17,23<br>96:2,8,17 97:5<br>97:8,16,24<br>98:6,9,19,22<br>99:3<br><b>root</b> 124:8<br><b>rotation</b> 23:18<br>23:25 24:3,9<br>24:14,16,25<br>25:4,16,18<br>28:13,15 30:4<br>30:14 49:11<br>73:5,11,16<br>76:6,11 78:2<br>78:10,10,18 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[rotation - schmidt]

|                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 79:7<br><b>rotational</b> 30:9<br>30:19 49:20,21<br>60:17,17 62:13<br>62:14 67:19,19<br>67:25 68:1<br>70:12 82:16<br><b>rotations</b> 41:10<br>42:7<br><b>rpr</b> 1:24 159:21<br><b>rules</b> 161:8                                                                                                                                                                                              | 111:25 132:7<br><b>says</b> 9:2 26:11<br>27:10 35:10<br>36:12,13 55:2<br>55:16 56:18<br>63:19 74:10<br>75:11,18<br>110:12 124:19<br>124:21 126:10<br>126:22 132:12<br>146:17 147:2<br>149:21 152:5                                                                                                                                                                                             | 15:18 16:4<br>17:10,24 18:9<br>18:14 19:1,4<br>20:6 21:15<br>22:1 23:2,23<br>24:4,20 26:1<br>26:12 27:2,13<br>27:20 28:3,24<br>29:10,19 30:11<br>31:1,5 32:3,11<br>33:15 34:1<br>35:23 36:11<br>38:2,10,17<br>39:17 40:5,16<br>41:6 42:1,15<br>42:21 44:1,20<br>45:7,17,22,23<br>46:17 48:12<br>49:14 50:3,24<br>51:9,20 52:12<br>52:22 53:11<br>54:21 55:1<br>56:5,9,17 58:3<br>59:5,13,17<br>60:4,13 61:7<br>61:20 62:11,23<br>63:1,18 64:10<br>65:5,15,23<br>66:4,15 67:16<br>69:4,17 70:8<br>70:21 71:9,24<br>72:15 74:5<br>75:10 76:8,21<br>77:21 79:1,10<br>80:18 81:21 | 82:3,22 83:24<br>85:14 86:10<br>87:19 88:3,13<br>89:1,11,16<br>90:1,11,22<br>91:5,9,18,24<br>92:9,18 93:8<br>94:5,16,21<br>96:15 97:3,15<br>98:7,16 99:4<br>99:21 100:19<br>101:23 102:9<br>102:17 103:20<br>104:9,23 105:9<br>105:14,18,19<br>106:7 107:10<br>108:4 109:5<br>111:11 112:21<br>113:12,24<br>115:1 117:20<br>118:16,22<br>119:13 120:6<br>120:18 122:22<br>124:4 125:1,8<br>125:24 126:13<br>127:9,21<br>129:24 130:9<br>131:7,12<br>132:10 133:20<br>134:5,18<br>135:10 136:1<br>137:16 138:1<br>138:22 139:4,9<br>140:13 141:4,7<br>141:24 142:19 |
| <b>s</b>                                                                                                                                                                                                                                                                                                                                                                                         | <b>scale</b> 24:22<br>25:5,16,18<br>30:5,13 76:6<br>76:12<br><b>scanlines</b> 101:9<br>102:24<br><b>scene</b> 8:19 9:1<br>9:7 96:7,12<br>103:13 135:1<br>150:15,17<br>152:10,11<br><b>scenery</b> 131:19<br><b>schedule</b><br>160:10<br><b>schematic</b><br>126:8<br><b>schmidt</b> 2:9 3:4<br>5:7,20 6:4,10<br>6:21 7:9,15<br>8:11 9:18 10:3<br>10:11,24 11:11<br>12:6,8,18<br>14:11,20 15:7 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>s</b> 25:6,8 26:4,14<br>27:5,17,23<br>28:7 162:3<br><b>salient</b> 8:2,13<br>8:19,25,25 9:3<br>9:7,10,17,20<br>10:2,14,20,22<br>14:2<br><b>satisfied</b> 59:8<br>59:20 60:20<br>89:23<br><b>satisfies</b> 62:5<br>68:9<br><b>satisfy</b> 62:3<br><b>satisfying</b><br>67:22<br><b>saw</b> 63:24<br>70:19 77:19<br>107:13<br><b>saying</b> 26:2<br>27:7 47:13<br>49:24 55:13,18<br>77:22 99:16 |                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

[schmidt - separately]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 143:14 144:7<br>144:13 145:8<br>145:16 146:1<br>146:11,19<br>148:1,21<br>149:17 150:3<br>150:10 151:4<br>151:15 152:7<br>152:24 153:11<br>154:7,25<br>155:24 156:4<br>157:2,19,21<br>158:1<br><b>sealed</b> 160:20<br><b>second</b> 7:3<br>20:20 23:8,11<br>23:22 47:23<br>53:25 55:20<br>57:17 58:1<br>59:2 60:22,22<br>61:12 64:20,22<br>65:13 68:4<br>71:20 72:11<br>100:8 110:12<br>112:22 115:7<br>126:20 136:14<br>136:19 137:20<br><b>secondary</b><br>151:25<br><b>seconds</b> 136:13<br>136:20<br><b>see</b> 5:16,19,23<br>6:11,16,19,19<br>7:5,16 8:5,20<br>9:24 10:6,8 | 11:14,19 12:23<br>18:17,25 19:14<br>19:16,23 20:17<br>20:24 21:6<br>22:4,17 24:22<br>24:23,25 25:9<br>31:17 32:9,18<br>32:23 33:1<br>34:11,14,23<br>36:21 46:3<br>47:2 48:18,23<br>49:25 50:4,7<br>52:5 53:4,15<br>53:19 56:22<br>58:7,16 63:7<br>63:23 64:6,17<br>66:7,22 67:8<br>68:12,16,21<br>69:2 70:22<br>73:8,10 74:12<br>77:5,6,8 78:5<br>79:20 80:5<br>81:1 82:8 83:1<br>83:6 84:24<br>85:6,23,25<br>86:1 90:23<br>91:2,3 96:12<br>100:7,10<br>102:13 105:7<br>105:10 108:15<br>108:17 109:12<br>109:23 110:17<br>111:9,23<br>112:14 118:8<br>120:23 121:6 | 121:10 124:6,8<br>125:25 126:5<br>126:18,25<br>127:19,24<br>128:3,4 129:1<br>129:5 130:23<br>132:16 139:16<br>139:21,25<br>140:2 141:25<br>142:5,15,17,23<br>146:8,14<br>147:23,25<br>149:20 150:18<br>152:14<br><b>seem</b> 36:8 37:3<br>57:25 62:3<br><b>seems</b> 49:23<br>62:17 69:24<br>145:13<br><b>seen</b> 18:22<br>39:18 49:12<br>96:5<br><b>segment</b> 58:24<br>59:1,8,21 60:7<br>60:21,22 61:12<br>61:13 62:21<br>71:11 72:2,4<br><b>segmented</b><br>66:21<br><b>segments</b> 58:12<br>58:20 59:7,19<br>65:9 66:12<br>68:16,19,23<br>69:11,20 72:19<br>72:21 | <b>selected</b> 102:20<br><b>selection</b><br>102:11<br><b>sense</b> 36:6 37:5<br>54:7 55:10<br>57:16 84:4,7<br>89:12 152:1<br><b>sensing</b> 42:23<br>46:25 47:9,17<br>47:24 48:2<br><b>sensor</b> 11:2,9<br>12:20 13:1,19<br>13:24 16:10<br>38:5,13 40:21<br>41:8,14,15<br>42:5 46:20<br>93:18,19 95:20<br>95:21,21,22,24<br>96:22 150:23<br><b>sensors</b> 11:16<br>11:16,21,25<br>12:15 13:5,10<br>13:21 14:10<br>15:2,4 41:2,20<br>41:20 45:9<br><b>sentence</b> 11:14<br>20:20 21:14<br>22:12 31:13<br>47:23 56:18<br>73:3 86:3<br>108:17 144:5<br><b>separate</b> 5:22<br>72:6<br><b>separately</b> 41:4<br>59:25 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[sequence - smoothed]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>sequence</b> 143:7<br>150:15<br><b>series</b> 5:11<br>64:16<br><b>server</b> 31:20,25<br>34:8,25 35:1<br>36:8,16 37:4<br>48:8<br><b>service</b> 34:16<br>34:22<br><b>set</b> 28:12 53:17<br>53:25 55:10<br>56:1 57:8,13<br>64:25 68:9<br>79:18 102:21<br>129:20 139:7<br>157:13 159:7<br>159:16<br><b>sets</b> 56:21<br><b>setting</b> 33:16<br>56:15 57:24<br>64:4,8,22<br><b>shaded</b> 145:14<br>149:18<br><b>shape</b> 67:9<br><b>sharp</b> 92:17<br><b>shi</b> 4:8 79:19<br>80:8,12,15,21<br>80:23 81:12,16<br>81:20,23 82:5<br>82:9 99:13,17<br>99:24 100:5,11<br>100:15,20<br>101:24 102:10<br>103:14,23 | 104:16 105:4<br>105:21 106:12<br>106:14,23,25<br>107:11,15<br>108:7,12,24<br>109:8 110:12<br>110:19 111:1<br>112:10,22<br>113:6,14 114:1<br>115:4,5,20,22<br>116:7,8,10<br><b>shi's</b> 104:12<br>116:9<br><b>shoot</b> 131:18<br><b>short</b> 31:3<br>62:24 114:11<br>118:20 150:5,8<br>157:23<br><b>shorthand</b><br>159:3<br><b>show</b> 45:18<br>68:5 156:13<br><b>showing</b> 25:23<br><b>shown</b> 12:1<br>54:9 65:16<br><b>shows</b> 35:7<br>52:2<br><b>shutter</b> 45:10<br>95:15,18,23<br>96:2,8,17 97:5<br>97:9,11,16,24<br>98:6,10,20,22<br>99:3<br><b>sign</b> 160:16<br>161:5 | <b>signal</b> 13:14<br>91:17,23 92:5<br>94:2,4,8,10<br>113:23<br><b>signature</b><br>159:20 160:22<br>160:24,24<br>161:9<br><b>similar</b> 20:22<br>31:15 32:15<br>42:12 76:12<br>114:7<br><b>similarities</b><br>98:19<br><b>similarity</b> 22:6<br>22:13 74:16<br>75:12<br><b>similarly</b> 58:1<br><b>simple</b> 54:22<br><b>simply</b> 124:11<br><b>single</b> 60:6<br><b>sir</b> 74:6 103:6<br>141:12<br><b>sit</b> 138:20<br><b>sitting</b> 33:18<br>157:12<br><b>situation</b> 16:12<br>17:9 41:22<br>115:5 123:4<br>129:21 134:7<br><b>situations</b><br>108:1<br><b>sixth</b> 20:11<br><b>sketch</b> 138:7 | <b>sketching</b><br>138:9<br><b>skill</b> 91:13<br>130:25 131:8<br><b>skilled</b> 124:21<br><b>skipping</b> 56:10<br><b>slanted</b> 96:13<br><b>slight</b> 118:3<br><b>slightly</b> 128:24<br><b>small</b> 143:6<br>148:16,24<br><b>smaller</b> 67:5<br>94:15 120:1<br><b>smao</b> 2:6 160:2<br><b>smith</b> 30:24<br><b>smooth</b> 17:22<br>25:5,18 30:8<br>53:6,10,16,21<br>54:2,14,18,23<br>55:3,11,12,15<br>56:1,2,3,3 57:1<br>57:3,5,6,8,9,15<br>57:18,23,24<br>58:11,19 64:1<br>64:20 66:11<br>68:24 109:17<br>122:21 135:17<br>136:20 137:8<br><b>smoothed</b><br>79:25 81:5<br>83:3,9 84:9,14<br>85:15,20 86:7<br>86:15 108:20<br>113:1,4 130:15<br>130:22 132:12 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[smoothed - states]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 132:19,22<br>133:6,9 135:1<br><b>smoothing</b><br>12:13 16:22<br>28:19 29:3,6<br>29:13,18,22,24<br>30:1 56:7,12<br>56:16 57:24<br>91:20 109:14<br>109:18 112:8<br>112:12,16,17<br>112:18 113:3<br>130:2 133:3<br>134:21 138:16<br>152:12<br><b>smoothness</b><br>25:4,6 26:3,14<br>26:19 27:5,15<br>27:22 28:6<br>30:13<br><b>solutions</b> 160:7<br><b>solving</b> 48:21<br><b>somebody</b> 55:6<br><b>sorry</b> 22:9<br>24:24 32:25<br>37:13 39:9<br>53:1 59:15<br>65:21 69:15<br>73:2 76:2<br>83:21 85:24<br>86:5,18 97:19<br>97:22 99:10<br>100:1,8 108:10<br>109:24 130:13<br>133:18 135:23 | 138:18 141:17<br>141:17 151:22<br><b>sort</b> 39:19 96:1<br><b>sounds</b> 18:1<br>152:25 155:1<br>155:18<br><b>sources</b> 41:2<br><b>south</b> 2:9<br><b>space</b> 51:13,24<br>52:4,4 75:19<br>75:19 79:7<br>101:20 128:22<br><b>sparse</b> 44:23<br><b>speak</b> 129:17<br><b>speaker</b> 153:16<br><b>speaking</b> 21:16<br>66:8 67:17<br><b>special</b> 62:9<br><b>specific</b> 13:11<br>40:13 45:15<br>49:6 52:9<br>67:14 102:8<br>104:25 116:8<br>153:22 154:6<br>156:16<br><b>specifically</b><br>23:21 83:12<br>103:8 107:18<br>119:6,18<br><b>specification</b><br>46:22 63:10,14<br>63:25 64:14<br>66:9,10,23<br>69:7 70:2<br>89:20 91:4 | 111:9,19<br>125:19 143:1<br>146:17,21,25<br>153:22<br><b>specification's</b><br>67:1<br><b>specified</b> 84:11<br><b>specify</b> 75:4<br><b>spectrum</b> 43:23<br><b>spell</b> 92:3<br><b>spend</b> 26:8<br><b>spherical</b> 108:9<br>108:13 113:7<br>113:15 114:3<br>116:10 128:1<br>128:12 129:3<br><b>spoke</b> 14:1 37:9<br>111:18<br><b>spread</b> 138:25<br><b>square</b> 78:4<br>124:8<br><b>squared</b> 124:9<br>124:9<br><b>stabilization</b><br>9:9,15,20<br>15:10,11,13,23<br>16:3,21 17:20<br>28:9 31:16,19<br>33:6 36:7,8<br>37:4,10 116:19<br>116:23,25<br>117:7,8,21,25<br>118:10 119:5<br>119:11,14<br>120:1,8,11,16 | 120:20 121:12<br>122:4,9 123:19<br>125:4,9,15<br>126:1<br><b>stabilizations</b><br>36:25<br><b>stabilize</b> 8:1,8<br>12:16 117:4<br>119:23<br><b>stabilizing</b><br>10:13 12:13<br>16:1<br><b>stable</b> 56:19<br>143:5,20,23<br><b>stand</b> 35:14<br>36:5,9,22 37:1<br><b>standard</b> 49:19<br><b>stands</b> 44:12<br><b>start</b> 7:21<br>73:13 131:14<br>137:19<br><b>started</b> 5:10<br>91:11<br><b>starts</b> 66:5<br><b>state</b> 8:16 47:7<br>159:4 160:9,12<br><b>stated</b> 77:16<br><b>statement</b> 17:7<br>41:1 42:17<br>47:8 55:19<br>152:23 153:1,8<br>154:9 155:19<br>155:25<br><b>states</b> 11:15<br>88:19 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[static - t]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>static</b> 58:14<br><b>stating</b> 36:4<br>76:25<br><b>station</b> 96:5<br><b>stationary</b><br>134:19,23,25<br>135:8 136:5,10<br>136:13,24<br><b>stationery</b><br>136:25<br><b>stella</b> 2:4 160:1<br><b>stemming</b><br>98:17,23<br><b>stenographer</b><br>83:20 129:17<br><b>stenographic...</b><br>1:23<br><b>step</b> 115:15<br>116:4<br><b>stepping</b><br>112:22<br><b>steps</b> 16:22<br>100:25 101:2<br>103:2 112:6<br><b>stick</b> 107:16<br><b>stickiness</b> 80:3<br>81:10<br><b>sticking</b> 150:12<br><b>stipulation</b><br>160:21<br><b>stop</b> 73:22<br><b>store</b> 156:23<br>157:1<br><b>stored</b> 90:24 | <b>storing</b> 156:7<br><b>straight</b> 66:5<br>70:7,25 71:22<br>96:13<br><b>straightforward</b><br>44:15 153:10<br><b>street</b> 2:9<br><b>strength</b><br>116:20,23,25<br>117:7,8,21<br>118:10 119:5<br>119:15 120:8<br>120:11,16,20<br>121:8,13 122:5<br>122:9 123:20<br>125:4,10,15<br>126:1,2,2,11,12<br><b>strengths</b> 120:2<br><b>strictly</b> 142:13<br><b>strike</b> 30:2 37:8<br>40:17 89:3<br>109:20 122:6<br>147:20<br><b>striving</b> 132:2<br><b>strong</b> 120:14<br><b>stronger</b> 82:1<br><b>struck</b> 95:24<br><b>studied</b> 40:3,7<br>40:14 46:7<br><b>subject</b> 92:7,14<br>92:25<br><b>submitted</b><br>79:16 99:6<br><b>subscribed</b><br>163:14 | <b>subset</b> 102:1<br><b>success</b> 146:9<br><b>successive</b><br>145:10,20<br>146:5,9 148:15<br>149:11<br><b>suggest</b> 30:19<br><b>suggests</b> 77:19<br>102:23<br><b>suite</b> 1:19<br><b>sullivan</b> 2:8,12<br><b>support</b> 32:6<br>32:14 33:5,18<br><b>sure</b> 22:2 28:25<br>33:12 82:8<br>83:25 97:23<br>109:2 113:13<br>116:9 118:9<br>153:20<br><b>sworn</b> 5:2,5<br>28:7 159:8<br>163:14<br><b>symmetric</b><br>95:12<br><b>symmetrical</b><br>95:9<br><b>system</b> 16:16<br>16:16 17:3<br>34:6,7,8,21,25<br>35:1,5,19 36:2<br>36:14,15,16<br>42:23 43:11<br>45:6 46:18,25<br>47:10,17,24<br>48:2 49:10 | 67:21 70:10<br>94:7 95:15<br>100:5 101:14<br>106:12 109:9<br>110:2 112:1<br>133:12,21<br>134:9,15 135:6<br>135:11,13,19<br>136:6,17<br>138:11,16,24<br>147:20,22<br>148:3,22 151:1<br>153:17<br><b>systems</b> 17:13<br>18:3,3,7 44:3                                                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>t</b><br><b>t</b> 2:9 25:15 53:4<br>53:6,9,15,16,21<br>53:24 54:2,5<br>54:24 55:14,15<br>56:11,20,25<br>57:3,8 58:13<br>108:14,14<br>109:10 110:4,9<br>110:13,14,16<br>110:16,22<br>111:16 113:7,8<br>113:16 114:4<br>114:18,18,23<br>114:24 115:8<br>115:23 116:1<br>116:11 128:13<br>140:3 159:1,1<br>162:3,3 |

**[take - thought]**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>take</b> 18:20 28:4<br>30:25 31:1,10<br>46:23 53:12<br>58:4 59:6,19<br>62:23 77:16,18<br>91:5 99:5,17<br>113:6 115:11<br>118:17 124:5<br>145:25 150:3,5<br>157:22<br><b>taken</b> 31:3<br>62:24 91:7<br>111:1 118:20<br>150:8 157:23<br><b>takes</b> 49:1<br>110:19 115:15<br>156:1<br><b>talk</b> 73:19 76:6<br>93:13 108:5<br><b>talked</b> 76:14<br>79:6 133:3<br><b>talking</b> 95:10<br>95:11 118:25<br>147:15<br><b>talks</b> 73:15<br>78:19 119:9<br>123:5 131:20<br><b>target</b> 121:8<br><b>task</b> 88:9<br><b>taught</b> 141:16<br>152:4 156:16<br><b>teaches</b> 10:4<br>26:13,18 31:23<br>35:12 46:18<br>124:14,17 | 141:20,23<br>149:4,8,9<br>151:21<br><b>teaching</b> 9:19<br>23:7 27:4,12<br>28:14 32:1<br>39:19 112:7,20<br>116:1,9 120:17<br>122:17 124:10<br>130:1 148:25<br><b>teachings</b> 14:17<br>35:8 127:13<br>151:3 153:8<br><b>technique</b> 11:1<br>12:14 21:18<br>37:21 40:22<br>101:2 105:21<br><b>techniques</b><br>12:12 17:15<br>28:9 33:6,20<br>40:4,8 117:4,5<br>117:11 119:10<br>124:22<br><b>technology</b><br>31:24 35:13<br><b>telephotic</b> 67:9<br><b>tell</b> 17:21 27:11<br>45:19 47:5<br>64:11 75:7<br>76:9,18 77:10<br>78:7,13 154:20<br><b>telling</b> 156:10<br><b>tells</b> 66:23 71:6<br>72:10,21 78:9<br>89:20 100:15 | 125:7 127:16<br>146:12<br><b>temporal</b><br>130:17,19<br>132:14,20,24<br>132:25,25<br>133:7,11,14,24<br>135:12,20<br>138:13 139:13<br>154:3,11<br>156:14<br><b>ten</b> 71:19 72:10<br>126:11<br><b>term</b> 29:15<br>45:2 91:14,20<br>92:1,7,11<br>97:10<br><b>terms</b> 15:8<br>46:11 47:15<br>68:6 69:25<br>70:17,20 86:25<br>92:3,13 116:8<br><b>test</b> 87:25<br>88:14 90:8<br>102:5 143:10<br>147:13,16<br><b>testified</b> 5:5<br><b>testifying</b> 49:15<br><b>testimony</b><br>73:25 105:1<br>159:9,9 163:8<br><b>thank</b> 63:3<br>68:15 69:6<br>79:11 118:24<br>157:20 | <b>thanks</b> 157:19<br><b>thereof</b> 34:9<br>36:17<br><b>theta</b> 25:6,8<br>26:4,14 27:5<br>27:17,23 28:7<br>144:21,21<br><b>thing</b> 55:9<br>77:25 95:2<br>121:5<br><b>things</b> 16:6<br>25:19 30:4<br>39:13 118:4<br>122:24 123:13<br>149:14 153:16<br>154:14 155:8<br>157:10<br><b>think</b> 25:22<br>42:3,9 56:6,12<br>72:16 82:1<br>99:9 125:20<br>138:9 145:23<br>150:4 156:12<br><b>thinking</b> 157:8<br><b>third</b> 20:14<br>23:8,12 31:13<br>53:25 57:17<br>58:1 59:2,3<br>64:25 65:13,18<br>67:4,5,7 68:2<br>71:20 72:12<br>108:23 109:3<br>111:2,15<br><b>thought</b> 29:23<br>92:6 157:17 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[thousands - transitions]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>thousands</b> 43:1</p> <p><b>three</b> 52:10</p> <p>58:12,20 59:6</p> <p>59:19 61:4</p> <p>67:6 68:6,7</p> <p>70:20 72:17</p> <p>73:5,6,11,18</p> <p>74:1,3,23 75:1</p> <p>75:5,9,19,21</p> <p>76:10,12,13,19</p> <p>77:2,11,19</p> <p>78:19,21,23</p> <p>81:6 146:7,8</p> <p>155:20,20,21</p> <p><b>threshold</b></p> <p>140:5,9,21</p> <p>143:6</p> <p><b>tie</b> 112:7,15</p> <p><b>tied</b> 107:18,25</p> <p>119:17</p> <p><b>tilt</b> 28:10</p> <p><b>time</b> 18:25 21:4</p> <p>26:8 28:4</p> <p>40:18 47:11,21</p> <p>47:25 48:4,7</p> <p>58:13,21 61:5</p> <p>62:1 66:13</p> <p>68:7,7,7 71:20</p> <p>72:11 87:22</p> <p>88:21,23,24</p> <p>89:5,6,13,17</p> <p>92:16 93:16</p> <p>95:22 96:24,25</p> <p>97:4,7 98:4,4,9</p> <p>98:14 100:13</p> | <p>100:22 102:1</p> <p>104:20 109:11</p> <p>110:5,14,16,16</p> <p>118:1 127:5</p> <p>136:12 138:10</p> <p>144:10,11</p> <p>154:18 155:4</p> <p>155:15,21,21</p> <p>156:1,6,10,24</p> <p>157:19 160:10</p> <p>160:18,25</p> <p>161:7</p> <p><b>times</b> 14:17</p> <p>71:19,20 72:10</p> <p>72:12 96:10,21</p> <p>96:23 99:2</p> <p>120:1 122:12</p> <p><b>today</b> 33:18</p> <p>157:5,7</p> <p><b>together</b> 20:10</p> <p>59:9,21 60:23</p> <p><b>token</b> 94:6</p> <p><b>took</b> 84:10</p> <p><b>top</b> 115:19</p> <p>124:5 125:2</p> <p><b>topic</b> 40:3,7,14</p> <p>104:19 130:10</p> <p><b>total</b> 101:25</p> <p>152:6</p> <p><b>toward</b> 116:1</p> <p><b>towards</b> 115:8</p> <p>115:23</p> <p><b>track</b> 8:1,18</p> <p>44:11 149:24</p> | <p><b>trackable</b></p> <p>37:11,14 38:24</p> <p>39:4 40:9</p> <p><b>tracked</b> 22:6,14</p> <p>40:13</p> <p><b>tracking</b> 8:13</p> <p>9:3,10 10:14</p> <p>14:2 37:15</p> <p>39:20 40:22</p> <p>44:3 47:1</p> <p><b>tracks</b> 9:20</p> <p><b>trade</b> 41:13</p> <p>43:8 47:18</p> <p>155:23</p> <p><b>tradeoff</b> 154:15</p> <p>154:22 155:8</p> <p>155:19</p> <p><b>trajectories</b></p> <p>149:7</p> <p><b>trajectory</b></p> <p>12:13,14,17</p> <p>13:16 15:24,25</p> <p>16:2,22,23</p> <p>17:22,23 30:23</p> <p>37:25 40:2,6</p> <p>60:15 68:17</p> <p>79:25 80:1</p> <p>81:5 83:3,4,9</p> <p>83:10,13,15,16</p> <p>83:21 84:1,2,5</p> <p>84:7,8,9,11,14</p> <p>84:15,16 85:8</p> <p>85:11,12,15,20</p> <p>85:21 86:7,8</p> <p>86:15,16 88:2</p> | <p>89:25 90:21</p> <p>108:20,21</p> <p>113:1,4,9</p> <p>122:21 130:16</p> <p>130:17,22</p> <p>132:13,14,19</p> <p>132:22,23</p> <p>133:6,10 135:2</p> <p>137:8 138:17</p> <p>142:21 143:4,5</p> <p>143:8,19,20,24</p> <p>144:1,11 148:8</p> <p>148:13,15</p> <p>149:10,12,18</p> <p>149:19,23</p> <p>150:16 151:18</p> <p>151:23,25</p> <p>152:2,3,12,13</p> <p>152:17 153:4</p> <p><b>transcript</b></p> <p>159:8 160:6,8</p> <p>160:10,13,13</p> <p>160:22 161:2,2</p> <p>163:5,8</p> <p><b>transformation</b></p> <p>73:16 101:13</p> <p>101:14,16,18</p> <p>108:24 109:21</p> <p>111:2,15</p> <p><b>transformatio...</b></p> <p>26:25 109:3</p> <p>111:1,18 112:3</p> <p><b>transitions</b></p> <p>143:9 147:10</p> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

[translates - unrelated]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>translates</b><br>124:12<br><b>translating</b><br>121:7<br><b>translation</b><br>22:5,13 23:19<br>24:16 34:21<br>35:5,19 36:2<br>49:11,22,23<br>73:16 76:7,11<br>125:11<br><b>translations</b><br>49:12<br><b>treat</b> 112:4<br><b>treating</b> 147:22<br><b>trial</b> 1:1<br><b>tries</b> 70:2<br><b>trigonometric</b><br>77:4<br><b>trigonometry</b><br>77:9<br><b>true</b> 27:3 28:18<br>30:3 31:19<br>40:17,18 41:7<br>42:22 43:2<br>44:5,21 45:8<br>51:10 65:25<br>69:19 82:6<br>90:2 105:3,21<br>106:12 111:15<br>112:12 119:16<br>120:10 121:12<br>122:6,8 159:9<br>163:8 | <b>try</b> 11:12 41:14<br>41:15 54:13,16<br>57:21 104:25<br>116:1 137:7<br><b>trying</b> 30:7<br>41:10 42:6<br>44:7,17 67:3<br>71:7 114:16<br><b>tuning</b> 130:1<br><b>turn</b> 20:7 22:3<br>24:21 32:20<br>34:13 48:13,16<br>52:23 63:4<br>72:25 79:12,17<br>79:22 84:19<br>85:18 109:7,19<br>110:11 116:12<br>120:19 126:14<br>126:15 127:23<br>130:10,13<br>139:10,11<br>147:17 153:24<br><b>turning</b> 70:22<br>82:11,24<br><b>two</b> 6:22 14:12<br>14:16,22 15:1<br>16:24 21:14<br>22:8,15 37:3<br>43:4 51:1,11<br>51:22 52:1,9<br>52:13 61:4,24<br>65:3,8 67:8<br>68:7 73:5<br>74:22,23,24<br>75:5,9,19 76:9 | 76:12,13,18<br>77:11 79:3,5<br>98:8 101:4,15<br>102:5,6,11<br>103:2 104:18<br>110:25 111:17<br>112:2 114:18<br>126:18 127:10<br>129:25 140:3<br>145:10,20<br>146:4,9 148:14<br>149:14 155:20<br>155:21,22<br>157:6,14<br><b>tx</b> 124:9 125:14<br><b>ty</b> 124:9 125:14<br><b>type</b> 30:1 44:3<br><b>typically</b> 48:8<br>95:3,6,7<br>119:25 | 78:15 88:4<br>104:24 106:20<br>106:21 107:11<br>114:16 124:22<br>134:14 135:24<br>136:2 137:21<br>137:22,24<br>138:2,5,18<br>155:11<br><b>understanding</b><br>9:12 10:13<br>15:12 21:17<br>24:8 55:6<br>74:19 91:14<br>95:17,19 96:17<br>112:23 127:2<br>131:1,9<br><b>understood</b><br>34:2 55:18<br>77:18 103:16<br>103:21 104:6<br>104:19 123:16<br>144:24<br><b>undesirable</b><br>39:21,24<br>122:15<br><b>unintended</b><br>132:3<br><b>unintentional</b><br>131:20<br><b>units</b> 155:20<br><b>unknown</b><br>152:13,16<br><b>unrelated</b><br>123:10 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>u</b>                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>u.s.</b> 1:3 2:2 3:6<br>3:8,22,24 4:3,5<br>4:7,9 7:11<br>18:17 19:7<br>46:1 99:23<br>141:9<br><b>unchanged</b><br>114:10<br><b>under</b> 83:10<br><b>undergoes</b><br>136:14<br><b>understand</b><br>8:22 21:8,17<br>25:11 57:12                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>urquhardt</b> 2:8<br/>2:12<br/><b>use</b> 8:2,14 9:6,7<br/>10:20 13:5<br/>17:21 23:6<br/>25:12 41:15<br/>43:4 44:10<br/>47:16,19 62:4<br/>62:4 68:6<br/>69:25 70:19<br/>84:8 86:21<br/>87:9,10,10<br/>88:1 91:2<br/>102:24 127:20<br/>128:12 130:17<br/>132:14,20,23<br/>132:25 133:7<br/>133:10 149:8,9<br/>153:2<br/><b>used</b> 23:1 25:7<br/>30:18 40:1<br/>95:5 101:21<br/>108:6,8,13<br/>112:25 113:15<br/>114:23 124:23<br/>125:3 151:3,7<br/>151:10 152:5<br/>153:7,23<br/><b>user</b> 131:16<br/>133:14,23<br/>134:4,8 138:12<br/><b>uses</b> 30:4 37:21<br/>86:17 114:1<br/><b>using</b> 13:24<br/>24:18 28:11</p> | <p>31:14 32:15<br/>41:7 42:4 43:6<br/>44:18 46:24<br/>50:18 87:12<br/>101:11 110:13<br/>111:2 115:6<br/>116:9,10 117:5<br/>117:14,17<br/>128:10 151:17<br/>152:3<br/><b>usually</b> 54:10<br/>115:15<br/><b>utilize</b> 87:8<br/>125:23<br/><b>utilized</b> 43:10<br/><b>utilizing</b> 15:24<br/>29:8 117:19</p> | <p><b>value</b> 28:19<br/>44:14 102:20<br/>103:24 104:13<br/>105:4,22<br/>106:13 114:5<br/>114:11 115:3<br/>117:7 119:17<br/>121:7 122:10<br/>125:23<br/><b>values</b> 27:23<br/>28:20 29:2,4<br/>29:12,17,21<br/>67:2 89:24<br/>90:14,15,24<br/>91:3 114:18,22<br/>114:23 115:14<br/><b>variable</b> 115:17<br/>116:5<br/><b>varies</b> 114:19<br/><b>variety</b> 143:2<br/>147:4<br/><b>various</b> 31:23<br/>36:25<br/><b>vector</b> 49:20<br/><b>velocities</b> 85:2<br/><b>velocity</b> 59:1<br/>60:17 61:18,25<br/>62:13,19 64:2<br/>65:17 67:19,19<br/>68:1,8 69:10<br/>69:12,21 70:12<br/>71:2,14 72:4<br/>78:4,11,20<br/>79:2,8</p> | <p><b>veritext</b> 1:18<br/>160:7,9,11,20<br/><b>versatile</b><br/>153:18<br/><b>version</b> 41:19<br/><b>versus</b> 78:8<br/>155:21<br/><b>vertical</b> 49:1,3<br/>124:13 125:12<br/>148:2,10<br/><b>video</b> 8:1,9<br/>10:14 31:15<br/>34:6,15,21<br/>36:14 73:7<br/>93:13,14 117:7<br/>119:23 136:17<br/>139:20 143:6<br/>150:15 151:6<br/><b>videos</b> 139:20<br/><b>view</b> 10:9,12<br/>23:3 29:11<br/>30:19 91:13<br/>131:18<br/><b>virtual</b> 84:21<br/>85:2,15 86:25<br/>87:6,21 88:16<br/>89:5,13 90:4,8<br/>90:13,14 109:9<br/>109:22 110:3<br/>110:12 111:7<br/>114:7,10 115:7<br/>126:20,23<br/>127:3,12 128:6<br/>128:23 129:8<br/>129:15 130:3</p> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p><b>v</b></p>                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <p><b>v</b> 84:23 85:5,16<br/>89:9 128:23<br/>160:4 162:1<br/>163:1<br/><b>v0t</b> 109:10,22<br/>110:3,7,9<br/><b>v1</b> 108:14<br/>110:13,22<br/>111:16 113:7<br/>114:18,18,23<br/>116:11<br/><b>v1t</b> 108:9<br/>113:16 114:4<br/>114:10,13<br/>115:8,23<br/><b>vague</b> 137:24<br/>140:11</p>               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

[virtual - witness]

|                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>134:22 135:4,6<br/>135:13<br/><b>virtue</b> 98:23<br/>99:1<br/><b>visible</b> 130:3<br/><b>vision</b> 1:3 2:2<br/>160:4 162:1<br/>163:1<br/><b>visually</b> 71:7<br/>71:16<br/><b>vs</b> 1:6</p>                                                                                                                                                                                                                        | <p><b>wanted</b> 80:19<br/>156:13<br/><b>wants</b> 122:14<br/><b>way</b> 7:21 8:1,15<br/>20:14 22:23<br/>106:1 108:2<br/>111:6,24 115:2<br/>122:4 128:11<br/>131:25 140:7<br/>144:4 149:13<br/>159:13<br/><b>ways</b> 9:16<br/>14:12 29:7<br/>117:4 141:1<br/>143:2 144:20<br/>146:23 147:5<br/><b>we've</b> 145:23<br/>157:6<br/><b>weight</b> 49:8,9<br/>67:4 80:2,12<br/>80:21 81:9,17<br/>81:19,23 82:6<br/>82:10 108:8,13<br/>128:11<br/><b>weighting</b><br/>129:4<br/><b>weights</b> 63:21<br/>65:14 66:19<br/>67:1 72:22<br/><b>welcome</b> 31:6<br/>63:2 91:10<br/>118:23<br/><b>went</b> 107:13<br/><b>whereof</b> 159:16</p> | <p><b>white</b> 42:14<br/>145:14<br/><b>wide</b> 131:18<br/><b>wilshire</b> 2:5<br/><b>window</b> 109:11<br/>110:4<br/><b>wisdom</b> 40:19<br/><b>withdraw</b> 65:6<br/>144:14<br/><b>withdrawn</b><br/>130:12<br/><b>witness</b> 3:2 5:1<br/>5:4,19 6:3,19<br/>7:8 9:14,24<br/>10:8,18 12:12<br/>14:5,15 15:1<br/>15:15,22 17:6<br/>17:17 18:6<br/>20:4 21:11,22<br/>22:23 23:16<br/>24:2,12 25:14<br/>26:8,18 27:9<br/>27:19 28:1,22<br/>29:6,15 30:7<br/>30:17 31:23<br/>33:9,22 35:21<br/>36:4 37:24<br/>38:7,15 39:8<br/>39:23 40:12,25<br/>41:13 42:9,19<br/>43:16 44:7<br/>45:1,14 46:14<br/>48:10 49:6,18<br/>50:13 51:6,15<br/>52:1,19 53:9</p> | <p>53:24 55:18<br/>56:15 57:21<br/>58:23 59:15,24<br/>60:12,25 61:17<br/>61:24 62:17<br/>64:8 65:12,21<br/>66:3 67:14<br/>69:2,15,24<br/>70:15 71:4,16<br/>72:6 74:3 75:7<br/>76:5 77:14<br/>78:17 79:5<br/>80:15 81:19<br/>82:1,19 83:21<br/>85:11 87:16,25<br/>88:19 89:8,19<br/>90:7,17 91:2<br/>91:16,22 92:3<br/>92:13 93:6<br/>94:1,12,19<br/>96:4,19 97:13<br/>98:3,12 99:1<br/>100:15,25<br/>102:4,13<br/>103:11 104:1<br/>104:16 105:7<br/>106:1,17,20<br/>107:21 109:2<br/>111:6 112:14<br/>113:11,22<br/>114:16 117:11<br/>118:15 119:9<br/>119:21 120:14<br/>122:12 123:24<br/>124:19 125:6</p> |
| <p><b>w</b></p>                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <p><b>w</b> 114:9,19,22<br/>116:9 128:12<br/>128:14<br/><b>w2</b> 116:5<br/><b>waived</b> 160:24<br/>160:24<br/><b>waiving</b> 160:21<br/><b>walk</b> 109:6<br/><b>wall</b> 107:6<br/><b>want</b> 7:21,22<br/>17:25 19:13<br/>20:8,19 31:9<br/>48:13,16 53:9<br/>53:25 54:3<br/>58:5 63:4,5<br/>79:15,17,22<br/>84:20 90:19<br/>99:7 100:3<br/>115:22,25<br/>116:3 118:17<br/>120:7 126:14<br/>140:14 145:1<br/>150:13</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

[witness - zoom]

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 125:18 126:5<br>127:7,16<br>129:11,18<br>130:6 131:5<br>132:5 133:18<br>134:2,14<br>135:23 137:14<br>137:24 138:16<br>139:2,7 140:12<br>140:23 141:22<br>142:17,25<br>144:4 145:6,13<br>145:25 146:7<br>146:16 147:25<br>148:18 149:3<br>150:1,7,25<br>151:12,21<br>152:21 153:6<br>154:5,14<br>155:18 156:19<br>157:17,20,21<br>159:6,10,16<br>160:13,16<br>161:2,5<br><b>word</b> 131:22<br>137:24,25<br><b>words</b> 17:25<br>36:23 133:4<br><b>work</b> 41:16<br><b>working</b> 51:17<br>142:17<br><b>works</b> 140:7<br><b>world</b> 52:20<br><b>wrap</b> 146:2<br>150:6 | <b>write</b> 11:15<br>31:14 88:5<br>102:23 115:16<br><b>writes</b> 46:24<br>53:13 100:5<br>109:8 152:9<br><b>writing</b> 10:8<br><b>wrong</b> 47:13<br>99:9<br><b>x</b><br><b>x</b> 3:1 50:5,6,16<br>51:21 52:5,6<br>70:24 71:13<br>72:3 121:8<br><b>xx</b> 160:12<br><b>y</b><br><b>y</b> 121:9<br><b>yeah</b> 13:4<br>35:10 43:7<br>44:7 45:3 47:8<br>49:23 50:15,19<br>52:19 55:3<br>61:17 62:17<br>68:15 69:18<br>70:15 71:16<br>74:23 93:1<br>94:15 98:21<br>99:1 105:12<br>106:20 110:1<br>118:18 121:25<br>123:16,24<br>125:13 129:18<br>130:6 139:7<br>142:10 144:4 | 147:2 148:6<br>150:1 151:12<br>153:20 155:21<br><b>york</b> 2:14,14<br><b>z</b><br><b>zero</b> 49:12 54:1<br>54:13 55:11,20<br>55:22 56:2,16<br>57:10,13,25<br>58:25 59:1,4<br>60:6,8 61:1<br>64:3,5,9,21,23<br>64:25 65:19<br>71:2,12,13,21<br>72:3,4,14 95:3<br>111:22 114:9<br>125:22 126:7,8<br>126:12 128:13<br>129:15,16<br>139:19 140:8<br>140:20,24,25<br>141:2 142:1,4<br>142:5,8,11,12<br>142:22,25<br>143:7,13<br>146:12,25<br>147:3,22 148:4<br>148:7,9,13,23<br>150:2,2 151:23<br><b>zhou</b> 3:23 7:12<br>7:22,25 8:7,16<br>9:2 10:4,12,25<br>11:8,15,20,25<br>12:12 13:6,8<br>13:22 14:1,5 | 16:14 31:14<br>37:10 116:15<br>116:20,23,25<br>117:3,11,24<br>118:12 119:2,6<br>119:9,21<br>120:14,19,20<br>121:13,15<br>122:5,8,13<br>123:5,8,16,19<br>123:24 124:6<br>124:10 125:14<br>125:15,25<br>153:24<br><b>zhou's</b> 9:19<br>13:1,18 17:2<br><b>zoom</b> 2:12<br>28:13 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

California Code of Civil Procedure

Article 5. Transcript or Recording

Section 2025.520

(a) If the deposition testimony is stenographically recorded, the deposition officer shall send written notice to the deponent and to all parties attending the deposition when the Original transcript of the testimony for each session of the deposition is available for reading, correcting, and signing, unless the deponent and the attending parties agree on the record that the reading, correcting, and signing of the transcript of the testimony will be waived or that the reading, correcting, and signing of a transcript of the testimony will take place after the entire deposition has been concluded or at some other specific time.

(b) For 30 days following each notice under subdivision (a), unless the attending parties and the deponent agree on the record or otherwise in writing to a longer or shorter time period, the deponent may change the form or the substance of the answer to a question, and may either approve the transcript of the deposition by signing it, or

refuse to approve the transcript by not signing it.

(c) Alternatively, within this same period, the deponent may change the form or the substance of the answer to any question and may approve or refuse to approve the transcript by means of a letter to the deposition officer signed by the deponent which is mailed by certified or registered mail with return receipt requested. A copy of that letter shall be sent by first-class mail to all parties attending the deposition.

(d) For good cause shown, the court may shorten the 30-day period for making changes, approving, or refusing to approve the transcript.

(e) The deposition officer shall indicate on the original of the transcript, if the deponent has not already done so at the office of the deposition officer, any action taken by the deponent and indicate on the original of the transcript, the deponent's approval of, or failure or refusal to approve, the transcript. The deposition officer shall also notify in writing the parties attending the deposition of any changes which the deponent timely made in person.

(f) If the deponent fails or refuses to approve the transcript within the allotted period, the

deposition shall be given the same effect as though it had been approved, subject to any changes timely made by the deponent.

(g) Notwithstanding subdivision (f), on a seasonable motion to suppress the deposition, accompanied by a meet and confer declaration under Section 2016.040, the court may determine that the reasons given for the failure or refusal to approve the transcript require rejection of the deposition in whole or in part.

(h) The court shall impose a monetary sanction under Chapter 7 (commencing with Section 2023.010) against any party, person, or attorney who unsuccessfully makes or opposes a motion to suppress a deposition under this section, unless the court finds that the one subject to the sanction acted with substantial justification or that other circumstances make the imposition of the sanction unjust.

DISCLAIMER: THE FOREGOING CIVIL PROCEDURE RULES ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY. THE ABOVE RULES ARE CURRENT AS OF APRIL 1, 2019. PLEASE REFER TO THE APPLICABLE STATE RULES OF CIVIL PROCEDURE FOR UP-TO-DATE INFORMATION.

VERITEXT LEGAL SOLUTIONS

COMPANY CERTIFICATE AND DISCLOSURE STATEMENT

Veritext Legal Solutions represents that the foregoing transcript is a true, correct and complete transcript of the colloquies, questions and answers as submitted by the deposition officer. Veritext Legal Solutions further represents that the attached exhibits, if any, are true, correct and complete documents as submitted by the deposition officer and/or attorneys in relation to this deposition and that the documents were processed in accordance with our litigation support and production standards.

Veritext Legal Solutions is committed to maintaining the confidentiality of client and witness information, in accordance with the regulations promulgated under the Health Insurance Portability and Accountability Act (HIPAA), as amended with respect to protected health information and the Gramm-Leach-Bliley Act, as amended, with respect to Personally Identifiable Information (PII). Physical transcripts and exhibits are managed under strict facility and personnel access controls. Electronic files of documents are stored in encrypted form and are transmitted in an encrypted

fashion to authenticated parties who are permitted to access the material. Our data is hosted in SSAE 16 certified facilities.

Veritext Legal Solutions complies with all federal and State regulations with respect to the provision of deposition services, and maintains its neutrality and independence regardless of relationship or the financial outcome of any litigation. Veritext requires adherence to the foregoing professional and ethical standards from all of its subcontractors in their independent contractor agreements.

Inquiries about Veritext Legal Solutions' confidentiality and security policies and practices should be directed to Veritext's Client Services Associates indicated on the cover of this document or at [www.veritext.com](http://www.veritext.com).