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UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSARA INC.,	)	
	)	
Petitioner,	)	
	)	
VS.	)	Case IPR2025-00574
	)	Patent No. 11,875,580
MOTIVE TECHNOLOGIES, INC.,	)	
	)	
Patent Owner.	)	
_____	)	

IN-PERSON DEPOSITION OF
SCOTT ANDREWS
FRIDAY, JANUARY 16, 2026

STENOGRAPHIC REPORTER: CHRISTA YAN, CSR NO. 14316, RPR

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16 ALSO PRESENT PERSONALLY:

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18 ALSO PRESENT REMOTELY:

19 JASON EISENBERG, Sterne Kessler

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Transcript of Scott Andrews
Conducted on January 16, 2026

4

1 BE IT REMEMBERED that on FRIDAY, the 16TH DAY OF
2 JANUARY, 2026, at the hour of 8:58 a.m., Pacific Standard
3 Time, of said day, at 101 Second Street, Suite 2200, San
4 Francisco, California 94105, before me personally, CHRISTA
5 YAN, a Certified Shorthand Reporter, State of California,
6 personally appeared SCOTT ANDREWS, who was examined as a
7 witness in said cause; that said transcript format was
8 prepared in accordance with California Code of Regulations
9 Section 2473.

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1 MR. DUTTON: This is Tyler Dutton here on behalf of
2 Samsara Inc. from the law firm of Sterne Kessler Goldstein
3 & Fox. Can counsel for opposing party state their name
4 for the record.

5 MR. RIBERA: This is Hector Ribera from Marton Ribera
6 Schumann & Chang, and we represent the patent owner,
7 Motive Technologies.

8 SCOTT ANDREWS,
9 the Witness, called on behalf of Petitioner, being duly
10 sworn to state the truth, the whole truth, and nothing but
11 the truth, testified on oath as follows:

12 EXAMINATION

13 BY MR. DUTTON:

14 Q Good morning, Mr. Andrews.

15 A Good morning.

16 Q Can you please state your name for the record.

17 A Scott Andrews.

18 Q And have you been deposed before?

19 A Yes, I have.

20 Q About how many times?

21 A Probably in excess of 80.

22 Q Okay. So as you know, today my job is to ask
23 questions and your job is to answer questions to the best
24 of your ability and truthfully. Do you understand that?

25 A Yes, I do.

1 Q And we have a court reporter here transcribing
2 the questions and answers. So let's not try to talk over
3 one another. Is that fair?

4 A Sure.

5 Q And I'd like to keep your answers as audible
6 responses, no head nods and stuff like that so the record
7 can be clear. Is that fair?

8 A Yeah.

9 Q Today Motive's counsel may object to questions,
10 but you understand that you still have to answer the
11 questions unless instructed not to answer. Do you
12 understand that?

13 A I understand that.

14 Q And I'll plan to take breaks approximately every
15 hour or so. But if you need a break at a different time,
16 just let me know. The only thing I ask is that you finish
17 responding to a question if the question is pending; is
18 that fair?

19 A Yes.

20 Q Okay. This case involves a dispute between
21 Motive Technologies and Samsara. Do you understand that?

22 A Yes.

23 Q And this deposition relates to an inter partes
24 review of one of Motive's patents. Do you understand
25 that?

1 A Yes.

2 Q This is -- handing the witness an exhibit that
3 has been previously marked Exhibit 2003.

4 I'll give you a chance to review that.

5 A Okay.

6 Q Do you recognize this exhibit?

7 A Yes, I do.

8 Q What is it?

9 A This is the declaration I wrote in support of the
10 preliminary patent owner response.

11 Q Okay. And if you go to the last page, page 40,
12 is that your signature?

13 A Yes, it is.

14 Q Do you stand by the opinions in your declaration?

15 A I do. There's a later revised declaration that
16 came out after, I believe, the PTAB instituted the file,
17 but...

18 THE STENOGRAPHIC REPORTER: I'm sorry, the what
19 instituted the file?

20 THE WITNESS: PTAB, P-T-A-B.

21 THE STENOGRAPHIC REPORTER: Thank you.

22 BY MR. DUTTON:

23 Q Okay. But you still stand by the opinions in
24 this declaration as well?

25 A Yes.

1 Q Let's mark this exhibit as Deposition Exhibit 1.
2 (Whereupon Deposition Exhibit 1 was
3 marked for identification.)

4 BY MR. DUTTON:

5 Q And I'll represent, Mr. Andrews, that this is, I
6 believe, your revised declaration. Which was also marked
7 as Exhibit 2003 in the IPR record.

8 A That's correct.

9 Q And can you just confirm that this is the revised
10 declaration that you were referring to earlier?

11 A It appears to be, yes. It's got a section added
12 at the end of some additional analysis.

13 Q And if we, again, go to the last page, page 54.

14 A Okay. My signature.

15 Q Okay. And you stand by the opinions in that
16 declaration as well?

17 A Yes, I do.

18 Q I'm handing the witness another exhibit that has
19 been previously marked in the record as Exhibit 1001.

20 And let me know if you recognize that document?

21 A Yes, I do. This appears to be the '580 patent.

22 Q Okay. It's U.S. Patent Number 11,875,580?

23 A Correct.

24 Q And this is a Motive Technologies Inc. patent?

25 A That's correct.

1 Q Okay. In your own words, what is the invention
2 of the '580 patent all about?

3 A The invention of the '580 patent is fundamentally
4 about determining camera initialization parameters to
5 essentially calibrate a camera so that it can then be used
6 to detect objects and scenes in front of a vehicle in a
7 nutshell.

8 Q And part of the invention of the '580 patent is
9 to determine a horizon line in the field of view; is that
10 right?

11 A That is part of the process. You determine a
12 horizon line, and using the horizon line, you are then
13 able to determine a set of camera parameters which
14 typically, are kind of referred to as camera pose. So it
15 would be the angles of the camera, up, down, right, left,
16 tilt, et cetera, as well as the height.

17 Q Would those camera parameters include pitch?

18 A That would be up, down. Yes.

19 Q What about yaw?

20 THE STENOGRAPHIC REPORTER: What about what?

21 MR. DUTTON: Y-a-w, yaw.

22 THE WITNESS: Yaw would be right and left angle.

23 BY MR. DUTTON:

24 Q And roll?

25 A That would be tilt, right and left tilt.

1 Q So you agree that pitch, yaw, and roll are
2 examples of camera parameters?

3 A They're some examples, yes.

4 Q Okay. What are some other examples?

5 A The height of the camera above ground would be
6 another.

7 Q Any more?

8 A Well, I mean, there are lots of camera
9 parameters, but those are the ones that are of primary
10 interest in '580.

11 Q All right. And if we can go to Column 1 of the
12 '580 patent.

13 A Okay.

14 Q And starting on the paragraph at line 36. And
15 I'll give you a chance to read that, that paragraph there.

16 A I see that.

17 Q The second sentence states that, In this
18 embodiment, a server-side system receives a video
19 comprising a set of image frames and identifies one or
20 more lines in the video using predictive model, for
21 example, a convolutional neural network. Do you see that?

22 A It's in this paragraph?

23 Q Yeah, the line starting at Column 1, line 37.

24 A Yes, I see it.

25 Q And do you agree that convolutional neural

1 networks is an example of a predictive model?

2 A It's one example. There are many things that a
3 predictive model could be, but it certainly is one
4 example.

5 Q Okay. What is a convolutional neural network?

6 A A convolutional neural network is a -- it's hard
7 to describe. It's a network that takes a set of input
8 values representing some parameter. In this case, it
9 would be representing an image. And it multiplies those
10 parameters by some factors at one layer. And then it will
11 take the outputs of that and do the same thing, and you
12 may have multiple layers of hidden layers.

13 And at the end of the day, it's a tool for
14 classification. So it will -- you train the network on
15 examples of the thing that it's trying -- you're hoping to
16 train it to recognize and examples that are not the thing
17 you're hoping to recognize. And eventually, you arrive at
18 that set of weights and then -- when you're confident that
19 it is reasonably accurate at recognizing, then you can use
20 it to, you know, recognize lane lines or recognize T pots
21 [phonetic] or whatever it is you're training it to do.

22 Q And why is a convolutional neural network a
23 predictive model in the context of the '580 patent?

24 MR. RIBERA: Objection; vague, beyond the scope.

25 THE WITNESS: It's a term of art. That is -- it's a

1 term that is often applied to or predictive model is a
2 term that's often applied to models of this type because
3 they predict what an object is. I think I've always
4 thought prediction is a little odd as opposed to
5 recognition. But... but they are predicting, you know, a
6 line or predicting that the object in the scene is, you
7 know, a baseball or a school bus or whatever the neural
8 net has been trained to recognize.

9 BY MR. DUTTON:

10 Q And the '580 patent uses a predictive model to
11 identify lines for a vehicle?

12 A Yes.

13 Q Examples of those lines could be lane lines?

14 A I think it uses the predictive model to recognize
15 multiple different types of lines, including lane lines
16 and horizon lines.

17 Q And what's your understanding of what a
18 predictive model is in the context of the '580 patent?

19 A Well, they provide a lot of examples. But they
20 don't ever say specifically. From my reading of the '580
21 patent, what they basically say is that a predictive model
22 is a model that will recognize these lines without using a
23 geometric approach, and that's stated in a couple of
24 different places in the patent. They distinguish it as
25 being a different approach than using geometry.

1 Q Okay. So in your view, a predictive model in the
2 '580 patent is a model that does not use geometric
3 calculations; is that correct?

4 A It doesn't predict or recognize lines using
5 geometric calculations.

6 Q Is a predictive model -- if a model that
7 recognizes lines -- strike that.

8 Can a predictive model, in the context of the
9 '580 patent, use geometric calculations at all?

10 MR. RIBERA: Objection; vague.

11 THE WITNESS: I noticed that... it's a very broad
12 question. I'm trying to find in here the specific
13 description where it describes how it is not using
14 geometry.

15 It's my understanding that they are basically
16 saying that it does not use -- here's an example.
17 Column 7, line 14, Systems can use the illustrated neural
18 network in some embodiments instead of a geometric process
19 to determine lane and horizon lines.

20 So they're basically arguing or saying that using
21 this predictive model, they're not using a geometric
22 process. Whether that means that there are no geometric
23 calculations whatsoever, hard to say. I mean, there's --
24 at the end of the day, there's geometry in the image, and
25 so you are looking at a geometric thing. Whether you're

1 doing geometric calculations I think is sort of the
2 question.

3 I think they're distinguishing that you're not
4 using geometric calculations.

5 BY MR. DUTTON:

6 Q But you agree that in the '580 patent images,
7 that there would be geometry that would be taken into
8 account?

9 A Well, I mean --

10 MR. RIBERA: Objection; vague.

11 Give me a second.

12 THE WITNESS: A line is a geometric thing, right? So
13 yes. You're -- you are determining geometric objects in
14 the scene. But you're not calculating -- we're not
15 determining on using geometric or trigonometric type
16 calculations. And there's some examples that they talk
17 about of using geometric calculations in the Khan and Ali
18 references that are incorporated by reference.

19 BY MR. DUTTON:

20 Q If we go to Column 8 of the '580 patent, line 12.

21 A Okay.

22 Q The '580 patent states that, In other
23 embodiments, a geometric process can be performed to
24 identify lane and horizon lines, right?

25 A That's correct.

1 Q So the '580 patent recognizes that geometric
2 process can be performed in some embodiments, right?

3 A In some --

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: In some embodiments. And I read this to
6 be embodiments not incorporating a predictive model.

7 BY MR. DUTTON:

8 Q Was determining the horizon line relevant to the
9 inventors of the '580 patent?

10 MR. RIBERA: Objection; vague.

11 THE WITNESS: Yes. It seems to be an element of what
12 is claimed, and Claim 1 has identified one or more lines,
13 The one or more lines included in the horizon line. So
14 they're not just trying to detect or determine any lines
15 in the image that -- they're determining multiple types of
16 lines, one of which needs to be the horizon line.

17 BY MR. DUTTON:

18 Q Why would the system need to detect the horizon
19 line?

20 MR. RIBERA: Objection; vague.

21 THE WITNESS: The horizon line tells you -- allows you
22 to -- provides a frame of reference relative to the image
23 in a camera. So that you can then determine camera
24 parameters such as pitch, roll, height, yaw, et cetera.

25

1 BY MR. DUTTON:

2 Q And were there computer vision techniques that
3 already existed to determine horizon lines in images?

4 A There are.

5 Q At the time of the '580 patent filing date, were
6 there techniques in computer vision that existed to
7 determine horizon lines?

8 MR. RIBERA: Objection; vague.

9 THE WITNESS: They actually reference them, and I
10 talked about it a few minutes ago, the Khan and Ali. It's
11 really the Ali paper, describes a purely geometric
12 approach for estimating horizon line from lane lines.

13 BY MR. DUTTON:

14 Q But so the inventors of the '580 patent would
15 have understood that there were techniques in computer
16 vision that existed prior to their patent that would
17 determine the horizon line?

18 MR. RIBERA: Objection; calls for speculation.

19 THE WITNESS: They provide a couple of examples, and
20 specifically, the Ali example of a geometric approach for
21 determining a horizon line. And that existed prior to
22 this patent.

23 BY MR. DUTTON:

24 Q And we refer to convolutional neural networks
25 previously. If I refer to that as a CNN; is that fair?

1 A Yes.

2 Q And were CNNs relevant to -- would a CNN be
3 relevant to the industry at the time of this invention?

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: Well, a CNN is one type of tool that can
6 be used to recognize features in an image. So yeah, could
7 be relevant.

8 BY MR. DUTTON:

9 Q And at the time of the invention, would -- strike
10 that.

11 If we turn to your declaration just real quick.

12 A Which one?

13 Q Deposition Exhibit 1.

14 If we go to paragraph 32.

15 A Okay.

16 Q And here, you state that you, Have read the
17 claims from the perspective of a person of ordinary skill
18 in the art at the time of the invention. Right?

19 A Yes.

20 Q Would a person of ordinary skill in the art at
21 the time of the invention know that CNNs were a computer
22 vision technique to determine lines and features and
23 images?

24 MR. RIBERA: Objection; vague.

25 THE WITNESS: By 2021, yes.

1 BY MR. DUTTON:

2 Q And would a person of ordinary skill in the art
3 at the time of the invention know that the CNN could
4 determine a horizon line in isolation of geometric
5 approaches at the time of the invention?

6 MR. RIBERA: Objection; vague.

7 THE WITNESS: They might. Would depend on what the
8 applications of neural networks had been of CNNs. You
9 know, there's CNNs that are used to recognize faces, CNNs
10 that are used to recognize vehicles.

11 So depending on what you -- what you train the
12 CNN on and how distinct the feature or features are in the
13 thing you're training it on, and what your experience as a
14 person of skill in the art would have been in terms of the
15 kinds of things you have trained CNNs on, you might or
16 might not have any understanding of using or might or
17 might not recognize that it could be used to determine a
18 horizon line.

19 Horizon line is very challenging because quite
20 often it is not obvious. You're not always driving on a
21 straight road in the desert. So...

22 BY MR. DUTTON:

23 Q Well, would a CNN that determined a horizon line
24 in isolation of geometric approaches be relevant to a
25 person of ordinary skill in the art at the time of the

1 '580 patent's invention?

2 MR. RIBERA: Objection; vague.

3 THE WITNESS: Can you read that question back?

4 (Record read.)

5 THE WITNESS: You say in isolation of geometric
6 approaches. I'm not sure if I understand what that means.
7 BY MR. DUTTON:

8 Q So you said earlier that the predictive models in
9 the '580 patent that are claimed don't use geometric
10 approach -- approaches. Is that...

11 A That's correct.

12 Q And would a -- then with that understanding, I'll
13 ask the question again.

14 Would a CNN that determined a horizon line in
15 isolation of geometric approaches be relevant to a person
16 of ordinary skill in the art at the time of the '580
17 patent's invention?

18 MR. RIBERA: Objection; vague and beyond the scope of
19 direct.

20 THE STENOGRAPHIC REPORTER: I'm sorry, you said vague
21 what?

22 MR. RIBERA: Beyond the scope of direct.

23 THE WITNESS: I don't know what you mean in isolation
24 of geometric approaches. It's a very strange way of
25 phrasing that. I -- you know, if you want to ask if it

1 would be understood that it could be used to determine a
2 horizon line without using geometric calculations, then I
3 would...

4 BY MR. DUTTON:

5 Q Okay. So would a CNN that determined a horizon
6 line without using geometric calculations be relevant to a
7 person of ordinary skill in the art at the time of the
8 '580 patent's invention?

9 MR. RIBERA: Objection; vague.

10 THE WITNESS: Hard to say. I mean, a person of skill
11 in the art -- an example of a person of skill in the art
12 is Choe, who uses a geometric method for determining those
13 lines.

14 THE STENOGRAPHIC REPORTER: You said Choe?

15 THE WITNESS: Yeah, C-h-o-e.

16 So it would really depend on the background and
17 the focus of the person of skill in the art because there
18 are many examples of determining horizon lines using
19 geometric approaches including Ali. And those are all
20 people of skill in the art. So it might be relevant, but
21 it might also not be relevant because they might have an
22 alternative that would be just as effective.

23 BY MR. DUTTON:

24 Q Okay. So how about the inventors of the '580
25 patent, would a CNN that determined a horizon line without

1 using geometric calculations be relevant to the inventors
2 of the '580 patent when developing the invention of the
3 '580 patent?

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: I don't know what they would have
6 thought. They certainly do describe using a CNN to
7 determine horizon line. So I would say they -- a portion
8 of their invention is that. Or it's using what they call
9 a predictive model, one example of which is a CNN.

10 So I -- you know, clearly, I think they would
11 have been -- they -- they contemplated that. Whether it
12 would be relevant to any person of skill in the art is
13 hard to say.

14 BY MR. DUTTON:

15 Q Okay. So the inventors of the '580 patent would
16 have contemplated CNNs that determined horizon lines
17 without geometric calculations when developing the
18 invention of the '580 patent?

19 MR. RIBERA: Objection; vague.

20 THE WITNESS: It's hard for me to know what they
21 contemplated. But I know what they described. And what
22 they described is the use of predictive models, such as a
23 CNN or various other kinds of predictive models to
24 determine horizon lines without using geometric
25 calculations.

1 BY MR. DUTTON:

2 Q Okay. In your view, if a model performed
3 geometric calculations, would it be a predictive model?

4 MR. RIBERA: Objection; vague, beyond the scope.

5 THE WITNESS: In the context of the '580 patent and
6 the way they used the term predictive model, they
7 specifically say that it is not using geometric
8 calculations. You know, somebody else might use that term
9 in a different way and would say they're predicting things
10 and they can use whatever models they want.

11 But I think the '580 patent is pretty clear that
12 they're distinguishing geometric calculations from the --
13 as being different from the operation of the predictive
14 model.

15 BY MR. DUTTON:

16 Q So in your view, the '580 patent is clear that if
17 you use geometric calculations to determine the lane or
18 horizon lines, you are not using a predictive model?

19 MR. RIBERA: Objection; vague, misstates the
20 testimony.

21 THE WITNESS: I'm just going to go here and find the
22 statement.

23 Would have been faster if I had a copy with my
24 highlighting in it. Well, one place they talk about it is
25 Column 8, beginning --

1 THE STENOGRAPHIC REPORTER: I'm sorry, is where?

2 THE WITNESS: Column 8, beginning at line 7. They
3 talk about using a neural net to predict, which is their
4 predictive model, to predict lane and horizon key points
5 in an embodiment -- I'm going to quote now, In an
6 embodiment, the neural network is trained to predict lane
7 and horizon key points.

8 During testing, image frames are fitted with lane
9 lines and horizon lanes, lines... based on estimated key
10 points. As described in some embodiments, human
11 annotators can be used to perform this fitting.

12 THE STENOGRAPHIC REPORTER: Sorry, you said human.
13 It's hard to hear you. I'm sorry.

14 THE WITNESS: Sorry. Human annotators can be used to
15 perform this fitting as described in the description of
16 Figure 2. In other embodiments, a geometric process can
17 be performed to identify lane and horizon lines.

18 And then later, they say pretty much the same
19 thing. They say that it reads -- here it is, Column 8,
20 beginning around line 43, That is, since the model is
21 capable -- and this is the predictive model -- Is capable
22 of predicting the horizon line directly, previous
23 requirements of having three lane lines in the frame,
24 e.g., to geometrically calculate horizon line, can be
25 relaxed.

1 So they're saying that by using this predictive
2 model, you do not need to have three lines. And you do
3 not need to be using three lines -- you can use a
4 geometric process to determine what the horizon line is.
5 So at least a couple of places in here where they
6 explicitly describe the fact that the use of the
7 predictive model relieves or removes the need for
8 performing a geometric process to determine a horizon
9 line.

10 BY MR. DUTTON:

11 Q So in your view, the '580 patent is clear that if
12 you use geometric calculations to determine the lane or
13 horizon lines, you are not using a predictive model; is
14 that correct?

15 MR. RIBERA: Objection; vague, misstates the
16 testimony.

17 THE WITNESS: They don't say it quite that way. What
18 they say is that using the predictive model, you do not
19 need to perform the geometric calculations. Now, somebody
20 might choose to perform some geometric calculations in
21 addition, but you -- the predictive model performs that
22 determination of a horizon line without performing
23 geometric calculations.

24 BY MR. DUTTON:

25 Q So in the '580 patent, would a model that

1 determines some -- that determines lane and horizon lines
2 using some geometric calculations be a predictive model?

3 MR. RIBERA: Objection; vague, beyond the scope.

4 THE WITNESS: Yeah, I don't think I have really
5 analyzed that question or tried to analyze that question.
6 What I know is that the patent is explicit that using the
7 predictive model, you can determine the horizon line
8 without performing a geometric process.

9 You may, in some other operations, perform
10 geometric processes, but in specifically, in determining
11 the horizon line, you don't have to use a geometric
12 process. And I think a lot of this is related, certainly,
13 the section I read in Column 8, around line 43 is the
14 method of Ali, which is referenced here as a geometric
15 process, requires having three lines in the image that are
16 related to the direction of travel.

17 So you have to have obviously your two lane lines
18 but some other line that's also parallel to those. And
19 they describe -- in Ali, they describe a purely geometric
20 process for then determining what they call lateral
21 vanishing points and forward vanishing points. And when
22 they do that, they then have three points roughly that --
23 through which a horizon line would pass.

24 And so that's the method -- that's the geometric
25 method for calculating a horizon line. And they're

1 describing here that you don't have to use that method and
2 that the -- somewhere else in the patent, they describe
3 that it will operate -- because of that, it will operate
4 just with having two lane lines instead of three.

5 BY MR. DUTTON:

6 Q And isn't that true that Khan can work when only
7 two visible lane lines are present?

8 THE STENOGRAPHIC REPORTER: Lane lines, what was that?

9 MR. DUTTON: Are present.

10 THE WITNESS: I'd have to go back and review which
11 part of Khan actually talks about two lane lines. But the
12 method -- Khan doesn't really describe much about
13 determining the horizon line. What he does is describes
14 that Ali describes it. And then you go back to Ali, and
15 that's the method with three lines.

16 So I'm sure Khan can perform some operations with
17 only two lane lines, but I don't recall that he performs a
18 horizon line calculation with only two lane lines.

19 BY MR. DUTTON:

20 Q Okay. Handing the witness what has been
21 previously marked as Exhibit 1007.

22 Do you recognize this document?

23 A I do.

24 Q What is this document?

25 A I think this is the Khan reference. Yes, it is.

1 Q And I'll -- you reference that Khan and Ali work
2 together; is that fair?

3 A Yeah, that's true.

4 Q I'll hand you what's been previously marked as
5 Exhibit 1008. And what is this exhibit?

6 A This is what we referred to as the Ali exhibit.

7 Q Okay. You don't dispute that Khan and Ali are
8 prior art to the '580 patent, right?

9 A No. They are actually incorporated by reference
10 in the provisional, I believe.

11 Q Is it your view that you can't incorporate by
12 reference prior art into the --

13 THE STENOGRAPHIC REPORTER: Sorry, I can't hear you.
14 BY MR. DUTTON:

15 Q Is it your understanding that you can't
16 incorporate by reference prior art into a patent?

17 MR. RIBERA: Objection; vague.

18 THE WITNESS: I don't know. That's a legal question.
19 I'd have to better understand that. I know that quite
20 often, prior art is provided as examples in patents.
21 So...

22 BY MR. DUTTON:

23 Q And you don't dispute in this case that Khan and
24 Ali are prior art to the '580 patent, right?

25 A I believe they are.

1 Q They are prior art to the '580 patent?

2 A Yes.

3 Q Okay. And both Khan and Ali were published in
4 2020?

5 A That's correct.

6 Q Can we agree that Khan uses a predictive model?

7 MR. RIBERA: Objection; vague, beyond the scope.

8 THE WITNESS: Khan describes using a convolutional
9 neural network to detect lane lines.

10 BY MR. DUTTON:

11 Q So you agree that Khan uses a predictive model to
12 detect lane lines?

13 MR. RIBERA: Objection; vague, misstates testimony.

14 THE WITNESS: The -- Khan, I don't know whether Khan
15 uses the term predictive model. So I don't know if I can
16 answer definitively what Khan says about predictive
17 models. I didn't study Khan to determine that. But I do
18 know that the '580 patent uses CNNs as one example of a
19 predictive model as that term is used in the '580 patent.

20 BY MR. DUTTON:

21 Q Okay. So we agree that a CNN is a predictive
22 model as referred to in the '580 patent, right?

23 A It's an example of a predictive model. Yes.

24 Q And you agree that Khan discloses a CNN to detect
25 key points and markers for lane lines, right?

1 A Correct.

2 Q So do you agree that Khan discloses a predictive
3 model to detect lane lines?

4 MR. RIBERA: Objection; vague, misstates the
5 testimony.

6 THE WITNESS: Well, I can take the time to see if Khan
7 uses the term predictive model. But the faster way of
8 answering that is that I don't believe -- I have not
9 studied Khan to determine if he uses the term predictive
10 model.

11 BY MR. DUTTON:

12 Q Have you studied Khan to determine whether Khan
13 discloses a predictive model?

14 A I have not looked at Khan to determine if he uses
15 that term. I can do that now.

16 Q That's not my question.

17 Have you studied Khan to determine whether it
18 discloses a predictive model?

19 A I have not tried to determine what a predictive
20 model is outside of the '580 patent. That's a term that's
21 used in the '580 patent, and it's described in the '580
22 patent with multiple examples. And I did not seek to see
23 how that term is used in other references.

24 Q So you haven't looked at Khan to determine
25 whether it discloses a predictive model, as that term is

1 used in the '580 patent?

2 MR. RIBERA: Objection; vague, misstates the
3 testimony.

4 THE WITNESS: I have looked at Khan... I have not
5 looked at Khan to see if he uses the term predictive
6 model. I know that he uses a CNN. And I know that a CNN
7 is provided in the '580 patent as an example of a
8 predictive model.

9 I don't know whether -- I didn't review Khan
10 to -- I certainly don't recall whether he actually uses
11 the term predictive model.

12 BY MR. DUTTON:

13 Q Would a person of ordinary skill in the art
14 regain Khan's disclosure about its CNN understand that to
15 be a predictive model as that term is used in the '580
16 patent?

17 THE WITNESS: I think they would understand that it
18 is -- that CNN is an example of a predictive model. As
19 it's used in the '580 patent.

20 BY MR. DUTTON:

21 Q And when you say that CNN, a person of ordinary
22 skill in the art would have understood that Khan's CNN is
23 an example of the predictive model as that term is used in
24 the '580 patent?

25 MR. RIBERA: Objection; vague.

1 THE WITNESS: Khan's example -- or Khan references a
2 CNN. And a CNN is used as an example in the '580 patent
3 as an example of -- one example of a predictive model.

4 BY MR. DUTTON:

5 Q Right. So a person of ordinary skill in the art
6 would have understood that Khan's CNN would be a
7 predictive model as that term is used in the '580 patent,
8 right?

9 A It's an example of a predictive model. It's not
10 the only example.

11 Q I -- understood.

12 It's not the only example of predictive model,
13 but a person of ordinary skill in the art would have
14 understood that Khan's CNN is an example of a predictive
15 model as that term is used in the '580 patent, right?

16 MR. RIBERA: Objection; vague.

17 THE WITNESS: I think that they would have understood
18 that a CNN, if they had read the '580 patent and
19 understood how the '580 patent described its predictive
20 model, they would understand that Khan's CNN is an example
21 of a predictive model.

22 BY MR. DUTTON:

23 Q Okay. And Khan uses that example of a predictive
24 model to determine lane lines, right?

25 A That's my understanding, yes.

1 Q And that predictive model example to detect lane
2 lines is shown in Figure 2 of the Khan reference; is that
3 right?

4 A Yeah, these are key points. But I think you
5 would then link together the key points to define a line.

6 Q So do you agree that Figure 2 shows an example of
7 a predictive model to determine one or more lane lines?

8 MR. RIBERA: Objection; vague.

9 THE WITNESS: Figure 2 --

10 BY MR. DUTTON:

11 Q Of Khan?

12 A -- of Khan, shows an example of -- or Khan's
13 example of a CNN.

14 Q Okay. And Khan's Figure 2 refers to an encoder
15 network and a decoder network. Do you see that?

16 A Yes.

17 Q Is the encoder a backbone of a predictive model?

18 MR. RIBERA: Objection; vague.

19 THE WITNESS: I'd have to review Khan to see how he
20 uses that term.

21 BY MR. DUTTON:

22 Q What's your understanding of a backbone of the
23 predictive model like a CNN?

24 A It is kind of the main -- is the main components
25 of -- it is -- it's the component of the CNN, which

1 accumulates and processes inputs.

2 Q And it is used for feature extraction?

3 A Among other things, yes.

4 Q Okay. And is the encoder network of Khan's CNN
5 used in that fashion, as a backbone?

6 MR. RIBERA: Objection; vague. Beyond the scope.

7 THE STENOGRAPHIC REPORTER: I'm sorry, I didn't hear
8 that part.

9 MR. RIBERA: Beyond the scope.

10 THE STENOGRAPHIC REPORTER: Thank you.

11 BY MR. DUTTON:

12 Q If you turn to page 1826.

13 A I'm almost there.

14 Q So sentence here (indicating) might be helpful.

15 A So they are saying here -- this is on page 1826,
16 left column -- that they use ResNet-50 architecture 13 as
17 a backbone for information encoding. And that is the
18 generically shown in Figure 2 as an encoder network. They
19 don't specifically say that what's shown in Figure 2 is
20 the backbone.

21 But it's implied that they're using an encoding
22 network, a third-party encoding network, as the backbone.

23 Q And in CNN, a person of ordinary skill in the art
24 would have understood that like decoder is typically
25 referred to as the head?

1 A Yes.

2 Q So the Figure 2 model shows a backbone and a
3 head?

4 A In a generic sense, yes.

5 Q And again, that model is used to determine one or
6 more lane lines?

7 A Yes --

8 MR. RIBERA: Objection; vague.

9 THE WITNESS: -- it is used to determine lane lines,
10 yes.

11 BY MR. DUTTON:

12 Q Okay. If we go to Figure 3 of Khan, there's a
13 box in the upper left titled, Lane Boundary Marker
14 Detection. Do you see that?

15 A Yes.

16 Q Do you understand that the model in Figure 2
17 would be located at that part of the process flow in
18 Figure 3?

19 A That's my understanding. Yes. Video frames are
20 applied to it. There's a lot going on in the lane
21 boundary marker detection box, but yes.

22 Q Okay. And then earlier, you referred to the '580
23 patent saying that it can relax the requirement of having
24 more than two lane lines, right?

25 MR. RIBERA: Objection; vague.

1 THE WITNESS: That's correct.

2 BY MR. DUTTON:

3 Q Okay. And if we go to Section 3.3.2 of Khan,
4 Khan also is able to detect missing lane boundaries,
5 right?

6 MR. RIBERA: Objection; vague.

7 THE WITNESS: So detect a weak or missing lane
8 boundaries, yes, so gaps in the lane lines for example.

9 BY MR. DUTTON:

10 Q And missing lane boundary would be a missing lane
11 line, right?

12 MR. RIBERA: Objection; vague.

13 THE WITNESS: I don't know if there was a completely
14 missing lane line, that Khan would have any ability to
15 deal with that. So I don't think -- when they talk about
16 a missing lane boundary, I think this is... let me see
17 what they say on it.

18 Okay, so your question was?

19 BY MR. DUTTON:

20 Q Missing lane boundary would be an example of a
21 missing lane line, right?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: It means that there is not enough
24 feature definition to -- for the CNN to detect the lane
25 line. And from what I understand with Khan, what he is

1 actually doing is using the detected lane lines together
2 with the width of the lanes in order to calculate, for
3 example, if I know that the lanes are a given width, but I
4 have a larger road, then I can use one of the lane lines
5 to infer geometrically where the center lines that would
6 be in the road.

7 BY MR. DUTTON:

8 Q But you agree that Khan's CNN model would be able
9 to remove the requirement of having three properly defined
10 lines on the road, right?

11 MR. RIBERA: Objection; vague, misstates the
12 testimony.

13 THE WITNESS: I think it's important to recognize
14 here -- I'd say no. It removes the requirement of having
15 the CNN recognize three lines. If you go to -- in Khan,
16 if you go to 2.3.1, which is the top of -- the part that's
17 relevant is the top left column of 18 -- page 1827.

18 BY MR. DUTTON:

19 Q Sorry, which section?

20 A 3.2.1. It says -- I'll start at the bottom of
21 page 1826 -- Critical part of initialization is the
22 estimation of vanishing line, horizon, from these lines.
23 These lines being the lane lines. This requires two sets
24 of vanishing points, VPs, forward and lateral VPs.
25 Forward VPs can be found from the cross product of the

1 world parallel lines, whereas the process of finding
2 lateral vanishing point is a bit involved.

3 So the forward vanishing point is -- if you have
4 defined some lane lines, it's where those lane lines
5 touch.

6 Q Okay. You can determine the forward vanishing
7 point with two lane lines, right?

8 A Correct. The -- they then say you have to use a
9 cross ratio of three world parallel lines, which are the
10 lane lines as used by Ali. And so the whole process here
11 in Khan of interpolating, if you will, the missing lines
12 is done so that you will have three lines. One of them is
13 a synthetic line determined geometrically.

14 So that you can then use the process of Ali as
15 described at the top of page 1827. And Ali is a geometric
16 process that requires a minimum of three lines.

17 Q And when you say synthetic line, you mean that
18 the line isn't visible on the image, right?

19 A It's not visible on the image, and as a result,
20 the CNN does not detect that line. But because of the
21 geometry of the road, you know that the road is wider than
22 a lane width. And then using that with the equation shown
23 on page 1827, Equations 2 and 3, you can then infer a
24 missing boundary and essentially, a missing lane line so
25 that you then have three lines.

1 You've got the far edge of the road. You've got
2 the right edge of the road. They're too far apart. You
3 can draw a line down the middle. That's what I mean by
4 synthetic line. It's not recognized by the CNN. And now
5 you have three lines, and now you can go and apply the
6 geometric process of Ali to determine the lateral
7 vanishing points.

8 Q So are you saying that the CNN in Khan uses
9 geometric processing to create a third lane line if one's
10 missing?

11 MR. RIBERA: Objection; misstates the testimony.

12 THE WITNESS: No. I'm saying that -- exactly not
13 that. The CNN will recognize features in the image. And
14 those features will be, say, two lane boundaries. And
15 Khan says that if you don't have at least two lane
16 boundaries, they just discard the whole thing. So you
17 have to have two boundaries that are recognized.

18 BY MR. DUTTON:

19 Q Where does Khan say that it's going to discard
20 the whole thing if there's...

21 A See, 3.3.1, page 1827 at the last sentence, At
22 less than two lines or curbs, the frame is ignored. So
23 the CNN will recognize, at a minimum, right and left
24 boundaries of a road. You may not have a lane line down
25 the middle, but it will recognize right and left

1 boundaries of the road. If it doesn't, if it can only
2 recognize one, then they just discard the frame because
3 there's not enough information to do anything with.

4 If they have right and left boundaries, then
5 using a geometric calculation, not the CNN, in
6 paragraph -- Equations 2 and 3, then they can calculate an
7 inferred lane line between the right and left boundaries
8 so that now they have three lines, and now they can go and
9 use Ali's three line geometric approach to determine a
10 horizon line.

11 Q But Khan would still work if there's only two
12 lane lines because it would determine the third lane line
13 you're saying, that detecting weak or missing boundaries
14 equations, right?

15 MR. RIBERA: Objection; vague.

16 THE WITNESS: They would be detecting -- I don't know
17 what you mean by work, but Khan, if it is missing a lane
18 boundary as right and left road edge boundaries, for
19 example, it can infer geometrically a centerline. And now
20 it has three lines which it can then use to geometrically
21 calculate the lateral vanishing points and from those
22 lateral vanishing points determine a horizon line. All
23 geometrically.

24 BY MR. DUTTON:

25 Q So Khan and Ali's algorithms will still function

1 if there are only two lane lines on the image, right?

2 MR. RIBERA: Objection; vague.

3 THE WITNESS: If there are only two lane lines on the
4 image, then Khan has a process for synthetically
5 estimating a third lane line. Ali cannot do anything
6 without three lane lines.

7 BY MR. DUTTON:

8 Q All right. And if we go to Figure 3, the lane
9 boundary marker detection occurs before the horizon
10 estimation, right?

11 A That's correct.

12 Q And so the two lane lines plus the synthetic
13 third lane line would then get input into the horizon
14 estimation, right?

15 MR. RIBERA: Objection; vague.

16 THE WITNESS: If you're using the Ali geometric
17 method, then you would have an additional box or an
18 additional step. So the lane boundary marker detection
19 step in Figure 3 would include two processes. One of them
20 would be using Khan's CNN to determine at least two lane
21 lines. If there were three that were determined, then
22 you'd go directly into Ali's geometric approach.

23 If there were only two that were determined, then
24 you would have to use a different geometric approach to
25 infer a third line.

1 BY MR. DUTTON:

2 Q And Khan discloses how you would use that
3 approach to infer a third line in Section 3.3.2, right?

4 A Yes.

5 Q And so if Ali's horizon estimation requires the
6 three lane lines, that synthetic line determination would
7 occur before the horizon estimation, right?

8 A Yes.

9 Q Okay. And those two lane lines and then the
10 third synthetically created lane line would then be input
11 into the horizon estimation algorithm of Ali, right?

12 THE STENOGRAPHIC REPORTER: I'm sorry, input into the
13 what?

14 MR. DUTTON: The horizon estimation algorithm of Ali.

15 THE WITNESS: Yes.

16 BY MR. DUTTON:

17 Q Okay. Now would be a good time for a short
18 break, if...

19 A Okay.

20 (Recess taken.)

21 BY MR. DUTTON:

22 Q All right. So going back to Figure 3 of Khan,
23 you agree that the horizon estimation box uses Ali's
24 horizon estimation algorithm, right?

25 MR. RIBERA: Objection; vague.

1 THE WITNESS: Well, they reference -- they don't
2 provide a -- they don't provide a separate algorithm or
3 explanation for estimating the horizon. They just refer
4 to Ali.

5 BY MR. DUTTON:

6 Q They being Khan?

7 A Khan. I imagine that, you know, someone could
8 choose to do -- use a different algorithm. The Khan
9 algorithm is actually derived from a textbook. So it's a
10 fairly well-known geometric algorithm.

11 Q The...

12 A The Ali algorithm.

13 Q So the Ali algorithm is derived from a textbook
14 that was well-known?

15 A Yes. Yes.

16 Q Which textbook is that?

17 A It was Hartley and Zisserman, Chapter 2. They
18 claim. But it's actually Chapter 8. Reference 14, more
19 single view geometry --

20 THE STENOGRAPHIC REPORTER: I'm sorry, could you speak
21 up?

22 THE WITNESS: More single view geometry, in multiple
23 view geometry in computer vision Chapter 8. Which really
24 just describes the mathematics of the cross ratios that
25 Ali talks about.

1 BY MR. DUTTON:

2 Q And that textbook is Reference 14 in Ali?

3 A Correct. They incorrectly reference Chapter 2 in
4 the text. But in the references, they correctly reference
5 Chapter 8. But the whole discussion in Figure 5 is
6 actually talked about in more detail in Hartley and
7 whatever his name is... Zisserman.

8 Q All right. So Ali shows the horizon estimation
9 algorithm on page 1104 at Algorithm 1, right?

10 A Yes. I mean, they certainly talk about it. They
11 don't -- it's not very informative. I had to go read
12 Hartley and Zisserman to understand what they were doing,
13 but...

14 Q Okay. And kind of the pseudocode that's shown in
15 Ali shows that the input is the detected markers by lane
16 detector, right?

17 A Yes.

18 Q So if Khan is using Algorithm 1 in Ali,
19 Algorithm 1 would use the output of the CNN lane detection
20 algorithm, right?

21 MR. RIBERA: Objection; vague.

22 THE WITNESS: It would use the -- it would use the
23 three lane lines that are detected either using the CNN in
24 Khan, or using a combination of the CNN in Khan and the
25 lane -- missing lane synthesis process also described in

1 Khan.

2 BY MR. DUTTON:

3 Q Okay. So Ali would use either the CNN of Khan or
4 the CNN plus the missing boundary approach of Khan; is
5 that right?

6 MR. RIBERA: Objection; vague, misstates the
7 testimony.

8 THE WITNESS: I think that is a reasonable
9 characterization, yes. They would use either the lane
10 lines, either three lines if it -- or identified by the
11 CNN, or if three lines were not identified by the CNN,
12 then they would fill in at least one line.

13 BY MR. DUTTON:

14 Q Okay. So just to be clear, Algorithm 1 of Khan
15 would use either the CNN -- sorry, strike that.

16 To be clear, Algorithm 1 of Ali would use the CNN
17 of Khan or the CNN of Khan plus the missing boundaries
18 approach of Khan, right?

19 MR. RIBERA: Objection; vague, misstates the witness.

20 THE WITNESS: Could you read that back?

21 (Record read.)

22 THE WITNESS: Yes.

23 BY MR. DUTTON:

24 Q Okay. So if Algorithm 1 is using the CNN model
25 of Khan with only two lane lines, it would determine the

1 forward vanishing point, right?

2 MR. RIBERA: Objection; vague.

3 THE WITNESS: It could.

4 BY MR. DUTTON:

5 Q So in Algorithm 1 of Ali, it refers to a variable
6 B, right?

7 A Yes.

8 Q And B equals then the number of lines?

9 A Yes.

10 Q And if B is equal to or greater than 2, then it
11 will determine the forward vanishing point, right?

12 A Correct.

13 Q Is the forward vanishing point a horizon line?

14 A No.

15 Q Okay. And why is that?

16 A Because the forward vanishing point is only a
17 single point on a line. So the horizon line could be
18 tilted in any direction around that point. That's why you
19 need lateral vanishing points.

20 Q Okay. If you just drew a horizontal line on the
21 forward vanishing point, would that be a horizon line?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: Do you know what horizontal is?

24 BY MR. DUTTON:

25 Q Horizontal to the image.

1 A It would be a candidate horizontal or horizon
2 line. But it isn't the horizon line.

3 Q Okay.

4 A Which is exactly what Choe does.

5 Q We can talk about Choe later.

6 But going back to Ali's Algorithm 1, Ali's
7 horizon detection would determine the forward vanishing
8 point if there were only two lane lines, right?

9 MR. RIBERA: Objection; vague.

10 THE WITNESS: It could determine the forward vanishing
11 point from two lane lines.

12 BY MR. DUTTON:

13 Q Okay. And it would also determine the forward
14 vanishing point if there were three lane lines, right?

15 A Correct.

16 Q And if there were greater than or equal to three
17 lane lines, Ali's algorithm would also determine the
18 lateral vanishing point, right?

19 A It would -- it would determine at least one
20 lateral vanishing point.

21 Q And so if there were two real lane lines in the
22 image and one synthetically created lane line, would Ali's
23 Algorithm 1 determine both the forward vanishing point and
24 the lateral vanishing point?

25 A Yes.

1 Q Okay. So in Khan and Ali, you don't actually
2 need three lane lines visible on the image to determine
3 the horizon line, right?

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: In the image that you are inputting to
6 the CNN, you do not need to have all three lines visible.
7 But in order to determine the vanishing point, you have to
8 create a third line. Which is what Khan describes.

9 BY MR. DUTTON:

10 Q So Khan and Ali would determine the horizon line
11 if only two lane lines were visible on the input image to
12 the CNN predictive model, right?

13 MR. RIBERA: Objection; vague.

14 THE WITNESS: They would determine a horizon line if
15 only two lines were visible on the image and they
16 synthetically derived a third line.

17 BY MR. DUTTON:

18 Q And Khan describes how it synthetically derives a
19 third line when that's the case, right?

20 A Yes.

21 Q Okay. Ali's Algorithm 1 then refers to something
22 called RANSAC, R-A-N-S-A-C, all capitalized.

23 A Right.

24 Q What's your understanding of what RANSAC is?

25 A My understanding of RANSAC is essentially an

1 algorithm for fitting a line to a series of points in such
2 a way --

3 THE STENOGRAPHIC REPORTER: Series of what?

4 THE WITNESS: To a series of points in such a way that
5 there are a minimum number of outlier points that are not
6 on the line.

7 BY MR. DUTTON:

8 Q And which points is Ali's Algorithm 1 fitting the
9 line to?

10 A It would be the forward and lateral vanishing
11 points. So if you have, for example, a series of images
12 and you've got kind of a scatter of points for the forward
13 point and two scatters of points on the right and left for
14 the lateral points, then you were going to try to fit a
15 line that best fits that set of points with the minimum
16 number of outliers.

17 Q Understood.

18 And so when you talk about a series of images,
19 you're referring to the image frames of the video?

20 MR. RIBERA: Objection; vague.

21 THE WITNESS: You could be.

22 BY MR. DUTTON:

23 Q In Ali, it refers to frames in a video, right?

24 A Yes. I believe it does. And that would give you
25 multiple examples of forward and lateral vanishing points.

1 Q So in Ali's Algorithm 1, it's fitting a horizon
2 line to the forward and lateral vanishing points of the
3 image frames within a video, right?

4 A That's my understanding, yes.

5 Q Okay. All right. If we go back to Figure 3 of
6 Khan.

7 A Okay.

8 Q After the horizon estimation, there's a step
9 called IPM computation. Do you see that?

10 A Yes.

11 Q And what's your understanding of that step?

12 A That is an inverse perspective mapping, and
13 essentially, it allows you to -- once you have determined
14 the -- what's known as the pose of the camera, which is
15 really the rotation, pitch, and yaw of the camera, or I
16 guess tilt, pitch, and yaw of the camera, as well as the
17 height of the camera, then you are able to take an image
18 from the camera, and essentially by applying this inverse
19 perspective mapping, you are able to rectify the image so
20 that it is -- it is an image that would be the same as an
21 image if the camera was perfectly positioned with zero
22 tilt, zero pitch, and zero yaw.

23 So you can essentially undistort the camera image
24 based on the distortions caused by the various angular
25 errors and height errors in the camera.

1 Q You say perfectly positioned. Is that positioned
2 relative to the vehicle or the road plane normal?

3 A Would be relative to the road plane normal.

4 Q Okay. And the IPM, an image rectification will
5 compute the road plane normal?

6 A No. It's sort of the other way around. He says
7 in Khan at 322, After estimating the horizon, we compute
8 the road plane normal N , using camera intrinsic matrix K
9 and horizon. He gives a formula for that. And then he
10 says, The IPM is then computed using another formula.
11 These are all matrix formulas.

12 And so he is -- he has to compute the road plane
13 normal based on tilt and pitch and other things from the
14 camera. And once he knows what those are, then he can
15 determine the rotation matrix R , and from that and the
16 camera -- intrinsic camera matrix, which is some
17 characteristics of the camera itself, he can then
18 determine what the IPM is.

19 Q Okay. And the road plane normal is computed
20 based in part on the horizon line, right, in Khan?

21 A Yes.

22 MR. RIBERA: Objection.

23 BY MR. DUTTON:

24 Q And the IPM is computed at least based on the
25 horizon line that's been determined in Ali's algorithm,

1 right?

2 THE WITNESS: Could you read that back?

3 (Record read.)

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: Well, I think Khan describes how the IPM
6 is computed. And it is not only based on the horizon
7 line. It's based on various other things, including the
8 horizon line.

9 BY MR. DUTTON:

10 Q So you agree that the IPM in Khan and Ali is
11 computed at least based on the horizon line, right?

12 MR. RIBERA: Objection; vague.

13 THE WITNESS: I guess when you say at least, there --
14 if all I had was a horizon line, I'm not sure that I would
15 still be able to calculate the IPM. So it... the horizon
16 line is a necessary but not sufficient piece of
17 information. So there's other information that's required
18 to compute the IPM.

19 BY MR. DUTTON:

20 Q Okay. So the horizon line is a necessary piece
21 of information used to calculate the IPM in Khan and Ali's
22 algorithm, right?

23 A I would say yes. Given the formula, N equals K
24 transpose times LH.

25 THE STENOGRAPHIC REPORTER: Transpose what?

1 THE WITNESS: K transpose times LH, Ls of H, which is
2 the horizon line.

3 BY MR. DUTTON:

4 Q And you agree that the IPM is computed based on
5 video in Khan and Ali?

6 MR. RIBERA: Objection; vague.

7 BY MR. DUTTON:

8 Q I'll rephrase. Do you agree that the IPM is
9 computed from a video in Khan and Ali?

10 MR. RIBERA: Objection; vague.

11 THE WITNESS: The IPM is computed from the camera
12 matrix, what they call a camera intrinsic matrix and the
13 rotation matrix. And the rotation matrix is computed
14 using the road normal and the horizon line. And so if the
15 horizon line is determined from video, then you will have
16 used video images to compute the IPM.

17 BY MR. DUTTON:

18 Q Okay. And in fact --

19 A It's not -- it's an indirect kind of...

20 Q Right. And the example that Khan and Ali
21 presented in their papers, the estimation of horizon and
22 IPM is on a short video clip. Do you see that?

23 A Yes.

24 Q Do you have any reason to dispute the accuracy of
25 that statement?

1 A No.

2 Q Okay. Is the road plane normal an example of a
3 camera parameter as that's used in the '580 patent?

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: No.

6 BY MR. DUTTON:

7 Q Why not?

8 A Because it's the normal vector from the road.
9 It's independent of the camera.

10 Q So a camera parameter has to not be independent
11 of the camera?

12 MR. RIBERA: Objection; vague.

13 BY MR. DUTTON:

14 Q Or sorry, that's a double negative.

15 A camera parameter has to be dependent on the
16 property of the camera?

17 A Well, if it's a parameter of the camera, then it
18 would certainly depend on the properties of the camera.

19 Q Okay.

20 A The road normal is what the road normal is,
21 regardless of how the camera is oriented. So there's
22 certainly a relationship between the rotation matrix and
23 the camera. Because that's how the camera is rotated
24 relative to the road normal. But the road normal is
25 independent of the camera.

1 Q Okay. But because it's a camera parameter, the
2 parameter has to be a property of the camera itself,
3 right?

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: It is a property -- what you say is a
6 property of the camera. There are lots of properties of
7 the camera that may or may not have anything to do with
8 how the camera is oriented in three dimensions. So
9 certainly, it is a characteristic that is a product of how
10 the camera is being operated. Which may or may not have
11 anything to do intrinsically with the camera itself, but
12 it may be how the camera is mounted, for example.

13 So, you know, is the angle of the camera an
14 intrinsic -- you know, the pose of the camera, is that an
15 intrinsic property of the camera? No. Because it can
16 change depending on how it's mounted. But so, you know,
17 what you call a camera parameter could be parameters that
18 are inherent to the physical construction of the camera.

19 But they could also be parameters that are
20 extrinsic but related to how the camera's being used.

21 BY MR. DUTTON:

22 Q So a camera parameter could be parameters
23 inherent to the camera itself, right?

24 MR. RIBERA: Objection; vague.

25 THE WITNESS: Well, there are camera -- there are

1 parameters that are inherent to the camera. You know, is
2 it a color camera or a black and white camera? How many
3 gray scales does it have? What's the frame rate? There's
4 a bunch of characteristics of a camera that have nothing
5 to do with any of this. So those are all camera
6 parameters.

7 But the camera parameters that are actually
8 relevant here are camera parameters related to -- some of
9 them are intrinsic, you know, the field of view of the
10 camera and the zoom level of the lens and things like
11 that. And some of them are related to the use of the
12 camera and how the camera's being used. Which means, you
13 know, I've mounted it to the windshield of a car and is
14 it --

15 THE STENOGRAPHIC REPORTER: I'm sorry, which means
16 what?

17 THE WITNESS: I've mounted it to the windshield of a
18 car or a truck, and it's tilted forward or tilted
19 sideways. It's not perfectly oriented.

20 Which is not inherent to the camera. It's --
21 it's a property of how the camera is mounted.

22 BY MR. DUTTON:

23 Q So is the camera parameter then a property of the
24 camera itself as it exists in its operational state, is
25 that what you're saying?

1 MR. RIBERA: Objection; vague.

2 THE WITNESS: A camera parameter -- the camera
3 parameters that are of interest here are parameters that
4 will affect the image of the roadway that the camera will
5 detect. And that will be affected by some parameters that
6 are not intrinsic to the camera itself as an object or as
7 a camera, as an optical device.

8 And those are pitch, yaw, roll, and height, which
9 are things that the camera can't do anything about. So
10 they are -- they are associated with the camera. But
11 they're really associated with how the camera is being
12 used, not a camera itself.

13 BY MR. DUTTON:

14 Q Okay. I think I understand.

15 A And then there are -- as he points out, there are
16 things that are intrinsic to the camera, which are like
17 the K matrix that he talks about in 3.2.2. Which would be
18 whatever, you know, the field of view and things like that
19 of the camera.

20 Q Okay. Would -- so would the intrinsic matrix K
21 be a camera parameter?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: It would be one of the camera parameters
24 that -- camera parameter as it is used in the '580 patent
25 includes things like the matrix K, and it also includes

1 these extrinsic usage-related parameters.

2 BY MR. DUTTON:

3 Q Okay. And the IPM would also be a camera
4 parameter according to the '580 patent, right?

5 MR. RIBERA: Objection; vague.

6 THE WITNESS: I don't know if they talk about it that
7 way.

8 BY MR. DUTTON:

9 Q If you go to Column 6, line 46.

10 A It certainly is a result of the camera
11 parameters. But... line 46... yeah. Okay. So they
12 consider the IPM, which is really all of these camera
13 parameters and horizon lines and things all rolled
14 together in a single represented, single model that allows
15 you to then rotate the image arbitrarily.

16 Q So you agree that the IPM that's referred to in
17 Khan is a camera parameter that's computed based on the
18 horizon line and road plane normal and other variables,
19 right?

20 MR. RIBERA: Objection; vague.

21 THE WITNESS: Well, the IPM is a -- is a... it's a
22 tool that depends on and is derived from a series of
23 camera parameters and the image that you're looking at.
24 So you're -- you take all of the angular errors that you
25 have calculated, pitch, yaw, roll. And using the

1 equations, for example, provided in Khan, you can then
2 compute the IPM.

3 So it's certainly there embedded in the IPM. I'm
4 not sure that I would characterize the IPM as a camera
5 parameter. That's kind of like saying that, you know, a
6 city is a road. It's certainly part of it.

7 BY MR. DUTTON:

8 Q The '580 patent, though, refers to IPM as a
9 camera parameter, right?

10 A It does, yes.

11 Q And Khan calculates the IPM based on the horizon
12 line and other variables, right?

13 A Yes.

14 Q Okay. So at least as camera parameters are
15 referred to in the '580 patent, Khan and Ali will
16 calculate a camera parameter based on at least a horizon
17 line, right?

18 MR. RIBERA: Objection; vague.

19 THE WITNESS: Well, they will calculate a camera
20 parameter based on -- based on information, including a
21 horizon line. If you have a horizon line alone, I don't
22 know that you can necessarily only, right -- I don't know
23 that you can calculate the IPM with only a horizon line.

24 BY MR. DUTTON:

25 Q Understood.

1 So Khan and Ali doesn't compute the IPM based
2 only on the horizon line, but nonetheless, it computes an
3 IPM which the '580 patent refers to as a camera parameter
4 based on a horizon line, right?

5 A A horizon line and other information, yes.

6 Q Okay. So just making the record clear here, Khan
7 and Ali will compute the IPM based on the horizon line and
8 other information, right?

9 MR. RIBERA: Objection; vague.

10 THE WITNESS: I believe that it is reasonable.

11 BY MR. DUTTON:

12 Q It's reasonable or is it correct?

13 A Well, the IPM is certainly calculated using the
14 horizon line and the road plane normal and what they refer
15 to as the camera intrinsic matrix K.

16 Q Okay. And the '580 patent refers to the IPM as a
17 camera parameter, right?

18 A It does. I'm curious, though... I'm wondering
19 what the specific components of the camera matrix A are.

20 Q So I'm not asking about camera matrix A.

21 A Well, I know, but to answer your question, I need
22 to know what is -- specifically whether the camera
23 matrix K includes other camera parameters, for example,
24 the tilt, yaw, and pitch, roll, and things of the camera.

25 But I don't think that they describe that here.

1 Yeah, they don't.

2 Q If you go to Column 14 of the '580 patent.

3 A Okay.

4 Q If we look at Equation 1, do you see that?

5 A Yes.

6 Q That is the equation for the road plane normal,
7 right?

8 A Yes. That's the same as the equation that's in
9 Khan.

10 Q Okay. So the '580 patent uses the same equation
11 to determine the road plane normal as Khan and Ali, right?

12 A Yes.

13 MR. RIBERA: Objection; vague.

14 THE WITNESS: Yes, it does.

15 BY MR. DUTTON:

16 Q And if we go to Equation 2, it's also correct
17 that the '580 patent uses the same equation to determine H
18 as Khan and Ali, right?

19 MR. RIBERA: Objection; vague.

20 THE WITNESS: Yes.

21 BY MR. DUTTON:

22 Q And it's also true that the '580 patent uses the
23 same equation for Equation 3 as Khan and Ali, right?

24 A Yes.

25 Q So the equations that the '580 patent uses for

1 the IPM computation are the same equations that are used
2 for Khan and Ali, right?

3 MR. RIBERA: Objection; vague.

4 THE WITNESS: They -- it appears that Equations 1, 2,
5 and 3 in the '580 patent are the same as the equations
6 referenced in 3.2.2 of Khan for road normal, rotation
7 matrix, and IPM.

8 BY MR. DUTTON:

9 Q So the '580 patent uses the same equations as
10 Khan and Ali to determine the IPM, correct?

11 MR. RIBERA: Objection; vague.

12 THE WITNESS: It uses the same equations that are
13 described in Khan. 3.2.2 of Khan.

14 BY MR. DUTTON:

15 Q Okay. And those equations are used for
16 determining the IPM, right?

17 A Among other things, yes.

18 Q Okay. I think I'm -- I'm going to shift to Choe,
19 so would be a great time for a break if that works for
20 you.

21 A Okay.

22 MR. RIBERA: Sure.

23 (Recess taken.)

24 BY MR. DUTTON:

25 Q All right. Welcome back.

1 Let the record reflect I'm handing the witness
2 what's been previously marked as Exhibit 1005.

3 Do you recognize this exhibit?

4 A Yes. This is the Choe or Choe patent.

5 Q And you've reviewed the Choe patent?

6 A Yes, I have.

7 Q Do you agree that Choe discloses predictive
8 models?

9 A I don't know that Choe uses that term.

10 Q Could we turn to Exhibit 2003, your first
11 declaration. If you go to paragraph 46. Let me know when
12 you're there. Take a moment to review that paragraph.

13 A I'm there, and I've now reminded myself of what
14 Choe talks about.

15 Q You agree that Choe discloses predictive models,
16 right?

17 A I'm looking for the place in Choe where he talks
18 about this. So I think that there's an erroneous
19 reference here, cite. Because paragraph 44, which is
20 cited in my paragraph 46 doesn't actually talk about these
21 machine learning engine and predictive models, 124. That
22 is actually talked about in paragraph 30 of Choe.

23 Q Okay. So the citation to paragraph 44 should be
24 paragraph 30?

25 A I'm not sure. Hang on. He uses 124 in multiple

1 places. Okay. So it is paragraph 30 that he talks about
2 this. Says, Based on driving statistics 123, machine
3 learning engine 122 generates or trains a set of rules,
4 algorithms and/or predictive models 124. So he refers to
5 predictive models, but he's referring to three different
6 elements, 124, onset of rules, algorithms, and/or
7 predictive models 124. Which appears to be all three of
8 those things referred to as 124 in different places.

9 Q Okay. You agree that Choe discloses predictive
10 models, right?

11 MR. RIBERA: Objection; vague.

12 THE WITNESS: He mentions predictive models in
13 paragraph 30.

14 BY MR. DUTTON:

15 Q So is that a yes, you agree that Choe discloses
16 predictive models?

17 MR. RIBERA: Objection; vague.

18 THE WITNESS: He says, Based on driving statistics
19 123, machine learning engine generate 122, generates or
20 trains a set of rules, algorithms, and/or predictive
21 models 124. So he certainly describes that machine
22 learning engine can generate or train, among other things,
23 rules, algorithms, and/or predictive models.

24 BY MR. DUTTON:

25 Q Okay. So you agree that Choe describes a machine

1 learning engine that can generate or train, among other
2 things, predictive models, right?

3 A Yes.

4 Q And if we go back to paragraph 46, your
5 declaration, you found that these predictive models 124
6 are used for sensor calibration, right?

7 MR. RIBERA: Objection; vague.

8 BY MR. DUTTON:

9 Q I'll rephrase that to remove the ambiguity.

10 In paragraph 46 of your declaration, you
11 concluded that the predictive models 124 are used for
12 sensor calibration to determine a set of calibration
13 parameters, right?

14 A That's what I said, yes.

15 Q And you stand by that opinion?

16 A Yes.

17 Q Okay.

18 A I believe actually in my... which version of this
19 declaration is this? Yeah. In my revised declaration, I
20 think I provided some clarification of that. And he
21 doesn't actually describe using predictive models to
22 determine calibration parameters. He actually describes
23 using algorithms 124.

24 Q Okay. But you found that the predictive
25 models -- so if I understand correctly, you determined

1 that the predictive models are used for sensor
2 calibration, but Choe doesn't really describe how those
3 predictive models are used in that fashion?

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: So in my -- I provide a more fulsome
6 explanation of this in my revised declaration. It says,
7 Petition relies on Choe's paragraph 30, referring to
8 predictive models 124 possibly used for sensor
9 calibration. As I discuss above, at most Choe describes
10 that predictive models 124 referenced in paragraph 0030,
11 which are based on machine learning processing of driving
12 statistics, for example, driving commands, speeds,
13 accelerations, decelerations, et cetera, are used for
14 sensor calibration to determine a set of calibration
15 parameters, not a horizon line. But in fact, Choe does
16 not actually describe using predictive models even for
17 camera calibration.

18 And I stand by that as well. I think I gave Choe
19 too much credit in my -- in paragraph 46 for describing
20 that you would use the predictive models to determine a
21 set of calibration parameters because he doesn't really
22 describe that.

23 BY MR. DUTTON:

24 Q So in your original declaration, you determined
25 that the predictive models 124 are used for sensor

1 calibration, and in your revised declaration, you
2 concluded that it doesn't really disclose the details for
3 how you would perform that sensor calibration on
4 predictive models, right?

5 MR. RIBERA: Objection; vague.

6 THE WITNESS: It actually doesn't describe it. It
7 kind of -- it sounds like it does. But it doesn't really.
8 It says, this is paragraph 0030, Based on driving
9 statistics 123, machine learning engine generates or
10 trains a set of rules, algorithms, and/or predictive
11 models 124 for a variety of purposes.

12 And then it goes on to say, In one embodiment,
13 algorithms 124, which is not the predictive models, may
14 include algorithms for autonomous driving a vehicle.
15 Algorithms 124 may further include sensor calibration
16 algorithms which would be described further below.

17 So he never actually says that the predictive
18 models component of 124 is used to perform calibrations.

19 BY MR. DUTTON:

20 Q A predictive model can have algorithms in it,
21 right?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: He actually distinguishes between
24 algorithms and predictive models. He describes them as
25 two separate things. So I'm not sure... since this is

1 the only time he mentions predictive models, it's not
2 clear what Choe actually means by that. Because he talks
3 about rules, algorithms, and/or predictive models.

4 So a predictive model is different -- what he
5 calls a predictive model is different than what he calls
6 an algorithm.

7 BY MR. DUTTON:

8 Q Could be reasonable to conclude that the
9 algorithms 124 are themselves predictive models, right?

10 A No. Because he describes them as separate
11 things. It's like he has A, B, and/or C.

12 Q But he labels them both Item 124, right?

13 A That's true. He says that there are three things
14 in this box, A, B, and C, but that doesn't mean that A is
15 the same as C or B is the same as C.

16 Q In your original declaration you interpreted
17 124 -- algorithms 124 as predictive models, right?

18 A The original... I don't think I stated it that
19 way. I said the predictive models -- this is
20 paragraph 46. Predictive models 124 are generated by
21 machine learning, thus these predictive models are based
22 on driving statistics and are used for sensor calibration
23 to determine a set of calibration parameters.

24 But I didn't say that predictive models were
25 algorithms or vice versa.

1 Q Okay. It was reasonable to conclude, at least in
2 your original declaration, that predictive models 124 were
3 used for sensor calibration, right?

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: I think that the correction that I made
6 in the revised declaration clarifies that Choe's
7 explanation is somewhat confusing because he uses the
8 designator 124 for three different things, but Choe -- as
9 I said in my revised declaration, Choe never actually
10 describes using the predictive models element of 124 or
11 doing sensor calibration.

12 So as I said, I think I gave Choe a little too
13 much credit in my initial declaration because when you
14 read Choe carefully, he never actually says you would use
15 a predictive model 124 for sensor calibration. He says
16 you would use an algorithm 124.

17 BY MR. DUTTON:

18 Q Would it be reasonable to call a predictive model
19 an algorithm?

20 MR. RIBERA: Objection; vague.

21 THE WITNESS: Well, within the context of Choe, I
22 would say no. Because he describes them as two separate
23 things. First of all, he describes them as two separate
24 things. And second of all, a predictive model as it is
25 described in many cases is -- I mean, as an example, it

1 doesn't have to be, but a predictive model in -- an
2 example of a predictive model in the '580 patent is a CNN,
3 which is not an algorithm.

4 So could a predictive model be -- contain an
5 algorithm or contain calculations? Sure. I'm not sure if
6 it would necessarily be called an algorithm.

7 BY MR. DUTTON:

8 Q You agree that a predictive model can include
9 algorithms, right?

10 MR. RIBERA: Objection; vague.

11 THE WITNESS: It would in the context of Choe or just
12 in general?

13 BY MR. DUTTON:

14 Q As a person of ordinary skill in the art,
15 according to the plain and ordinary meaning of the terms,
16 they would understand that a predictive model can include
17 algorithms, right?

18 A In the context that a predictive model -- well, I
19 guess the only way I can talk about this is in the context
20 of the '580 patent. Because that's where the term
21 actually makes -- what we call the term actually makes a
22 difference. The '580 patent is very clear that examples
23 of predictive models are CNNs and various variations of
24 neural networks and -- and any method that is not using
25 geometric computations.

1 So to the extent that you might have an algorithm
2 that allowed you to predict a horizon line that was not a
3 CNN but didn't use geometric calculations, then, yes, you
4 could have an algorithm, a predictive model that contained
5 an algorithm, that was implemented using an algorithm.

6 Q What's the distinction between a model and an
7 algorithm?

8 MR. RIBERA: Objection; vague, beyond the scope.

9 THE WITNESS: An algorithm is a procedure. And so if
10 you could use a procedure to implement a predictive model,
11 then you could use an algorithm to implement a predictive
12 model. There are also -- and as I said earlier, I think
13 the distinction here is that the '580 patent describes
14 that the predictive model as that term is used in the '580
15 patent allows you to not have to perform geometric
16 processes, which would be geometric algorithms, in order
17 to determine a horizon line. But that's about all it
18 says.

19 So in the context of Choe, I mean, he clearly
20 states that there are algorithms and/or predictive models.
21 So in Choe's mind, these are different things.

22 BY MR. DUTTON:

23 Q If one of Choe's algorithms implemented a
24 predictive model -- strike that.

25 So if I'm understanding you correctly, an

1 algorithm can include a predictive model, right?

2 MR. RIBERA: Objection; vague.

3 THE WITNESS: I would say it the other way around. I
4 would say that...

5 BY MR. DUTTON:

6 Q So you would say that a predictive model would
7 include an algorithm?

8 A May include.

9 Q May.

10 A Might include --

11 Q Okay.

12 A -- an algorithm.

13 And, you know, to bring it back to Choe, Choe
14 describes them as separate things. Which kind of implies
15 that Choe's idea of a predictive model is perhaps more
16 restrictive. In the '580 patent, it appears that a
17 predictive model could be an algorithm, but it would
18 exclude a geometric algorithm.

19 Q And Choe also refers to a set of rules, right?

20 A Right.

21 Q And rules would be in an algorithm?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: Not necessarily. I mean, I believe that
24 Choe's idea of rules is like stop at stop signs and drive
25 on the right side of the road and things like that.

1 That's not...

2 BY MR. DUTTON:

3 Q It's not the algorithmic sense?

4 THE STENOGRAPHIC REPORTER: It's not the what?

5 MR. DUTTON: Algorithmic sense of rules, like rules
6 based.

7 MR. RIBERA: Objection; vague.

8 THE WITNESS: Well, he doesn't really describe it. So
9 we're left to speculate. But his discussion of -- his
10 minimal discussion of rules is where the kind of rules of
11 the road and rules associated with how a car is driven on
12 the road, and which I suppose might feed into an
13 algorithm. But he again describes them separately and
14 describes them as separately.

15 BY MR. DUTTON:

16 Q So it's your view that Choe uses driving
17 statistics to generate rules of the road, that's what it's
18 referring to in paragraph 30?

19 A So I think it would use -- well, the rules seem
20 to be based on driving statistics. Right? I mean, based
21 on driving statistics 123, machine learning engine
22 generates or trains a set of rules, algorithms and/or
23 predictive models. And Choe uses those in a variety of
24 ways.

25 As an example on paragraph 0037, part way down

1 that paragraph he says, For example, if the object is a
2 vehicle at an opposing direction and the current driving
3 environment includes an intersection, prediction model
4 will predict whether the vehicle will likely move forward
5 or make a turn. If the perception data indicates that the
6 intersection has no traffic light, prediction model may
7 predict the vehicle may have to fully stop prior to
8 entering the intersection.

9 So these appear to be kind of how you would apply
10 rules based on driving statistics that you stop at stop
11 signs and things like that.

12 Q Would those rules be used in an algorithm to
13 actually perform the function of stopping at a stop sign?

14 A They might be. Or they might be in an algorithm,
15 for example, that says if there is no traffic light, then
16 assume that there's a stop sign or look for a stop sign or
17 something like that. But Choe is, you know, remarkably
18 bereft of any detail on how this is done.

19 Q And Choe is also lacking detail on how it would
20 use predictive models for a variety of purposes in the
21 context of autonomous driving, right?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: I mean, all Choe says is that you could
24 use rules, algorithms, and/or predictive models for a
25 variety of purposes. That's as much as he says. And then

1 he's more explicit that you can use algorithms to perform
2 sensor calibration.

3 BY MR. DUTTON:

4 Q Okay. Does Choe say that the predictive models
5 are trained based only on driving statistics?

6 MR. RIBERA: Objection; vague.

7 THE WITNESS: He doesn't really say one way or the
8 other. What he says is, Based on driving statistics,
9 machine learning engine 122 generates or trains a set of
10 rules, algorithms, and/or predictive models for a variety
11 of purposes.

12 So he doesn't -- it's not clear whether machine
13 learning engine only works on driving statistics or
14 whether there may be other things. He's just vague about
15 how that's done.

16 BY MR. DUTTON:

17 Q But Choe doesn't say that you can only use
18 driving statistics to train the predictive models, right?

19 MR. RIBERA: Objection; vague.

20 THE WITNESS: Well, I mean, another place he says
21 that, In one embodiment -- this is paragraph 29. In one
22 embodiment, data analytic system 103 includes data
23 collector 121 and machine learning engine 122. Data
24 collector 121 collects driving statistics 123 from a
25 variety of vehicles, either autonomous vehicles or regular

1 vehicles driven by human drivers.

2 Driving statistics 123 include information
3 indicating the driving commands, for example, throttle,
4 brake, and steering commands issued and responses of the
5 vehicles, for example, speeds, accelerations,
6 decelerations, and directions, captured by sensors of the
7 vehicles at different points in time.

8 Driving statistics 123 may further include
9 information describing the driving environments at
10 different points in time as -- such as, for example,
11 routes starting in destination locations, MPOIs, road
12 conditions, weather conditions, et cetera.

13 So, I mean, this is a lot of stuff that goes into
14 these driving statistics, and he doesn't say that anything
15 else is used. But he doesn't really talk about using any
16 of this anyway except for a variety of purposes.

17 BY MR. DUTTON:

18 Q So... but Choe does not say that you can't use
19 something other than driving statistics to train the
20 predictive models that it uses for a variety of purposes,
21 right?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: Can you read that back?

24 (Record read.)

25 THE WITNESS: He doesn't say that you cannot. But he

1 doesn't say that you would either.

2 BY MR. DUTTON:

3 Q Okay. So Choe does not say that you can't use
4 images to train its predictive models 124, right?

5 MR. RIBERA: Objection; vague.

6 THE WITNESS: He says that it's based on driving
7 statistics. And it's -- there's no -- no statement about
8 whether you can or cannot use images. He certainly
9 doesn't proactively say you cannot use certain data. But
10 he also doesn't say that you would. So he doesn't really
11 have any disclosure.

12 BY MR. DUTTON:

13 Q So Choe doesn't proactively say that you can't
14 use image data to train predictive models 124, right?

15 MR. RIBERA: Objection; vague.

16 THE WITNESS: Choe doesn't prohibit it. But he also
17 doesn't describe it.

18 BY MR. DUTTON:

19 Q Okay. And Choe does not prohibit predictive
20 models 124 from being used for sensor calibration
21 algorithms, right?

22 A He doesn't prohibit that. But he doesn't
23 describe the predictive models being used for sensor
24 calibration.

25 Q Okay. If you go to Figure 7 of Choe.

1 A Okay.

2 Q First step of Figure 7 determines a horizon line
3 representing a vanishing point from the viewpoint of an
4 ADV based on a pitch angle of a camera that captured the
5 first image representing a 2D view. Do you see that?

6 A Yes.

7 Q Do you agree that Choe describes the detection of
8 a horizon line?

9 MR. RIBERA: Objection; vague.

10 THE WITNESS: He determines a horizon line based on
11 the pitch angle of the camera.

12 BY MR. DUTTON:

13 Q Would you agree that Choe determines a horizon
14 line using an algorithm?

15 MR. RIBERA: Objection; vague.

16 THE WITNESS: He doesn't really describe how you
17 determine a horizon line. He just says that it is
18 determined from the camera parameters. So, you know, we
19 can speculate how he would do that. Presumably, he takes
20 the camera parameters, you know -- and in case of
21 Figure 7, it's the pitch angle -- and performed some kind
22 of a mathematical operation on it.

23 So I guess that would be an algorithm, but that's
24 all he says about it.

25

1 BY MR. DUTTON:

2 Q So Choe doesn't disclose whether he uses an
3 algorithm or a predictive model to determine the horizon
4 line?

5 A He doesn't say that he uses a predictive model.
6 He says that he determines a horizon line based on a pitch
7 angle of a camera.

8 Q And you testified that he doesn't say how he
9 determines the horizon line based on the pitch angle of
10 the camera, right?

11 A He doesn't provide a formula for that. As I
12 understand Choe, he essentially provides a candidate
13 horizon line in the image. Which is derived however he
14 chooses, and he then presents that horizon line to an
15 annotator who then adjusts the pitch, roll, and yaw of
16 the -- of the -- associated with the image to correctly
17 position the horizon line and the subsequent lane lines in
18 an orientation that the annotator feels is correct.

19 Q Does Choe determine -- or does Choe disclose the
20 implementation details for how you determine the candidate
21 horizon line?

22 A Other than based on -- he says in a variety of
23 places. He says in Figure 7, it's based on a pitch angle
24 of the camera. And in other places, it's based on camera
25 parameters. And the horizon line is determined based on

1 the hardware parameters of the camera.

2 Q Would Choe be interested in other methods on how
3 you would determine that candidate horizon line?

4 MR. RIBERA: Objection; vague.

5 THE WITNESS: I don't think so. Because Choe doesn't
6 care how accurate that candidate horizon line is. He's
7 going to stick a line on there based on his best guess
8 from the camera parameters. And the pitch angle could be
9 assumed to be zero. And you can assume the camera's
10 perfectly aligned. You throw a horizon line on it. And
11 then you move things around until it actually fits based
12 on the annotator.

13 And then you correct the orientation of the
14 camera so that the image that you have is consistent. The
15 image that you have, including now or taking into account
16 these camera angles, is now equivalent to what the
17 annotator has identified.

18 BY MR. DUTTON:

19 Q Where does Choe say that it doesn't care about
20 the accuracy of the candidate horizon line?

21 A I don't think he says. He just says you
22 determine a horizon line based on the camera parameters,
23 which would be some assumed set of camera parameters.
24 Since you don't know them, I mean, the whole point of Choe
25 is you're going to figure out these camera parameters.

1 But if the horizon line is determined on the basis of the
2 camera parameters, then you must start with some
3 assumptions about what those camera parameters are.

4 Based on that, you draw a horizon line, and then
5 you give it to an annotator who then corrects it. And in
6 correcting it, you determine what the errors were in your
7 assumptions about the camera parameters at the start.

8 Q Wouldn't a person of ordinary skill want to have
9 an accurate candidate horizon line so you wouldn't have to
10 correct as much?

11 A Well, it doesn't matter. Because that's --
12 that's Choe's entire approach, is to have the user do the
13 right and left and up and down arrow keys until he sees an
14 image with the horizon at the right place and he looks at
15 the lane lines from above and sees that they're pointed in
16 the right direction, his 2D and 3D images.

17 So it really doesn't matter where you start. You
18 can start anywhere. As long as you end up with a picture
19 that's consistent in 2D and 3D from the annotation, you
20 can then read how much correction got put in by the
21 annotator. And now you are ready to calibrate the camera.
22 So it doesn't really matter. There's nothing in Choe that
23 says, you know, you have to do the best job you can of
24 coming up with the candidate horizon line.

25 He just says you -- you do the best you can based

1 on what information you have, and then you're going to
2 correct it from there.

3 Q So to be clear, Choe is referring to autonomous
4 vehicles, right?

5 A Yes.

6 Q And your position is that it doesn't care about
7 the accuracy of its initial horizon line?

8 A Well, if you are having a human annotator provide
9 the corrections and this is long before any autonomous
10 operation of the vehicle is taking place. So, you know,
11 it's... the question is you -- if it's an autonomous
12 vehicle, you certainly want the corrected calibrated
13 camera to be as accurate as possible.

14 But the whole point of Choe is to calibrate the
15 camera.

16 Q Well, let me -- you refer to the -- that this
17 operation takes place long before, but Choe refers to
18 calibrating its cameras in real time, right?

19 A Where does he refer to that?

20 Q For example, paragraph 17, I think it refers to
21 it throughout the application.

22 A Yeah, you could calibrate the sensors, I guess,
23 in real time. That would be a rather risky thing to do
24 because if you don't have a good calibration to start
25 with, then your system is driving autonomously and it

1 would be incorrect.

2 Q So Choe would have reason to want an accurate
3 calibration candidate horizon line, right?

4 A If he wanted a reason, he didn't explain it.

5 Q I think it's common sense that you would want
6 accuracy when you're calibrating your sensors in real time
7 for an autonomous vehicle, right?

8 A Well, this is a --

9 MR. RIBERA: Objection; vague.

10 THE WITNESS: This is -- he says that it may be
11 performed in real time. And perhaps you might want to do
12 that. You might want to recalibrate because something was
13 operating incorrectly. He also says, The above processes
14 can be performed offline based on previously captured
15 images or point clouds.

16 THE STENOGRAPHIC REPORTER: You said point clouds?

17 THE WITNESS: Point clouds, yes.

18 So, you know, we can -- we can put words in
19 Choe's mouth and say that it has to be as accurate as
20 possible, but he is providing a variety of operational
21 scenarios and says nothing about the initial accuracy of
22 the horizon line determination.

23 BY MR. DUTTON:

24 Q It would be desirable to use a method that
25 calibrates that candidate horizon line accurately during

1 realtime calibration of Choe's autonomous vehicle, right?

2 MR. RIBERA: Objection; vague.

3 THE WITNESS: Choe doesn't say anything about that.

4 BY MR. DUTTON:

5 Q A person of ordinary skill in the art would have
6 understood that an accurate candidate horizon line would
7 have been beneficial for the real time calibration, right?

8 A Well, I mean, that's -- let's walk through that.
9 If you had an accurate calibration to start with, then
10 there would be no need to calibrate. So how inaccurate
11 does it have to be before Choe then decides that he's
12 going to put you through this, this new calibration
13 process? I mean, the point is that if it was accurate to
14 start with, there's no reason to calibrate.

15 So if you're going to be calibrating, then it
16 wasn't accurate. And how inaccurate? Choe is silent on
17 that.

18 Q So a person of ordinary skill in the art would
19 have understood that having a candidate horizon line with
20 a smaller margin of error would have been beneficial for
21 real time calibration, right?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: Choe is silent on that. And he is
24 saying that you would calibrate the system in real time,
25 and if you are calibrating it -- one way of doing it is

1 calibrating it in real time. And if you are calibrating
2 it, then presumably, you have a reason to calibrate it,
3 and that means that the calibration that you started with
4 was incorrect.

5 He doesn't describe how incorrect that needs to
6 be. If it was off by a thousandth of a degree, that might
7 not matter. Right? But given no disclosure by Choe, we
8 can't speculate as to how far off it would have to be
9 before you would decide to recalibrate.

10 BY MR. DUTTON:

11 Q I believe earlier, you said Choe doesn't care at
12 all about the accuracy of the candidate horizon line, do
13 you recall that testimony?

14 A I said that --

15 MR. RIBERA: Objection.

16 THE WITNESS: Yeah, I said that. And what I mean by
17 that is that Choe doesn't describe and doesn't specify how
18 accurate anything has to be to start with. And so by
19 definition, if you're going to calibrate using Choe's
20 method, then there's a reason you needed to calibrate,
21 which is that you were not calibrated.

22 And so how much calibration is necessary, he
23 doesn't say. But clearly, some calibration is required
24 because otherwise, you wouldn't go through the process.

25

1 BY MR. DUTTON:

2 Q You could do it for just a safety check?

3 A You could. In which case, there would be zero
4 change. Right?

5 Q Right.

6 But a person of ordinary skill in the art would
7 have understood that having an accurate candidate horizon
8 line would have been beneficial for the real time
9 calibration, right?

10 MR. RIBERA: Objection; vague, asked and answered.

11 THE WITNESS: I wouldn't phrase it that way. I would
12 say that having an accurate calibration would be desirable
13 from an operational perspective. You know, having an
14 accurate initial calibration so that you can then
15 calibrate doesn't really seem to make a lot of sense. And
16 that was the question that you asked me.

17 BY MR. DUTTON:

18 Q Okay. I think I understand your distinction
19 here. You would agree that having an accurate calibration
20 would be desirable from Choe's operational perspective --
21 or sorry --

22 MR. RIBERA: Objection.

23 BY MR. DUTTON:

24 Q Sorry, let me rephrase that. I think I misspoke.
25 A person of ordinary skill in the art would have

1 understood that having an accurate candidate horizon line
2 would be desirable for Choe's operational process, which
3 requires manual annotation, right?

4 MR. RIBERA: Objection; vague, asked and answered.

5 THE WITNESS: That's not exactly what I said. What I
6 said is that if you're going to operate an autonomous
7 vehicle using a camera that requires calibration that is
8 capable of being calibrated to operate that vehicle
9 safely, you would want the calibration to be as accurate
10 as possible.

11 Now, obviously, Choe is talking about
12 calibrating, which means that it wasn't calibrated before
13 you went through the process of calibrating it. So how
14 inaccurate does it have to be before Choe wants you to
15 calibrate, he doesn't say. But the operation of the
16 vehicle, a person of skill in the art would understand
17 that in order to operate the vehicle, the camera should be
18 calibrated as accurately as possible.

19 But that has nothing -- that says nothing about
20 how inaccurate it needs to be before you have to go
21 through the calibration process.

22 BY MR. DUTTON:

23 Q So let's kind of take a step back in Choe's
24 process. It's correct that Choe will first determine a
25 candidate horizon line during calibration, right?

1 A Yes.

2 Q And then a person will manually adjust that
3 candidate horizon line if needed to match ground truth,
4 right?

5 MR. RIBERA: Objection; vague.

6 THE WITNESS: They -- yes, they will actually input
7 corrections in pitch, yaw, and roll using this, buttons,
8 until they have a 2D image and a 3D image, which are
9 consistent with one another. And at that point, they will
10 take whatever the horizon line is that results from that.

11 So that's -- that's Choe's process.

12 BY MR. DUTTON:

13 Q And a user would use, as part of that process,
14 like an input device like a keyboard to move up or down
15 the horizon line?

16 A Yeah, up and down for pitch, and they're not
17 really moving the horizon line. They're moving the
18 implied pitch, tilt, and yaw of the camera. And every
19 time you input a new incremental change in one of those,
20 it then redraws the lines. Like you can look at where's
21 the horizon line now, relative to the road I'm looking at
22 and the lane lines, and are the lane lines straight or are
23 they skewed in some way.

24 So that -- that's why he's giving you -- he calls
25 it a 2D and 3D. It's really a forward and a downward

1 bird's-eye view.

2 Q And so you agree that a user would -- one example
3 in the embodiment would use arrow keys on the keyboard to
4 change the pitch angle?

5 A Exactly.

6 Q And pressing the arrow key ten times would take
7 longer than pressing it once, right?

8 MR. RIBERA: Objection; vague, calls for speculation.

9 THE WITNESS: Might be. Depends on how you might hold
10 the arrow key down, and it moves slowly to begin with and
11 then faster if you keep holding it down. He doesn't talk
12 about it.

13 BY MR. DUTTON:

14 Q With all things equal, pressing the arrow key ten
15 times takes longer than once, right?

16 MR. RIBERA: Objection; vague.

17 THE WITNESS: Well, I can say that yes, if it takes a
18 certain amount of times to press a key, then pressing it
19 ten times more will take longer. I don't know whether
20 that is really relevant here because Choe doesn't talk
21 about that.

22 BY MR. DUTTON:

23 Q So when calibrating the system in real time,
24 preferably, you would want the adjustment to the candidate
25 horizon line to be moved as fast as possible so that a

1 calibration can occur as fast as possible, right?

2 MR. RIBERA: Objection; vague, beyond the scope.

3 THE WITNESS: As I said, Choe doesn't describe that.
4 I can speculate. But, you know, presumably if you're
5 going to recalibrate in real time, there would need to be
6 some threshold mechanism by which you would decide that
7 the calibration that you have is inaccurate.

8 I mean, Choe doesn't tell us anything about that,
9 completely silent on this point. So that, you know, if I
10 were to answer what a POSITA would say about that, they
11 would say well, there's some undisclosed way that we'd
12 have to invent that would allow us to figure out when our
13 calibration is outside of a threshold, and at that point,
14 we would then initiate the recalibration process.

15 And so what that threshold is, I have no idea.
16 And neither does Choe. But certainly, there would be need
17 to be one. And maybe, maybe that threshold would be
18 rather small. And so then you would start with the
19 horizon line you had before and correct it. Doesn't mean
20 that that horizon line was somehow more accurately -- the
21 candidate might just be the last one you had. And, you
22 know, it was derived a while ago, and now you need to
23 recalibrate. Doesn't mean that it was created in some
24 other way.

25

1 BY MR. DUTTON:

2 Q So are you maintaining that a person of ordinary
3 skill in the art wouldn't have appreciated that having a
4 more accurate candidate horizon line during calibration of
5 real time images would have been beneficial?

6 MR. RIBERA: Objection; beyond the scope.

7 THE WITNESS: What I'm saying is that a person of
8 skill in the art -- and I'll preface this by saying that
9 Choe is absolutely silent on this point. Right, zero
10 disclosure of this.

11 But a person of skill in the art would have
12 understood that if you are driving an autonomous vehicle
13 using the system, that you would want it to be calibrated
14 as accurately as possible. And if through some
15 undisclosed mechanism, the system decided or observed that
16 it was making errors, driving too close to the line or
17 something, at some point, it might decide on its own
18 through some mechanism that would have to -- the person of
19 skill in the art would have to invent, the system would
20 decide that it needed to be recalibrated because something
21 crossed a threshold.

22 It was too far off the centerline of the road or
23 whatever. And at that point, it would then -- if I was a
24 person of skill in the art, I would take the last
25 calibration I had as the starting point, and I would take

1 that horizon line and give it to -- because -- I don't
2 know -- I don't have any better horizon line than that. I
3 would take that horizon line and give it to the annotator
4 and say, you know, correct this one. Seems to -- seems to
5 be off. This is the last one I had, so now, give me a new
6 one.

7 That's how I understand or that's my opinion of
8 how a person of skill in the art would do it. They
9 wouldn't use some other mechanism to come up with a new
10 candidate that has no basis in anything. Why would they
11 do that?

12 BY MR. DUTTON:

13 Q Well, Choe says that the horizon line has a basis
14 because it's representing a vanishing point, right?

15 MR. RIBERA: Objection --

16 BY MR. DUTTON:

17 Q So that would be the basis?

18 MR. RIBERA: Objection; vague. Sorry, are you
19 finished with your question?

20 BY MR. DUTTON:

21 Q You agree that Choe discloses that it determines
22 a horizon line representing a vanishing point from the
23 viewpoint of the autonomous vehicle, right?

24 A Mm-hmm.

25 Q And it's your opinion that Choe doesn't care

1 about the accuracy of that candidate horizon line that it
2 determines?

3 MR. RIBERA: Objection; asked and answered.

4 THE WITNESS: Choe doesn't disclose any required level
5 of accuracy for that horizon line. He merely says that
6 it's determined from camera parameters and a vanishing
7 point. So, you know, the simple way of determining that,
8 if you're starting with no previous horizon line -- I
9 mean, we're way off the reservation here with Choe now.

10 But you're starting with no previous horizon
11 line, you find a vanishing point and you draw a line as
12 the most horizontal line that you can draw. You have no
13 idea what horizontal really is. You draw a line through
14 that point. You only have one point, so you don't know
15 exactly where to tilt that line. And then you present
16 that.

17 And so if I were a person of skill in the art, I
18 would say I'm going to use zero tilt, zero pitch, zero
19 roll. I'm going to put the -- I'm going to draw a line,
20 pretty much an arbitrary line as horizontal as I can find
21 through that vanishing point and then I'm going to present
22 that to the annotator. And then I'm going to present that
23 to the annotator, and they're going to tell me how much
24 tilt it needs.

25 You know, if the camera was really, really

1 tilted, I have no control over, then the initial line
2 would be really wrong. And the annotator would have to
3 correct it.

4 BY MR. DUTTON:

5 Q Is it your testimony today that a person of
6 ordinary skill in the art wouldn't have wanted to make
7 that initial candidate horizon line accurate?

8 A Well, the point is they have no basis for making
9 it any more accurate than whatever the camera parameters
10 are, per Choe. Whatever the camera parameters are and
11 where the vanishing point is, that's all they have. So
12 there's no -- there's no way that they can make it more
13 accurate than that based on what Choe is saying they're
14 going to use. They're going to use the vanishing point
15 and the camera parameters.

16 You don't know what the camera parameters are, so
17 you assume that they're zero. And you do have a vanishing
18 point, so you draw a line through it, and then you correct
19 that.

20 Q Does Choe say that -- how it determines a
21 vanishing point?

22 A Presumably, it's from the lane lines. So he
23 detects that lane lines and sees where --

24 THE STENOGRAPHIC REPORTER: So the what the lane
25 lines? I didn't hear that.

1 THE WITNESS: He detects the lane lines, sees where
2 they cross, draws a -- the horizontal relative to the
3 frame, and starts from there. It would be nice if he
4 provided more detail on that, but he doesn't. So that's
5 how a POSITA would assume that he would do it.

6 BY MR. DUTTON:

7 Q And a process that would show how you could
8 determine the horizon line with the vanishing point would
9 be relevant to Choe's system?

10 MR. RIBERA: Objection; vague.

11 THE WITNESS: You said a process that would tell you
12 how to determine the vanishing or the horizon line from a
13 vanishing point?

14 BY MR. DUTTON:

15 Q Yeah.

16 MR. RIBERA: Same objection.

17 THE WITNESS: I -- you know, all I can go on is what
18 Choe says. And so Choe says that you determine it from I
19 think he says the pitch, angle, and the vanishing point.
20 So that's as good as it gets.

21 BY MR. DUTTON:

22 Q So other than disclosing that you determined the
23 candidate horizon line based on pitch, angle, and the
24 vanishing point, Choe doesn't explain how its process will
25 determine the horizon line?

1 MR. RIBERA: Objection; vague.

2 THE WITNESS: Well, paragraph 15 he says, According to
3 one embodiment, in response to a first image captured by a
4 camera of an automated -- an ADV, automated driving
5 vehicle, our horizon line is determined based on the
6 camera's hardware settings. And then he says, The horizon
7 line represents a vanishing point from a viewpoint of the
8 ADV, based on an initial or default pitch angle of the
9 camera.

10 So initial or default pitch angle of the camera,
11 so he assumes some default value for the pitch. I don't
12 know what that is. He doesn't tell us what it is. If you
13 were going to assume a default value as a person of skill
14 in the art, you would assume zero because there's no
15 reason to assume anything different. And then you would
16 correct from there.

17 BY MR. DUTTON:

18 Q So after -- like let's take your assumption that
19 the pitch angle is set to zero, the candidate horizon line
20 would be adjusted by -- manually by a user, right?

21 A Correct.

22 Q And that adjustment would determine the change in
23 pitch angle?

24 A Yes.

25 Q And then that change in pitch angle would get

1 sent to -- back to the camera system to adjust, right?

2 MR. RIBERA: Objection; vague.

3 THE WITNESS: That change in pitch angle would then be
4 used to -- you can't adjust the camera. I mean, he's not
5 talking about physically adjusting the camera. So it
6 would be used in the -- in the calculation of the IPM so
7 that you would be able to then rectify the image.

8 So you figure out how is the pose, it's that R
9 vector in Khan, how is the pose of the camera different
10 than neutral. Everything being zero.

11 BY MR. DUTTON:

12 Q Yeah.

13 A And based on that, you then can essentially
14 distort or transform the image so that you are looking at
15 an image that is what you would see in a neutral pose.
16 But it's all done analytically.

17 Q So let's assume just for the simplicity that
18 after the manual calibration, the pitch angle was off five
19 degrees. Would the five-degree -- would that be the
20 calibration factor?

21 A You're saying that the annotator had to dial in
22 five degrees of pitch to get the horizon line to the right
23 place? Then the camera calibration rotate -- the pitch
24 portion of the rotation matrix would be moved by five
25 degrees.

1 Q Got it.

2 And at that point in time, the pitch of the
3 camera would be five degrees, right?

4 MR. RIBERA: Objection; vague.

5 BY MR. DUTTON:

6 Q If we started at, with zero?

7 A It would imply that the camera pitch was five
8 degrees off of normal, the road plane normal.

9 Q So the pitch portion of the rotation matrix would
10 show five degrees off of the road plane normal --

11 A Yes.

12 Q -- in this example?

13 A Yes.

14 Q Okay. And in this example, the camera would be
15 five degrees off of the road plane normal, right?

16 MR. RIBERA: Objection; vague.

17 THE WITNESS: I guess you could say that. I mean,
18 there are many factors that go into the pose of the
19 camera. I mean, it could be that the vehicle is tilted or
20 is pitched. But the net result would be that the
21 camera -- you know, let's suppose here's an example.

22 Camera is perfectly aligned with the vehicle. So
23 when the vehicle is standing still on flat ground, the
24 camera's exactly pointed, I mean, zero tilt, zero roll,
25 zero pitch, relative to the plane of the road and the

1 direction of the vehicle. If I then, you know, put a
2 bunch of concrete in the trunk and the vehicle pitch is
3 up, the camera is going to pitch up with it, right?

4 And so, you know, this is not necessarily, you
5 know, how the camera is positioned relative to the
6 vehicle. It's how the combination of the camera and the
7 vehicle are positioned relative to the road and that kind
8 of nominal access of the vehicle, that longitudinal and
9 lateral axes of the vehicle.

10 BY MR. DUTTON:

11 Q Understood.

12 So the five-degree pitch would be relative to the
13 road surface independent of the vehicle?

14 A Yes.

15 Q Okay. All right. Just a few more questions, and
16 then I think we can break for lunch.

17 So if we go to Choe paragraph 22. Kind of
18 halfway down, right before -- or not halfway down. Three
19 lines before paragraph 23, it states that, Cameras 211 may
20 be still cameras and/or video cameras, right?

21 A Yes.

22 Q Okay. So Choe contemplates embodiments that use
23 video cameras, right?

24 A It's still cameras and/or video cameras, yes.

25 Q And video cameras capture video, right?

1 A Yes.

2 Q And a video is a set of image frames?

3 A A video is a set of image frames. Choe doesn't
4 say that any of the processes that are done to calibrate
5 are not on a video. He says they're not on images.

6 Q Those images can be video frames, right?

7 A But it would be a single image. He doesn't
8 describe doing it on multiple images.

9 Q Well, if you look at Figure 6A and 6B, I don't
10 know if you can see in this copy, but the third line down
11 at the top left, it has a frame ID. And the first one is
12 Frame ID 1110, right?

13 A Yes.

14 Q And then in Figure 6B, the frame ID, same
15 location in that figure is 1109, right?

16 A Yeah.

17 Q So Choe performs its process on a set of image
18 frames, right?

19 A Well, let's see what he says about that.

20 He doesn't say that you would do this in multiple
21 images or multiple frames. His example is in Figure 6A.
22 This is top of paragraph 55. In this example, the system
23 is calibrating pitch angle with the camera. The image 601
24 was captured by a camera to be calibrated --

25 THE STENOGRAPHIC REPORTER: Image what?

1 THE WITNESS: 601 was captured by camera to be
2 calibrated and processed by the perception module 302, et
3 cetera, et cetera, et cetera.

4 And he basically is saying -- saying that the
5 pitch angle is too high. And then he says -- oh, I'm
6 sorry. That it's too low. So this is in 57 from the top
7 down view when a pitch angle of the camera has been
8 calibrated, lane line 621 and 623 should be relatively or
9 substantially parallel. In this example, assuming horizon
10 line 610 is too low, which causes the lane lines to be
11 diverged, similarly, if the horizon line is too high as
12 shown in Figure 6B.

13 So he's using Figure 6A and B not as examples of
14 sequential frames of video, which they happen to be, but
15 in this case, he's using them as an example of a horizon
16 line that's too low and then horizon line that's too high.
17 So the fact that they are subsequent frames of video, I
18 think is not relevant to Choe's under -- Choe's
19 description of what's being shown.

20 THE STENOGRAPHIC REPORTER: Did you say subsequent
21 frames of video or --

22 THE WITNESS: Yes, video.

23 THE STENOGRAPHIC REPORTER: Okay. Thank you.

24 BY MR. DUTTON:

25 Q You agree that what's shown in Figure 6A and 6B

1 are two image frames, right?

2 MR. RIBERA: Objection; vague.

3 THE WITNESS: There are image frames with two
4 different frame IDs. There's nothing about -- there's
5 nothing to imply that these are necessarily sequential.
6 But more importantly, Choe is not saying that you're
7 performing this process on sequential frames in a video.
8 He's using frame 110 as an example of a horizon line
9 that's too low.

10 And he's using frame 109 as an example of a
11 horizon line that's too high. And that's all he says
12 about that.

13 BY MR. DUTTON:

14 Q Are you disputing that Figure 6A and 6B show a
15 horizon line that is being overlaid on two frames?

16 MR. RIBERA: Objection; vague.

17 THE WITNESS: Well, one of them shows a horizon line
18 overlaid on one frame. And another one shows that's too
19 low. And another one shows a horizon line that's too high
20 on a different frame. There's nothing about these as
21 being frames of a video that Choe describes. So these are
22 just images that happen to have been grabbed from a video.
23 There's nothing in Choe's description about this
24 that says that his algorithm is supposed to work on
25 sequential frames of a video.

1 BY MR. DUTTON:

2 Q But Choe shows its process working on at least
3 two frames of a video, right?

4 A Well --

5 MR. RIBERA: Objection; vague.

6 THE WITNESS: He is using two frames of a video in two
7 different examples. One showing a horizon line that's too
8 low and one showing a horizon line that's too high.

9 BY MR. DUTTON:

10 Q Okay. You agree that the images with Frame ID
11 1110 and 1109 are frames from a video?

12 MR. RIBERA: Objection; vague.

13 THE WITNESS: I would have to make an assumption about
14 that. Because Choe says nothing about it.

15 BY MR. DUTTON:

16 Q Video consists of image frames, right?

17 A A video does consist of image frames. Choe
18 doesn't mention whether these are just subsequent frames
19 from a still camera. Or, you know, could be Photo Number
20 1110 and 1109 --

21 Q Okay.

22 A -- from my iPhone, right? He doesn't -- he
23 doesn't provide any detail or any description about the --
24 whether or not these frames are representative of a video
25 and why that might matter. You know, they could be, but I

1 would be speculating.

2 Q So if Choe is using a video camera as its sensor
3 instead of a still image camera, frame -- the frames in
4 Figures 6A and 6B would be frames from a video, right?

5 MR. RIBERA: Objection; calls for speculation.

6 THE WITNESS: They would be frames from a video, and
7 there's nothing about Choe's presentation of those two
8 images that would imply that the calibration process was
9 done on -- was done using a full set of images.

10 He's only using two examples, one where the line
11 is too low and one where the line is too high. He's not,
12 for example, saying that I'm looking at a whole sequence
13 of videos and I'm moving a line up and down on the set of
14 videos, you know, as the video plays. He doesn't describe
15 anything like that.

16 Could we read that in a year, you can do that,
17 but I'm not going to.

18 BY MR. DUTTON:

19 Q A set can be two, right?

20 A A set can be two, and you would have to describe
21 that there is some sequential meaning to the set. Which
22 Choe doesn't do. He just uses one example of too low and
23 one example of too high. He doesn't say that there's
24 some, some important relevance to the fact that these are
25 sequential frames. That even presents them in reverse

1 order.

2 THE STENOGRAPHIC REPORTER: Presents them in what?

3 THE WITNESS: Reverse order. 6A is a later frame than
4 6B.

5 MR. DUTTON: I think now's a good time for breaking
6 for lunch.

7 THE WITNESS: Okay.

8 (Recess taken.)

9 BY MR. DUTTON:

10 Q Welcome back, Mr. Andrews.

11 A Thank you.

12 Q If I could have you turn to paragraph 32 of your
13 second declaration.

14 A Okay.

15 Q And here you say that in rendering your opinion,
16 the opinions set forth in this declaration, you have read
17 the claims from the perspective of a person of ordinary
18 skill in the art at the time of the invention, in 2021.

19 A Yes.

20 Q Is this because the '580 patent has a priority
21 date of October 4th, 2021?

22 A Yes.

23 Q And you do not have an opinion that the '580
24 patent is entitled to a priority date before October 4th,
25 2021, right?

1 A I have not provided any opinions on that.

2 THE STENOGRAPHIC REPORTER: I'm sorry, repeat that?

3 THE WITNESS: I have not provided any opinions on
4 that.

5 THE STENOGRAPHIC REPORTER: And you said October 4th,
6 right?

7 MR. DUTTON: That's right.

8 THE STENOGRAPHIC REPORTER: Thank you.

9 BY MR. DUTTON:

10 Q In October of 2021, a person of ordinary skill in
11 the art would have been at least aware of computer vision
12 techniques, right?

13 A Yes.

14 Q That's because in the automotive industry,
15 designers would have been working on computer vision
16 techniques, right?

17 MR. RIBERA: Objection; vague.

18 THE WITNESS: In certain areas designers might have
19 been using computer vision techniques.

20 BY MR. DUTTON:

21 Q Okay. Handing the witness what has been
22 previously marked as Exhibit 1011.

23 Do you recognize this document?

24 A Yes, I do.

25 Q What is it?

1 A This is Workman. It's a paper by Workman and
2 some other people called, Horizon Lines in the Wild.

3 Q And do you understand that this Workman paper was
4 published in 2016?

5 A Yes.

6 Q Okay. And what is the Workman paper about?

7 A It is really about -- it's fundamentally about
8 describing a dataset of different examples of horizons,
9 images with horizons that can be used to train neural net
10 models to detect horizon lines.

11 Q Okay. And if we look at kind of the end of the
12 abstract, Workman states that, An extensive evaluation
13 shows that using our CNNs, either in isolation or in
14 conjunction with the previous geometric approach, we
15 achieve state-of-the-art results on the challenging HLW
16 dataset and two existing benchmark datasets.

17 Do you see that?

18 A Yes.

19 Q So do you agree that Workman discloses the use of
20 CNNs?

21 A It does disclose the use of CNNs among other
22 things.

23 Q And according to Workman, a CNN could be used in
24 isolation of previous geometric approaches to achieve
25 state-of-the-art results on horizon detection, right?

1 MR. RIBERA: Objection; vague.

2 THE WITNESS: Well, he says that, Using our CNNs,
3 either in isolation or in conjunction with previous
4 geometric approach, they achieve state-of-the-art results
5 on the challenging HLW dataset. HLW dataset is the
6 horizon lines in the wild. So this is a set of apparently
7 challenging images that can be used to both I guess to
8 train but also to test neural net.

9 BY MR. DUTTON:

10 Q And according to Workman, a CNN could be used in
11 isolation of a previously geometric approach for detecting
12 the horizon line, right?

13 A Could be.

14 Q And Workman also states that the CNN could be
15 used in conjunction with previous geometric approaches to
16 determine the horizon line, right?

17 A Yes.

18 Q As Workman says in the first sentence of the
19 intro, The horizon line estimation is one of the most
20 fundamental geometric properties in computer vision,
21 right?

22 MR. RIBERA: Objection; misstates the record.

23 THE WITNESS: What he says is a single image horizon
24 line has estimation is one of the most fundamental
25 geometric problems in computer vision. So detecting a

1 horizon line from a single image.

2 BY MR. DUTTON:

3 Q Do you agree that at the time of this
4 publication, that same image horizon line estimation was a
5 fundamental geometric problem in computer vision?

6 A Well, I'm going to take their word for it. I
7 mean, they're making the assertion that this is a
8 fundamental problem determining a horizon line from a
9 single image. I mean, horizon lines have been around a
10 long time. So I'm not sure if I would place the date at
11 which it became a fundamental geometric problem in 2016.

12 Q Sure. That's fair.

13 And then the next sentence of the introduction,
14 Workman refers to different applications that the horizon
15 line estimation can be used for, right?

16 A Yes.

17 Q And Workman states that one of the applications
18 include vehicle detection?

19 A Yes. His words are, Geometrically biased
20 pedestrian and vehicle detection.

21 THE STENOGRAPHIC REPORTER: Pedestrian what?

22 THE WITNESS: Pedestrian and vehicle detection.

23 THE STENOGRAPHIC REPORTER: Thank you.

24 BY MR. DUTTON:

25 Q So Workman states that the knowledge of the

1 horizon line was applicable to applications including
2 geometrically biased pedestrian and vehicle detection?

3 A That's correct, yes.

4 Q Okay. I think we can move to -- back to the '580
5 patent.

6 A I want to point out before we go there that
7 geometrically biased pedestrian and vehicles detection is
8 reference to Reference 14. Which is a paper called,
9 Putting Objects in Perspective. So it isn't necessarily a
10 paper about using neural nets in the automotive context.
11 It's about detecting objects in general. And one of the
12 objects it's detected is, obviously, pedestrians and
13 vehicles.

14 Q Is detecting pedestrians and vehicles relevant to
15 autonomous vehicles?

16 MR. RIBERA: Objection; vague.

17 THE WITNESS: Sometimes. Depends. You know, you can
18 go out here in the streets of San Francisco and see all
19 these Waymo cars running around, and they use lidars and
20 things to detect vehicles. So... might be applicable. It
21 might not.

22 BY MR. DUTTON:

23 Q I'd like us to turn to Claim 1 of the '580
24 patent.

25 A Okay.

1 Q And Claim 1 is a method claim, right?

2 A Yes.

3 Q And it includes a series of steps?

4 A Yes.

5 Q I'd like us to, if we could, just refer to these
6 as Steps A through G, which I believe that the parties
7 have used that convention; is that fair?

8 A Sure.

9 Q Okay. So Step A is the receiving step?

10 A Yes.

11 Q Step B is the identifying step?

12 A Yes.

13 Q Step C is the computing step?

14 A Yes.

15 Q Step D is the overlaying step?

16 A Yes.

17 Q Step E is the first transmitting step?

18 A Yes.

19 Q F is the receiving step, the second receiving
20 step?

21 A Second receiving step.

22 Q And then G is the second transmitting step?

23 A Correct.

24 Q Okay. So I'd like us to focus on Steps A and B
25 first. And Step A recites, Receiving, over a network from

1 a camera device, a video comprising a set of image frames.

2 Do you see that?

3 A Yes.

4 Q And then Step B recites, Identifying one or more
5 lines in the video using a predictive model. And that
6 includes some additional claim language. Do you see that?

7 A Yes.

8 Q Step B would have to occur after Step A because
9 it refers to the video, right?

10 MR. RIBERA: Objection; vague, beyond the scope.

11 THE WITNESS: It appears that that's the case, yes.

12 BY MR. DUTTON:

13 Q Okay. So Step B would be performed after Step A
14 then?

15 MR. RIBERA: Same objection.

16 THE WITNESS: Well, you are identifying lines in the
17 video. And -- actually, it's not clear that it has to be
18 done before -- Step B has to be done before Step A. If --
19 if you are identifying the lines in the video using a
20 predictive model, I don't know, this is going to sound
21 redundant, but after receiving it over the network, then
22 yes. You would receive it over the network and then
23 identify the lines.

24 But there's nothing that would prevent you from
25 identifying the lines in the video before receiving it

1 over the network.

2 BY MR. DUTTON:

3 Q Okay. So it's your opinion that Step B can
4 happen before Step A?

5 MR. RIBERA: Objection; beyond the scope.

6 THE WITNESS: It could. I'm just saying that the --
7 because it's a method claim, it doesn't specify where the
8 identification step takes place. And so it could
9 conceivably take place in either place. Right? It
10 could -- you can identify the one or more lines in the
11 video using the predictive model before it was transmitted
12 and subsequently received over the network.

13 Or you could identify it after you had received
14 it. Depends on where your predictive model is
15 implemented.

16 BY MR. DUTTON:

17 Q Okay. Similar questions for Steps B and C.
18 Let's see. Or sorry, Steps B and C, yeah. So Step C
19 recites, Computing at least one parameter based on the one
20 or more lines. And the one or more lines are identified
21 in Step B. Right?

22 MR. RIBERA: Objection; beyond the scope of the
23 direct.

24 THE WITNESS: I guess first of all, I haven't provided
25 any opinions about the order of steps here in my

1 declaration. But if you're just asking me looking at the
2 claim, the computing of the camera parameter is based on
3 the one or more lines, which means you have to have
4 identified the lines first.

5 BY MR. DUTTON:

6 Q Okay. So reading this claim, you would say that
7 Step C would have to occur after Step B?

8 MR. RIBERA: Objection; beyond the scope.

9 THE WITNESS: I'm saying that it's based on one or
10 more -- the one or more lines, and these are lines that
11 are identified in the video. So if you didn't have those
12 lines, then you would -- I mean, if you hadn't identified
13 them, then you wouldn't have the lines to compute the
14 camera parameter.

15 BY MR. DUTTON:

16 Q So in your opinion, Step C would have to occur
17 after Step B?

18 MR. RIBERA: Objection; beyond the scope.

19 THE WITNESS: I would have to spend more time
20 reviewing this, I think, to give you a concise answer to
21 that. Because I haven't analyzed the order of steps in my
22 declaration.

23 BY MR. DUTTON:

24 Q All right. So you don't provide opinions in your
25 declaration on the order of steps?

1 A No.

2 Q Would -- so Step D also recites, Overlaying the
3 one or more lines on the video. Do you see that?

4 A Yes.

5 Q And the one or more lines is referring to the
6 same one or more lines in the first identifying Step B,
7 right?

8 A It would appear so. I haven't provided any
9 opinions on this.

10 Q Okay. Do you have an opinion on whether Step D
11 has to occur before or after Step B?

12 MR. RIBERA: Objection; beyond the scope.

13 THE WITNESS: I have not provided any opinions on
14 that.

15 BY MR. DUTTON:

16 Q Do you have an opinion on whether Step D has to
17 occur after Step B?

18 A I would have to really review the specification
19 with that objective to be able to give an answer.

20 Q Do you have an opinion on whether Step E has to
21 occur after Step D?

22 MR. RIBERA: Objection; beyond the scope.

23 THE WITNESS: Same answer.

24 BY MR. DUTTON:

25 Q That answer is that you don't have an opinion on

1 whether Step E has to occur after Step D?

2 A I have not provided an opinion in my declaration
3 and -- for me to provide an opinion now, I would need to
4 analyze the patent again in more detail.

5 Q Do you have an opinion on whether Step F has to
6 occur after Step E?

7 MR. RIBERA: Objection; beyond the scope.

8 THE WITNESS: Same answer.

9 BY MR. DUTTON:

10 Q You don't have an opinion on the order of steps
11 with respect to Steps E and F?

12 A I have not provided an opinion in my declaration,
13 and I am not prepared to provide an opinion right now,
14 without studying the patent in more detail.

15 Q Do you have an opinion on whether Step G has to
16 occur after Step C?

17 MR. RIBERA: Objection; beyond the scope.

18 THE WITNESS: Haven't provided an opinion, and -- in
19 my declaration, and I would need to study the patent in
20 more detail to provide an answer.

21 BY MR. DUTTON:

22 Q Okay. Just one more here.

23 Do you have an opinion on whether Step G has to
24 happen after Step F?

25 MR. RIBERA: Objection; beyond the scope.

1 THE WITNESS: Step G is transmitting?

2 BY MR. DUTTON:

3 Q Yeah, the second transmitting step.

4 A Same answer. I haven't provided any opinions
5 about this. And I would need to study the patent in more
6 detail before giving an answer.

7 Q Okay. Do you have any opinions about the order
8 of any of these steps in Claim 1 of the '580 patent?

9 MR. RIBERA: Objection; beyond the scope.

10 THE WITNESS: I have not provided any opinions on
11 that.

12 BY MR. DUTTON:

13 Q So you have not provided any opinion in this IPR
14 about the order of steps with respect to the '580 patent?

15 A Correct.

16 Q Okay. Do you have any opinions on the order of
17 steps with respect to the '580 patent sitting here today?

18 MR. RIBERA: Objection; beyond the scope.

19 THE WITNESS: I would have to analyze the patent in
20 more detail with that objective in mind.

21 BY MR. DUTTON:

22 Q Okay. So you haven't, as of today, done an
23 analysis on whether there's a required order of steps in
24 the '580 patent?

25 A I have not --

1 MR. RIBERA: Objection; beyond the scope.

2 THE WITNESS: I have not.

3 BY MR. DUTTON:

4 Q All right. So again, Step A recites, Receiving,
5 over a network from a camera device, a video comprising a
6 set of image frames. Did I read that correctly?

7 A Yes.

8 Q Is it your opinion that the network has to be
9 remote or like the -- the receipt has to be received
10 remotely from the autonomous vehicle?

11 MR. RIBERA: Objection; beyond the scope.

12 THE WITNESS: Going to be one second.

13 I haven't provided any opinions about that. And
14 I don't think it specifies -- the patent doesn't specify
15 whether that network has to be remote or not.

16 BY MR. DUTTON:

17 Q Okay. So the network could be local to the
18 camera?

19 MR. RIBERA: Objection; beyond the scope.

20 THE WITNESS: It just doesn't say.

21 BY MR. DUTTON:

22 Q If we go to Figure 1, and Item 108 in the middle
23 is labeled, Bus. Do you see that?

24 A Yes.

25 Q Is that a CAN bus?

1 MR. RIBERA: Objection; beyond the scope.

2 THE WITNESS: It says it could be.

3 BY MR. DUTTON:

4 Q And what is a CAN bus?

5 A Controller area network.

6 THE STENOGRAPHIC REPORTER: I'm sorry, it's a what?

7 THE WITNESS: Controller area network. It's a bus
8 that's commonly used in automotive applications.

9 THE STENOGRAPHIC REPORTER: Sorry, you're saying CAN,
10 C-A-N?

11 THE WITNESS: C-A-N.

12 THE STENOGRAPHIC REPORTER: Okay, thank you.

13 BY MR. DUTTON:

14 Q And Figure 1, there's a box labeled, Cameras
15 102D, right?

16 A Yes.

17 Q And I believe we -- Camera 102 can be like a
18 video camera?

19 A It just says digital cameras in this, but could
20 be some form of camera.

21 Q If camera 102 is a video camera, the system would
22 receive video at Camera 102, right?

23 MR. RIBERA: Objection; vague.

24 THE WITNESS: Which system?

25

1 BY MR. DUTTON:

2 Q The system shown in Figure 1.

3 MR. RIBERA: Same objection.

4 THE WITNESS: You're saying it would receive video?

5 BY MR. DUTTON:

6 Q I'll -- I can rephrase the question to would a
7 Camera 102 capture a video in Figure 1?

8 MR. RIBERA: Objection; vague.

9 THE WITNESS: Camera 102D would capture images based
10 on whatever kind of camera it was.

11 BY MR. DUTTON:

12 Q If it was a video camera, would it capture image
13 frames?

14 MR. RIBERA: Objection; vague.

15 THE WITNESS: If it was a video camera, it would
16 capture a sequence of -- some sequence of image frames.

17 BY MR. DUTTON:

18 Q And then the video could get sent over Bus 108
19 to, for example, Memory 112, right?

20 MR. RIBERA: Objection; vague.

21 THE WITNESS: Sorry, one sec.

22 The patent -- I guess to answer your question,
23 the patent talks about both kinds of processes, both kinds
24 of architectures where it could be performed in the
25 vehicle or remotely.

1 BY MR. DUTTON:

2 Q It being...

3 A The processes of the patent. If you look at
4 Column 8. Let's see. What does it say? So specifically,
5 it's Column 8, line 31, Specifically, the processing in
6 Figure 2 utilizes a remote computing system to annotate
7 horizon and lane line, and in some cases, manually adding
8 lane markers.

9 THE STENOGRAPHIC REPORTER: Adding what?

10 THE WITNESS: In some cases, manually adding lane
11 markers.

12 In some systems, a vehicular system can use the
13 system of Figure 3A. And -- so Figure 3A includes all of
14 these processes in the vehicle.

15 BY MR. DUTTON:

16 Q Okay. So when we are referring to Step A of
17 Claim 1 of the '580 patent, the, A network could be local
18 or for a remote connection?

19 MR. RIBERA: Objection; vague.

20 THE WITNESS: I guess first of all, I haven't provided
21 any opinions on this in my declaration. But it appears
22 that the patent describes two different embodiments where
23 this process is carried out, may be carried out either
24 remotely or locally.

25 So it could be received by some other element in

1 the vehicle or it could be received by a remote element.

2 BY MR. DUTTON:

3 Q Okay. So for example, a memory could receive
4 over a CAN network, so -- rephrase.

5 For Step A, an example would be that a memory
6 receives over the CAN bus from a camera device a video
7 comprising a set of images. Would that satisfy that
8 limitation?

9 MR. RIBERA: Objection; vague, beyond the scope.

10 THE WITNESS: If the network was in the vehicle,
11 connecting a camera to a memory, then the memory would
12 receive the video locally within the vehicle.

13 BY MR. DUTTON:

14 Q Okay. And a CAN is a network?

15 MR. RIBERA: Objection; vague.

16 THE WITNESS: CAN is a bus. And it is common to refer
17 to it as a network. But it isn't really a network. So
18 hard to -- hard to say.

19 BY MR. DUTTON:

20 Q The bus is kind of interfaced for the network of
21 components?

22 MR. RIBERA: Objection; vague, beyond the scope.

23 THE WITNESS: No. It really is that a network implies
24 that all -- how do I want to say this?

25 A network implies that all nodes on the network

1 are able to -- actually, it would be hard to describe
2 this. And I haven't really provided any opinions about
3 it. But CAN is typically referred to as CAN bus. And a
4 bus is kind of a single point to multipoint serial
5 communication system whereas network is a more general
6 concept.

7 So a bus could be a network, but a network isn't
8 necessarily a bus.

9 BY MR. DUTTON:

10 Q In the context of the '580 patent, is the CAN bus
11 a network?

12 MR. RIBERA: Objection; beyond the scope.

13 THE WITNESS: I mean, I guess they call it controller
14 area network. So I guess you could use the terms
15 interchangeably.

16 BY MR. DUTTON:

17 Q Okay. They being the inventors of the '580
18 patent?

19 A Just CAN bus in general.

20 Q Okay. If you go to paragraph 32 of your
21 declaration -- actually, 39.

22 A The revised declaration?

23 Q Yeah.

24 A Okay.

25 Q Here is a section where you describe your

1 understanding of obviousness, right?

2 A Mm-hmm. Yes.

3 Q And at about the end of the paragraph, you state
4 that you were informed of so-called objective indicia of
5 nonobviousness, known as secondary considerations. Do you
6 see that?

7 A Yes.

8 Q And then you list six secondary considerations,
9 right?

10 A Yes.

11 Q And you understand that these secondary
12 considerations can be considered when assessing
13 obviousness?

14 A Yes.

15 Q In your report, you didn't provide any opinions
16 on these secondary considerations of obviousness, right?

17 A No.

18 MR. RIBERA: Objection; vague.

19 THE WITNESS: No, I haven't.

20 BY MR. DUTTON:

21 Q Just to be clear, you haven't provided any
22 opinions on these secondary considerations of obviousness?

23 A I don't believe I explicitly provided any
24 opinions on that.

25 Q Okay. And sitting here today, you don't have any

1 opinions on secondary considerations of obviousness with
2 respect to the '580 patent?

3 A I have not provided any today. And I don't have
4 any to offer right now.

5 Q Okay. All right. I'm handing the witness what
6 has been previously marked as Exhibit 1002.

7 Do you recognize this exhibit?

8 A This is the... this appears to be the file
9 history for the '580 patent.

10 Q And you reviewed this file history, right?

11 A Yes. I didn't review every single page of it.
12 But I reviewed the various office actions and responses.

13 Q If we could go to page 145. And I'll represent
14 that this is an office action response from the applicants
15 of the patent.

16 Have you reviewed this response?

17 A Yes.

18 Q Okay. And this is a response to the office
19 rejecting the claims based on -- based on a Kwant1 and a
20 Kwant2 reference, right?

21 A Yes.

22 Kwant is spelled with a K.

23 THE STENOGRAPHIC REPORTER: Oh, thank you.

24 THE WITNESS: K-w-a-n-t.

25 BY MR. DUTTON:

1 Q And in response, the patent owner argued that
2 Kwant1 did not use a predictive model, right?

3 A He said it does not use a predictive model to
4 detect a horizon line.

5 Q Okay. What else did the patent owner argue to
6 overcome Kwant1?

7 A He said that Kwant describes predicting lane
8 lines, and then it describes extending the lane lines and
9 using a geometric approach identifying a horizon line.

10 Q And that's the argument with respect to the
11 identifying step in Claim 1 of identifying one or more
12 lines in the video using a predictive model?

13 A The one or more lines including horizon line,
14 yes.

15 Q The applicant also raised arguments with respect
16 to other limitations of Claim 1, right?

17 A Yes. They had an argument or response relating
18 to the term or the description of camera parameters in
19 Kwant.

20 Q Okay. They argued that the parameters in Kwant1
21 did not relate to the camera, right?

22 A Yes. So I'll just read it as page 146 of section
23 cites to, quote, 12 parameters, unquote, in Kwant1
24 described in paragraph 113. However, these parameters are
25 not parameters related to a camera. They are of a para --

1 quote, Parametric representation of a single lane line,
2 unquote. That is, these parameters define the parametric
3 coefficients of a given lane line and thus define the lane
4 line.

5 These parameters simply have no relation to the
6 camera used to generate the image but rather describe the
7 lines that are a pure mathematical representation of a
8 line.

9 Q So according to the applicant, the camera
10 parameters have to relate to the camera itself, right?

11 MR. RIBERA: Objection; vague.

12 THE WITNESS: Well, he was -- he does say that they're
13 not -- Kwant's parameters are not parameters related to a
14 camera. They're parameters that -- mathematical
15 parameters that simply describe a line. He goes on to
16 say, Applicant notes that the specification is clear that
17 a camera parameter is a property of the camera itself, for
18 example, height viewing angle, road plane normal --

19 THE STENOGRAPHIC REPORTER: I'm sorry, I can't hear
20 you.

21 THE WITNESS: Height viewing angle, road plane normal,
22 et cetera, unquote.

23 BY MR. DUTTON:

24 Q Do you agree with the applicant that the
25 specification is clear that a camera parameter is a

1 property of the camera itself?

2 MR. RIBERA: Objection; beyond the scope.

3 THE WITNESS: I think it is -- I think the applicant
4 could have been clearer. The patent does specifically
5 give examples a couple of different times about the camera
6 parameters being height, viewing angle, road plane normal,
7 et cetera.

8 THE STENOGRAPHIC REPORTER: Sorry, you're trailing
9 off. It's a bit hard to understand you.

10 THE WITNESS: I'm sorry.

11 The patent itself describes camera parameters as
12 being these geometric parameters associated with the pose
13 of the camera, height, viewing angle, road plane normal,
14 et cetera. The patent doesn't, for example, mention other
15 parameters associated with the camera itself, as you
16 stated it. You know, operational -- or I shouldn't say
17 that. You know, kind of structural aspects of the camera,
18 the size of the frame, the frame rate, various other
19 things that might be related to the way in which the
20 camera is constructed.

21 So the camera parameters that are at issue in the
22 '580 patent are really relating to the pose of the camera.
23 This is how I read it. All the examples that are given
24 are related to the pose of the camera and not some sort
25 of, I think we use the term earlier today, intrinsic

1 elements of the camera, like, you know, the field of view
2 and the, you know, the lens F-stop and various other
3 things like that.

4 BY MR. DUTTON:

5 Q So for the '580 patent, a camera parameter is
6 related to the pose of the camera?

7 A I don't know that it uses that term. That's the
8 term that I used. But it does provide several examples
9 where -- so here's an example in Column 1, line 61,
10 Finally, the on-vehicle device can compute a camera
11 parameter, for example, height, viewing angle, road plane
12 normal, et cetera, based on the horizon line and key lane
13 points.

14 So the examples that the patent gives of the
15 camera parameter are generally these geometric
16 pose-related parameters.

17 Q Okay. So going back -- so I think we covered
18 that the applicant argued the predictive model limitation
19 and the camera parameter limitation. The applicant also
20 included other arguments for Claim 1, right?

21 A Hard to read where the pages are.

22 Q Might be easier to just unclip it.

23 A Yeah. Yes. He had argued a variety of other
24 reasons why Kwantl did not disclose or render obvious
25 Claim 1.

1 Q Okay. And one of those arguments was that Kwantl
2 did not disclose the overlaying step, right?

3 THE STENOGRAPHIC REPORTER: You said overlying?

4 MR. DUTTON: Overlaying.

5 THE STENOGRAPHIC REPORTER: Thank you.

6 THE WITNESS: That's correct.

7 BY MR. DUTTON:

8 Q And part of this argument, the last sentence
9 states that, Applicant asserts that Kwantl must describe a
10 process for generating an image, and the failure to do so
11 renders Kwantl deficient, right?

12 A That's what he says, yes.

13 Q So according to the applicant, this overlaying
14 step required a process for generating an image?

15 MR. RIBERA: Objection; beyond the scope.

16 THE WITNESS: So his argument here is that there is an
17 image that the examiner cited in Kwantl, but this is not
18 an image, has superimposed on it some additional lines,
19 which are used to explain something in the image. They're
20 not a -- they're not a product of a process of overlaying
21 the lines. It's really more of an explanatory tool in
22 Kwantl.

23 And he's arguing that they haven't described any
24 process whereby the description of Kwantl isn't using the
25 diagram that the examiner is referring to as part of the

1 process. It's using it as part of an explanation of what
2 Kwant1 is talking about.

3 BY MR. DUTTON:

4 Q Okay. And then the next argument relates to the
5 transmitting overlay video to an annotator device for
6 manual review, right?

7 A I'd have to look at Kwant1 to know what his
8 Figure 4 is, but he says that Kwant1 fails to describe
9 transmitting an overlaid video to a, quote, Annotator
10 device for manual review.

11 Q And the applicant included another argument for
12 the receiving a confirmation from the annotator device,
13 that step, right?

14 A Correct.

15 Q And --

16 A This is Kwant2.

17 Q This is Kwant2, right.

18 And so why didn't Kwant2 not disclose this
19 element?

20 MR. RIBERA: Objection; beyond the scope.

21 THE WITNESS: All he's arguing is that Kwant2 is
22 describing a neural network learning process as opposed
23 to -- which is an automated process, as opposed to a
24 manual process where an annotator, which is an individual,
25 would...

1 BY MR. DUTTON:

2 Q Okay. So that would be like the example in Choe?

3 A Choe.

4 Q Yeah.

5 So if we go to Claim 1, just to kind of as a
6 recap, during the prosecution history in this response to
7 the office's rejection, the applicant argued that the
8 combination of Kwant1 and Kwant2 failed to disclose
9 Steps B through F, right?

10 A Yes.

11 Q Let's go then to the notice of allowance. Which
12 is on -- starts on page 164.

13 A Okay.

14 Q And if we then go to the -- first off, did you
15 review the notice of allowance when providing your
16 opinions?

17 A Briefly.

18 Q Okay. On page 169 are the reasons for allowance.
19 Do you see that?

20 A Yes.

21 Q All right. The end of this page, the examiner
22 stated that, The prior art was found for the claims as
23 follows. Are you following?

24 A Yeah.

25 Q Regarding Claim 1, Kwant1 discloses, colon, and

1 then it includes a couple of limitations, right?

2 A Yes.

3 Q The first being the receiving step, Step A,
4 right?

5 A One second. I'm trying to... I'm on the wrong
6 page.

7 Q So at the top of page 170.

8 A Yeah, I was looking at 171. Sorry. Okay, so
9 Kwantl describes -- question was?

10 Q Right, so the examiner maintained that Kwantl
11 disclosed Step A, which is the first receiving step,
12 right?

13 A Yes.

14 Q And the examiner maintained that Kwantl disclosed
15 the identifying step, right?

16 A That's what he says, yes.

17 Q And the examiner maintained that Kwant's, what
18 the applicant argued was a geometric approach disclosed
19 the predictive model to identify the one or more lines
20 including a horizon line, right?

21 MR. RIBERA: Objection; misstates the record.

22 THE WITNESS: So he provides some parenthetical
23 explanation of what he thinks in Kwantl represents,
24 identifying one or more lines in a video using a
25 predictive model.

1 BY MR. DUTTON:

2 Q And according to the examiner, the Kwantl
3 disclosed a predictive model that was used to identify the
4 horizon line, right?

5 A That's what the examiner says. Yes.

6 Q Okay. And the applicant had argued that that
7 predictive model used the geometric approach?

8 A Yes.

9 Q So the examiner was not persuaded that the
10 predictive model excluded geometric calculations for both
11 horizon line detection, right?

12 MR. RIBERA: Objection; vague, misstates the record.

13 THE WITNESS: I think that the examiner read the --
14 this is my opinion, and I haven't offered this in the
15 declaration, but I think he's reading prediction
16 confidence values and things related to the way that Kwant
17 is describing the outcome of its process as representing
18 the predictive model.

19 And I think the examiner is not really
20 understanding what a predictive model is as described in
21 the patent. But this is the examiner's opinion, and he's
22 entitled to it.

23 BY MR. DUTTON:

24 Q Okay. And the examiner did not maintain its
25 position that Kwantl disclosed Steps C through F, right?

1 MR. RIBERA: Objection; vague.

2 THE WITNESS: I'm looking...

3 BY MR. DUTTON:

4 Q We can take these one by one.

5 A F is -- I think he does say that -- or you said
6 Kwant1?

7 Q Yeah, let me rephrase. Because F -- F is Kwant2
8 and that made it confusing.

9 A Yeah.

10 Q The examiner did not maintain its rejection with
11 respect to Steps C through E as it relates to Kwant1,
12 right?

13 MR. RIBERA: Objection; vague.

14 THE WITNESS: He didn't say anything about that.

15 BY MR. DUTTON:

16 Q Okay. So the -- so in the notice of allowance,
17 the examiner did not --

18 THE STENOGRAPHIC REPORTER: I'm sorry, so what?

19 BY MR. DUTTON:

20 Q In the notice of allowance, the examiner did not
21 allege that Kwant1 disclosed Steps C through E, right?

22 MR. RIBERA: Objection; vague.

23 THE WITNESS: So he was silent on Steps C through E.
24 In fact, in paragraph or, yeah, paragraph 6 of 171, he
25 describes what the unique -- what, in his opinion, the

1 uniquely claimed features were.

2 BY MR. DUTTON:

3 Q And among those are Steps C through E, correct?

4 A Identifying, computing, overlaying, transmitting.

5 Q Okay. So the combination of those steps?

6 A And receiving a confirmation.

7 Q Okay. If we go to paragraph 25 of your
8 declaration, this is where your analysis of prosecution
9 history is, right?

10 A Yes.

11 Q And you discuss the prosecution history from
12 paragraphs 25 through 28?

13 A Yes.

14 Q And you limited your analysis to the identifying
15 step, right?

16 A In this portion of my declaration, yes.

17 Q And in your declaration, you do not analyze the
18 examiner's handling of the other arguments that the
19 applicants raised with respect to Kwant1 and Kwant2,
20 right?

21 A That's correct.

22 Q I think now's a good time for a short break.

23 (Recess taken.)

24 BY MR. DUTTON:

25 Q All right. Mr. Andrews, during any of the breaks

1 today, did you talk about the substance of your testimony
2 with counsel?

3 A No. No.

4 Q I appreciate you sitting for a deposition today.
5 We have no further questions at this time.

6 A Okay. Thank you.

7 MR. RIBERA: We don't have any further recross.

8 (WHEREUPON THE DEPOSITION WAS
9 CONCLUDED AT 2:10 P.M.)

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1 Please be advised I have read the
2 foregoing deposition, pages 1 through
139, inclusive.

3 I hereby state there are:

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(Check one) _____ no corrections

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_____ corrections per attached

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SCOTT ANDREWS

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WITNESS'S CHANGES OR CORRECTIONS

NOTE: If you are adding to your testimony, print the exact words you want to add. If you are deleting from your testimony, print the exact words you want to delete. Specify with "Add" or "Delete" and sign this form.

Deposition of: SCOTT ANDREWS
Case Title: SAMSARA V. MOTIVE
Date of Deposition: JANUARY 16, 2026

I, _____ have
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CERTIFICATE OF SHORTHAND REPORTER/STENOGRAPHER

I, Christa Yan, Certified Shorthand/Stenographic Reporter within and for the State of California do hereby certify:

That Scott Andrews, the Witness whose deposition is hereinbefore set forth, was duly sworn by me before the commencement of such deposition and that such deposition was taken before me and is a true record of the testimony given by such witness.

I further certify that both parties were represented by counsel at the deposition.

I further certify that the deposition of Scott Andrews, occurred personally at the offices of Greenberg Traurig on January 16, 2026, commencing at 8:58 a.m., to 2:10 p.m.

I further certify that I am not related to any of the parties to this action by blood or marriage, I am not employed by or an attorney to any of the parties to this action, and that I am in no way interested, financially or otherwise, in the outcome of this matter.

IN WITNESS WHEREOF, I have hereunto set my hand this 22nd day of January 2026.



CERTIFIED SHORTHAND/STENOGRAPHIC REPORTER
IN AND FOR THE STATE OF CALIFORNIA

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