Deposition Transcript

Case Number: N/A
Date: February 27, 2026

In the matter of:

SAMSUNG ELECTRONICS CO. LTD., et al v CM HK, LTD

MAJID SARRAFZADEH, PH.D.

CERTIFIED COPY

Reported by:
ANNETTE ARLEQUIN



Steno
Agency, Inc.

315 West 9th Street
Suite 807
Los Angeles, CA 90015
concierge@steno.com
(888) 707-8366
NV: Firm #108F

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,

Petitioner,

v.

CM HK LIMITED,

Patent Owner

IPR2025-01071

Patent 11,852,687

and

IPR2025-01023

REMOTE ZOOM DEPOSITION

OF

MAJID SARRAFZADEH, PH.D.

Friday, February 27, 2026

Reported stenographically by:
ANNETTE ARLEQUIN, CA CSR #15085, RPR, CRR, RSA
JOB NO. 2435766

February 27, 2026

9:00 a.m. (Pacific)

REMOTE ZOOM Deposition of MAJID SARRAFZADEH, PH.D., pursuant to Notice, before Annette Arlequin, a California Certified Shorthand Reporter #15085, a Registered Professional Reporter, a Certified Realtime Reporter, a Realtime Systems Administrator and a Notary Public.

A P P E A R A N C E S: (Remotely)

PAUL HASTINGS - DEFENDING
Attorneys for Petitioner Samsung
Electronics Co., Ltd.
MetLife Building
200 Park Avenue
New York, New York 10166
BY: ROBERT LAURENZI, ESQ.
CHETAN BANSAL, ESQ.

OFFOR EVANS PLLC
Attorneys for Patent Owner, CM HK Limited
1122 Jackson Street, Suite 901
Dallas, Texas 75202
BY: CHRISTOPHER EVANS, ESQ.
Email: chris@offorevans.com
Phone: 214-593-9121
BY: ANDREW HUFFSTETLER, ESQ.
Email: andrew@offorevans.com
- and -
(Continued on following page)

A P P E A R A N C E S (Cont'd.): (Remotely)

THE SHORE FIRM
Attorneys for Patent Owner
5646 Milton Street, Suite 423
Dallas, Texas 75206
BY: MICHAEL SHORE, ESQ.
Phone: 214-593-9110

ALSO PRESENT:

CASEY STARK, Videographer (Morning/Midday
SHAWN JOHNSON, Videographer (Late Afternoon)

- o0o -

I N D E X

WITNESS PAGE

MAJID SARRAFZADEH, PH.D.

DIRECT EXAMINATION BY MR. EVANS

QUESTIONS INSTRUCTED NOT TO ANSWER

Page	Line
128	5
131	3
131	8
132	22
133	13
278	13
278	19

I N D E X O F E X H I B I T S

DESCRIPTION	PAGE
Deposition Exhibit 1002, Declaration of Dr. Majid Sarrafzadeh in Support of Petition for Inter Partes Review of U.S Patent No. 11,698,687	11
Deposition Exhibit Paper014, Document titled "List of Exhibits,"	74
Deposition Exhibit 2026, Responsive Declaration of M. Ray Mercer, Ph.D.	113

I N D E X O F E X H I B I T S(Cont'd.)

DESCRIPTION	PAGE
Deposition Exhibit 1021, Claim Construction Opinion and Order	147
Deposition Exhibit 2033, Rebuttal Declaration of Professor Majid Sarrafzadeh	
Deposition Exhibit 1001, U.S. Patent No. 10,852,846	204
Deposition Exhibit 2032, Declaration of Professor Majid Sarrafzadeh	205
Deposition Exhibit 1006, International Publication Number WO 2009/156499 A1	315

THE VIDEOGRAPHER: We are on the record. My name is Casey Stark. I'm a notary public contracted by Steno. I am not financially interested in this action, nor am I a relative or employee of any of the attorneys or any of the parties.

Today is February 27th, 2026. The time is 8:57 a.m. Pacific time.

This video deposition is taking remotely via Zoom.

The name of the case is Samsung Electronics Co., Ltd. et. al., versus CM HK, Ltd. filed in the United States Patent and Trademark Office, case IPR 2025-01071.

This is the video recorded deposition of Dr. Majid Sarrafzadeh.

Volume one.

The attorney taking this deposition is Christopher Evans.

Will the attorneys please introduce themselves and state whom you represent?

MR. EVANS: My name is

Christopher Evans, I represent CM HK, and I will be taking the deposition today.

Joining me today are my colleagues Michael Shore and Andrew Huffstetler.

MR. LAURENZI: Robert Laurenzi, of Paul Hastings on behalf of petitioner, and I'm joined by my colleague Chetan Bansal.

THE VIDEOGRAPHER: We are ready to proceed.

The court reporter today is Annette Arlequin with Steno.

Would the reporter please swear in the doctor.

(Oath administered)

THE WITNESS: I do.

M A J I D S A R R A F Z A D E H, Ph.D.
called as a witness, having been duly sworn testified as follows:

- - - - - - - -

EXAMINATION

- - - - - - - -

BY MR. EVANS:

Q. Hello, my name is Christopher Evans. I'm going to be representing the patent owners, CM HK, Limited in this deposition.

And I apologize I'm going to do the my best with pronunciation, Sarrafzadeh? Sarrafzadeh?

A. Yes.

08:59AM Q. I'm assuming you've been deposed before?

A. I have.

Q. And you've been an expert in inter partes review proceedings before?

09:00AM A. I have.

Q. Approximately how many IPRs have you submitted opinions in?

A. I'm not certain, maybe -- if I had to guesstimate, maybe 5, 6, but I'm not certain.

09:00AM Q. Okay. And you previously represented Google in IPRs against CyWee Group?

A. I do recall a case that involved Google and CyWee Group, yes.

Q. And that involved patents that were predecessors of the patents-at-issue here?

A. There were some patents. I don't know their relationship to these patents.

Q. Now you understand that you are under the same oath as if you were testifying in a courtroom, correct?

A. I do understand that.

Q. I'm going to assume that you understand my questions unless you tell me otherwise.

Is that fair?

A. That's fair.

Q. Please don't hesitate to ask for clarification if you need it.

A. I do appreciate that.

Q. Is there anything preventing you from thinking clearly or testifying truthfully here today?

A. Nothing that I can think of.

Q. Who else is in the room with you today?

A. Mr. Laurenzi is here in the room with me.

Q. And where are you located right now?

A. I am in Irvine, California.

Q. At the offices of Paul Hastings?

A. That's correct.

Q. How far from your house is that?

A. I would say about 20 minutes.

Q. If you need a break at any point in this deposition, just let me know. I'm happy to give you one.

The only exception would be if there is a question pending, I would just ask you answer it before we take a break. Is that okay?

A. I do appreciate that very much. Thank you.

MR. EVANS: Let's pull up Exhibit 1002.

Andrew, are you there? Can you make that bigger? It's pretty hard to read.

(Deposition Exhibit 1002, Declaration of Dr. Majid Sarrafzadeh in Support of Petition for Inter Partes Review of U.S Patent No. 11,698,687,

marked for identification, as of this date.

BY MR. EVANS:

Q. Is this a declaration that you submitted in the IPR involving the '846 [sic] patent?

MR. LAURENZI: Doctor, you can the download it as well.

Did they teach you how to do that?

THE WITNESS: Yeah, let me see how I would download that.

MR. LAURENZI: In Steno Connect.

THE WITNESS: And if you show me.

MR. EVANS: Actually, Andrew, if you can go to the declaration that goes with the '687 patent for the IPR 1071.

(Document review.)

MR. LAURENZI: Do you see that?

THE WITNESS: I do appreciate it. How do I go back to Zoom?

MR. EVANS: Don't worry, you're being recorded.

MR. LAURENZI: Just look at the exhibit. I'll let you know if there is

a problem with the video.

MR. EVANS: Hang on. I think we're swapping to the exhibit from the other IPR proceeding involving the '687 instead of the '846 patent.

BY MR. EVANS:

Q. While you're doing that, you submitted declarations in the IPRs, the two IPRs at issue here today?

09:04AM A. I have indeed submitted two declarations in this case.

Q. In the two IPRs that we're here about today are IPR 2025-01071, which involves the '687 patent, and IPR 2025-01023, which involves the '846 patent.

A. Read those numbers again, please?

Q. Which ones, the patents or the IPRs or all of them?

A. The IPRs and the patents.

09:05AM Q. Sure.

The two patents that are at issue are 11,698,687 and that goes with IPR 2025-01071.

A. Okay. Where do I see the IPR number on the document?

Q. That's okay. I don't need you to testify about that.

A. Okay. I take your word for it then.

09:05AM Q. Are those the two patents that you submitted declarations about, though?

A. There are two patents. And if you don't mind, I'll refer to them as the '846 patent and the ''687 patent throughout

09:06AM the day.

Q. That works for me.

MR. LAURENZI: By the way, Counsel, so you know, the witness does have paper copies of his declarations.

09:06AM MR. EVANS: I was just going to ask.

BY MR. EVANS:

Q. I noticed that you were looking at some documents.

09:06AM What do you have in front of you in the table where you're at?

A. A number of things. The laptop, my glasses, pencil, a glass of water and among other things that are on the table.

09:06AM In terms of documents, I have a

binder with a number of tabs. And by way of example, one of the documents is the declaration that I have submitted, for example, for the '846 patent.

09:06AM Q. What other documents are in that binder?

A. Sure.

The next set of document that I have in my binder is my declaration related

09:07AM to '687 patent.

The next one is U.S. Patent 1,052,846 B2, which I shall refer to it as the '846 patent.

The next tab is an International

09:07AM Publication No. W02009/15649981. One of the inventors is Bassompiere.

If you don't mind, I'll refer to it as the Bassompiere publication.

Q. Is that the translation of it or

09:08AM is that the original French version?

A. This is an English translation of it.

Q. Okay.

A. The next tab is a publication is

09:08AM a IEEE publication with the name

"Quaternion-Based Orientation Estimation Algorithm Using an Inertial Measurement Unit."

There are two authors Anthony Kim and M.F. Golnaraghi.

And throughout the day, if you don't mind, I will refer to it as the Kim publication.

Q. That makes sense.

09:08AM A. The next tab -- sorry?

Q. I agree.

I will understand what you say when you say "Kim."

A. Thank you, sir.

09:08AM The next is U.S. Patent 8,462,109 B2. There are two inventors on this patent, Nasiri and Sachs.

And I shall refer to it, if that's okay as the Nasiri patent.

09:09AM Q. That's okay.

A. And the final tab is U.S. Patent 11,698,687 B2.

And as I mentioned earlier, I shall refer to it as the '687 patent.

09:09AM Q. That makes sense. I'll use those

same names.

A. Thank you.

And in terms of documents, that's all I have, and there are tabs in there.

09:09AM So there are tabs labeled 1, 2, 3, et cetera, which are not part of the original documents.

Q. Are there any notes on those documents?

09:10AM (Document review.)

A. I have asked the attorneys to provide me with a clean copy. And I just took a quick scan of the document, not page by page. And I don't see any notes on

09:10AM them, other than the tab numbers that I mentioned earlier.

Q. So you were provided that binder by the attorneys?

A. That's correct, at my request.

09:11AM Q. Who selected the content of the binder?

A. I did.

Q. Did you review any other materials besides those in the binder in

09:11AM preparation for this deposition?

A. These are the one that comes to mind. If throughout the day I recall other documents, I'll let you know.

Q. Who did you meet with in preparation for this deposition?

A. I met with Mr. Laurenzi and Mr. Bansal.

Q. Okay. I'd like to go to paragraph 39 of your declaration that's -- in relation to the '846 patent that we have up on the screen.

A. And please let me know the paragraph number again.

Q. 39.

A. Thank you. Okay.

Q. Do you have it in front of you?

A. I do have it in front of me in hard copy, not the electronic version.

Q. Okay. Do you see the last sentence of page 39 where you say "For purposes of my opinions in this declaration, I have applied the plain and ordinary meaning as understood by a person of ordinary skill in the art at the time of the alleged invention"?

A. Did you mean to say paragraph 39 and not page 39?

Q. Yes.

A. I do see that sentence that says, "For the purposes of my opinion in this declaration, I have applied the plain and ordinary meaning as understood by a person of ordinary skill in the art at the time of the alleged invention."

09:13AM Q. So you, for every claim term in the patents-at-issue, you used the plain and ordinary meaning; is that accurate?

A. That's correct.

Q. Okay. I see immediately under that you propose a construction for the term "spatial reference frame" in paragraph 40.

Do you see that?

A. I do.

09:13AM Q. Is that the plain and ordinary meaning in your view of spatial reference frame?

A. In the context of these patents, yes, it is.

09:13AM Q. Who came up with that definition?

A. Certainly something that I thought about it.

Q. Did you propose that definition to Samsung's attorneys?

09:14AM MR. LAURENZI: I caution the witness not to reveal any conversations with attorneys.

A. It's been a while, more than a year. I don't know how the conversation

09:14AM begin, but certainly that's construction that I agree with and that's my opinion and I know I had. Other than that, it's the discussion with the attorneys.

Q. When were you hired to work on

09:14AM this case?

A. In this case, you're referring to these two declarations basically?

Q. The two IPRs, correct?

A. The two IPRs.

09:14AM It's been a while. If I had to guess, I would say either sometime late 2024 or maybe early 2025. And that's purely a guesstimate. I'm not certain.

Q. How much time did you spend

09:15AM working on your declarations?

A. Again, this is roughly a year ago. I do not recall the number of hours I spent on it.

Q. Do you keep billing records?

09:15AM A. Sorry?

Q. Do you keep billing records when you work on these cases?

A. I do.

Q. Okay. So you do have a record of

09:15AM how much time you spent on this?

A. I think I believe I do, yes. If I still have them, yes.

Q. Well, how much have you been paid to date?

09:15AM A. For what?

Q. For these declarations.

A. I do not recall that.

Q. How much are you charging?

A. I don't understand the question.

09:16AM Q. How are you being compensated for your work?

A. I receive a check from the attorneys, I believe.

Q. And how do they know how much to

09:16AM pay you?

A. I send an invoice.
Q. And what is your invoice based on?
A. Based on the number of hours that I worked.
Q. So are you charging an hourly basis for this case?
A. I do.
Q. And what is your hourly rate?
A. My customary hourly rate for this and many other cases are $700 and over.
Q. And you don't know how much you've been compensated by Samsung for these two IPRs?
A. I do not recall that, no. It's been a while.
Q. What percentage of your annual personal revenue comes from expert work?
A. It varies from year to year.
Q. Last year, how much of your income was based on expert work?
A. I don't have a record of that.
Q. Do you know how much you made last year from expert witness work, roughly?

A. I do not recall that. I don't remember.

Q. More than 100,000?

A. I have to go back and check. I'm not clear.

Q. Have you ever earned more than a 100,000 in a year for expert witness work?

A. I have to go back and check. I don't pay as much attention to my income because my main salary comes from my university, and that's enough to support my life.

Q. Is your university income, then, the majority of your income?

A. My university income is the income that is sufficient for my life.

Q. That's not the question I asked.

A. I do not recall the exact numbers. I don't pay as much attention to the incomes. I do know that the salary that I receive from my university is sufficient to support my life and my family's life.

Q. Well, what is your annual university salary?

A. I believe for nine months, because we have a nine-month and 12-month salary, it's about 350K, approximately.

Again, that's not something I don't remember exactly or I pay as much attention to.

Q. Do you know how much you make typically in total in a year?

A. I don't know that. I have to go check.

Q. Going back to paragraph 40 here, in your proposed definition, why did you choose 3D pointing device?

Why is it a reference frame associated with a 3D pointing device?

(Reporter clarification.)

MR. EVANS: That's the question.

(Document review.)

A. By way of example, if we look at patent '846, and if we look at column 11 starting at line 41 --

Q. Hold on a second. Let's pull up the '846 patent so we can look at it with you.

A. Of course. I do appreciate it.

(Document review.)
MR. LAURENZI: Download it?
THE WITNESS: That would be amazing.
(Document review.)
BY MR. EVANS:
Q. So we got the '846 patent on the screen.
Where did you want us to look at?
A. If you give us one moment. I'm trying to download that.
Q. Sure.
A. I do appreciate it. Thank you.
MR. LAURENZI: We tried to copy it.
THE WITNESS: Great.
A. If you don't mind, please go by way of example to column 11. Let's start with line, I believe, it's 41.
Are you ready?
Q. Yep.
A. So it says figure 5, and in parallel, or if you could refer to figure 5 earlier in the patent.
It says it's "...a schematic

diagram showing an electronic device 500 utilizing a nine axis motion sensor module according to another embodiment of the present invention in a 3D spatial reference frame, as shown in figure 5, the electronic device 500."

09:23AM

Q. I see the words electronic device twice where you're quoting, but I don't see the words 3D pointing device anywhere.

09:24AM

Would you agree?

A. Sorry, I was not finished with my answer.

Are you withdrawing the question or should I proceed?

09:24AM

Q. You can answer the question I just asked.

So from line 31 to 45, I see it referred to as an electronic device 500, but I don't see the words 3D pointing

09:24AM

device.

Do you?

A. So just to be clear, the previous question has been withdrawn?

Q. No. I'm okay with your answer so

09:24AM

far.

A. I have not given you -- sir, I have not given you a complete answer.

Q. Okay. Show me what you're relying on. I will note that your declaration does not cite these lines anywhere.

A. I'm unclear as to what you're saying, which lines?

Q. Column 11, lines 41 it is not cited in your declaration.

A. So, column 11, line 41 is just an example of a review to draw the construction. And it says, "As shown in figure 5, electronic device 500 may comprise two parts, 560 and 570 in data communication with each other."

So one of ordinary skill in the art looking at figure 5, understands that 560 is a 3D pointing device.

That term is used in the patent approximately 56 times in the '846 patent.

And one of ordinary reading that would understand that's by way of example in figure 5, what is labeled as 560. And 570 is the screen part of it.

So in my construction where I say reference frame associated with a 3D pointing device, which always has its origin at the same pointing device and which the axis is always fixed with respect to the device.

In paragraph 41 of my declaration, I provide other explanation in addition to what I just showed in figure 5, which says the '846 patent, it explains the spatial reference frame refers to a 3-axis reference frame of a 3D pointing device that is column 9, 5 through 17, column 9 lines 49 through 65, and figures 1 through 4.

09:26AM
09:26AM
09:27AM

Q. Okay. Well, let me ask you, is a 3D pointing device a type of electronic device?

MR. LAURENZI: Objection. Form.

09:27AM

MR. EVANS: I don't think the answer is in the patent.

This is a more general question than that.

A. So the electronic device, for example, of figure 5 is what is exactly

09:28AM

shown in figure 5.

Q. I'm asking is a 3D pointing device --

A. Sorry, I really appreciate it if you allow me to finish my question -- my answer to the question.

Q. I understand, Doctor. But I would really appreciate it if you would listen to the questions and answer the questions I ask because that would make this go a lot smoother.

Can we agree to do that today?

Your attorney will have a chance to ask you the questions and allow you to say whatever you want at the end.

But this is my time, and I would like to spend it focusing on the topics that I think are important and that's what this adversarial proceeding allows me to do.

So will you agree to listen carefully to my questions and try to answer the question I asked here today?

Is that fair?

MR. LAURENZI: Objection to the

colloquy. That is exactly what the witness has done so far.

MR. EVANS: I was responding to your objection.

09:28AM A. I'm giving you a complete technical and truthful answer, but I'm entitled to provide a complete answer without being cutting off.

And in return, as you requested, 09:29AM I will not interrupt you while you are asking a question.

Is that fair?

Q. Well will you agree to answer the questions I ask? Because that is the 09:29AM question I asked you if that's fair, and you did not answer that just now.

A. That's exactly my plan. That's exactly what I've done so far, and that's what I'll do for the rest of the day.

09:29AM Q. Perfect.

So listen to this question: If we're talking about geniuses and species, we'll pull this out to a higher level, would an electronic device be higher in 09:29AM that hierarchy or lower in the hierarchy

from a 3D pointing device?

MR. LAURENZI: Objection. Form.

A. I can answer that in the context of these patents because that's what I have analyzed.

I have mentioned that Bassompiere discloses the device for pointing by a user at a mobile element in a plain surface.

For example, as shown in figure 1, the pointer has the shape and appearance of a television remote control. It is of elongate form, able to be held in the user's hands. The pointer includes a gyroscope and an accelerometer. Figure 2 shows the system, i.e. electronic device --

MR. EVANS: I'm going to object as nonresponsive because I didn't ask you the composition of it. I'm asking you a far, far simpler question.

BY MR. EVANS:

Q. Let me ask you in a different way. Could a 3D pointing device be considered an electronic device?

MR. LAURENZI: Objection. Form.

A. What I needed to do for my

analysis, and by way of example looking at claim 1, I have stated that figures 2 shows the system electronic device, which includes a pointer and a screen.

09:31AM Q. I don't follow that answer at all.

I asked could a 3D pointing device be an electronic device?

"Yes" or "no" is all I'm looking for.

09:31AM Would you say "yes" or would you say "no" to that question?

A. I would say in the context of the patent that I have analyzed, for example, take --

09:31AM Q. I don't need an example. I just need a "yes" or a "no," Doctor, or it's going to be a very long day.

A. I appreciate that. Science sometimes is not yes/no. That is not a responsible scientific response.

Q. Well, let me ask you a different question.

If I said a 3D pointing device is

09:32AM an electronic device, would you agree with

me?

MR. LAURENZI: Objection. Form.

BY MR. EVANS:

Q. In the context of this patent?

09:32AM A. In the context of this patent, what I have looked at and provided examples of is clearly mentioned in my declaration is by way of example, figure 2 shows the system electronic device which includes a 09:32AM pointer and a screen.

MR. EVANS: I'm going to object as nonresponsive.

BY MR. EVANS:

Q. What question did I just ask you? 09:32AM What is the question I'm seeking an answer to, Doctor?

A. You asked me if a pointer is an electronic device.

Q. And what's the answer to that 09:32AM question?

A. The answer is in the context of this patent. And what I've analyzed and I've clearly stated, for example, on page 63 of my declaration, is that figure 2 09:33AM shows the system electronic device which

includes a pointer and a screen. So that's the electronic device that I have identified.

Q. So a pointer is an electronic device then?

09:33AM

MR. LAURENZI: Objection. Form.

A. That's not what I said.

What I did say --

Q. So are you saying -- well, I just want to know, are you contending a 3D pointer is equivalent or a type of electronic device or not?

A. I'm stating in my analysis and what I needed to do was to show what the electronic device of, let's say, '846 patent is.

09:33AM

09:33AM

And I have stated by way of example, figure 2 shows the system, i.e., electronic device, which includes a pointer and a screen.

09:33AM

So the combination of them is an electronic device. That's what I needed for my analysis.

MR. EVANS: Andrew, can we go down to claim 1 in the '846 patent?

09:34AM

Zoom in on the preamble.
BY MR. EVANS:
Q. Can you see claim 1, Doctor?
A. One moment, please. Let me get the hard copy of it.
Q. We have it up on the screen for you, too.
A. Oh, part of it is cut off, claim 1. So let me get the complete version --
Q. I'm only going to ask about the very first two lines of it.
A. Please go ahead. I can see that.
Q. Claim 1 is directed to an electronic device, correct?
A. It says -- claim 1, what it says, "...which is an electronic device subject to movements and rotation in dynamic environments, comprising."
Q. So why in your definition of "spatial reference frame" have you imported a 3D pointing device limitation?
A. This is a question that you asked earlier, and I tried to respond to it, give a response to it before I was cut off. So let me please go ahead and respond to that.

So...

(Document review.)

A. Looking at figure 1 of the patent or figure 2 of the patent or figure 5 of the patent and many other figures and explanation. And by way of example, I'm going to use figure 5, but you could use figure 1, too, and other description that is provided in the patent.

09:36AM When we look at the electronic device figure 5, which consists of a pointer and a screen, when we talk about the reference frame, for example, in figure 1, the frame is capital Xp, Yp, Zp.

09:36AM If that frame, reference frame, is defined with respect to the pointer, it does make sense. It's a 3D pointing device. It has -- one can define a reference frame as the patent has done.

09:37AM Now if you take the combination, of let's say, 570 and 560 in figure 5, these are two parts, a screen and a 3D pointing device. They do not have a common reference frame.

09:37AM Therefore, if you just say "the

electronic device," which is the combination of the two, the reference frame becomes vague and undefined.

Therefore, what I've done in my claim construction in order to avoid that issue, I've said that spatial reference frame is a reference frame associated with a 3D pointing device which always has its origin at the same point in the device and in which the axes are always fixed with respect to the device.

Q. Did you put -- apply the plain and ordinary meaning to an electronic device?

A. Yes.

Q. And what did you interpret "electronic device" to mean?

A. In the context of '846 patent, an example of an electronic device in this context of, let's say, the preamble of claim 1, is, for example, taking figure 2, which shows the system i.e., electronic device, which includes a pointer and a screen.

Q. Could a smartphone qualify as an

electronic device?

MR. LAURENZI: Objection to form.

A. In context, for example, the figure 6 embodiment, a smartphone just being an electronic device, yes, it can be an electronic device.

Q. So if the electronic device is a smartphone, then the spatial reference frame and the display reference frame will be the same, right?

MR. LAURENZI: Objection. Form.

A. So column 13, figure -- always talking at this time about the same patent '846, it talks about figure 6, which is an exploded diagram showing a portable electronic device, such as, for example, a 3D pointing device.

And here the spatial reference frame and the display reference frame could potentially be the same frame.

Q. Looking at claim 1, where does the term 3D pointing device appear?

A. Claim 1 talks about an electronic device. So, obviously, you have to look at the intrinsic evidence of this patent, the

'846 patent, and you see by way of example figure 2 or figure 1 or figure 5, and a number of other explanation that the patent provides in this spec. And you realize the electronic device includes, in this case, let's say in figure 2, a pointer and a screen.

09:41AM

And when you review the pointers that is discussed in this patent, you see the term "3D pointing device" and that's the context in which the patent uses, for example, the pointers of figure 1, 2 or figure 5 and others.

09:42AM

Q. In your view, would a smartphone be a 3D pointing device?

09:42AM

MR. LAURENZI: Objection. Form.

A. I have discussed a specific type of mobile phone that Nasiri talks about and all the description that Nasiri provides and that shows what Nasiri shows in his embodiment is a 3D pointing device.

09:43AM

I have not provided opinion on a generic 3D point -- on a generic cellphone; for example, the cellphone in figure 6 embodiment of '846 patent.

09:43AM

Q. Let me ask it a little different.
Could a smartphone be a 3D pointing device?
MR. LAURENZI: Objection. Form.
09:43AM A. The mobile phone of Nasiri, as I have discussed in my declaration and the way he treats and discussed and elaborates on his particular mobile phone, is an example of a 3D pointing device. It all
09:44AM depends, the answer is.
Q. Let me just ask a different question.
So the answer to could a smartphone be a 3D pointing device seems to
09:44AM be yes, and you have identified one in the Nasiri reference.
Is that accurate?
A. It is accurate that a specific type of mobile phone, along with everything
09:44AM that goes with it, as described by Nasiri, it can be a 3D pointing device.
Q. So you're relying on Nasiri to define the term "3D pointing device"?
MR. LAURENZI: Objection. Form.
09:45AM A. No, that's not what I said.

MR. EVANS: We can -- you can take the patent down, Andrew.

BY MR. EVANS:

Q. In the prior case when you were working for Google in the CyWee Group, did you also apply the plain and ordinary meanings of the terms of those patents?

MR. LAURENZI: Objection to form. Scope.

A. It's been a while.

What year were those?

Q. 2018, 2019.

A. So about eight years ago. You have to show me those. I do not recall. It's been a while.

Today I'm here to -- sorry -- today I'm here to discuss the IPR declaration that I have provided.

Q. So you didn't look at any of the CyWee patents or any of the declarations you submitted in the CyWee IPRs as part of your preparation for your declarations in this IPR?

A. The materials that I have considered for preparation are shown on

page 4 of my declaration of, let's say, '846 patent.

Q. You can still answer my question.

A. So there were parts of these IPRs, for example, Exhibit 1011, 1012 and 1013, that I have discussed in my declaration. So those parts were relevant, and I have looked at.

But, in generality, I have not looked at recently the declarations that I submitted, taking your word for it, around 2017, 2018, six years ago.

Q. Looking at page 4 of your declaration, it says that you reviewed U.S. Patent 8,441,438; is that correct?

A. Exhibit 1009, yes.

Q. So you read that patent as part of your work in this case?

A. I just looked at it.

Q. Okay. And that's one of the patents that was at issue in CyWee.

Are you aware of that?

A. That's correct.

Q. Okay. And right below that is the other patent that was at issue in

CyWee, right, 8,552,978?

A. That's correct.

Q. And you said you reviewed those materials, right?

09:47AM A. I have looked at them.

Q. But earlier you said you had no memory of them?

MR. LAURENZI: Objection.

A. What I said --

09:48AM MR. LAURENZI: Objection to form.

A. What I said earlier is that I have not analyzed them, reviewed in details for in preparation for today. And that's a fact.

09:48AM Q. Now the '438 and '978 patents share significant portions of the specification with the patents-at-issue here, the '687 and '846 patents, right?

A. As similarities, I have not done

09:48AM a percentage overlap or any other kind of analysis.

Q. But they relate to similar inventions?

A. There are some relationship

09:48AM between '438, '978 and the patent-at-issue

today.

Q. And they both cover methods of using sensor fusion with accelerometers and gyroscopes?

09:49AM A. That sounds familiar.

But why don't you show them to me so I can verify whatever you want me to verify. It's been a while that I've looked at it. I've provided a detailed view of

09:49AM '438 and '978. It's been more than eight years, I think.

Q. To the extent the '438 and '978 contain the same type, the same claim terms as those at issue here, did you apply the

09:49AM same meaning as you did in CyWee to the terms in this case that overlap?

MR. LAURENZI: Objection to form.

A. I need to look at it. It's been eight years. Every patent is different.

09:49AM Every word that changes, anything wrong, extra word in a spec could make it change, interpretation of the claim terms. So I have not performed that analysis.

Q. So you don't know if you've

09:50AM maintained consistent constructions in this

case as to the positions you took in the CyWee IPRs?

A. I have looked at every patent and analyzed it in its own context. I have not done a comparison of the patents-at-issue today with the patents of eight years ago.

When I did that analysis back then, it was an accurate analysis using my knowledge. And I did exactly in terms of the declaration that I've provided and we are discussing today.

Q. In the context of your analysis in this case, what plain and ordinary meaning of the term "predicted axial accelerations" did you use?

A. As the term suggests, I've used the term "axial acceleration," as understood by one of ordinary skill in the art. I've provided example of that.

And the predicted value of that is a value that predicts that value, the axial acceleration. That's the plain and ordinary meaning of it.

Q. What is the -- what is an axial acceleration then?

A. Axial acceleration is an acceleration around a given axis.

Q. Is it rotational or linear?

A. Axial acceleration, in general, can be anything that an axial acceleration is. An example of that is a linear acceleration.

Q. What are all the different types of axial accelerations?

A. There are linear and non-linear, by way of example. There are continuous and non-continuous. And depending on the context, there are many ways of classifying axial acceleration.

Q. In the patents-at-issue here, when they talk about axial accelerations, what are they referring to?

A. Exactly that, the axial acceleration.

Q. Which ones?

A. Generally speaking, it's talking about axial acceleration, and they provide accelerometers that are part of axial acceleration. They are not specific on the type of axial acceleration.

Q. So you don't know what axial accelerations this patent is measuring?

MR. LAURENZI: Objection. Form.

A. Of course I do. And I have discussed that in detail in my declaration.

Q. Please enlighten me. Which ones?

(Document review.)

A. So looking at column 11, starting with line 41 where figure 5 is being described, the patent is talking about an accelerometer 544, among other sensors.

And it's talking about a signal that it receives Ax, Ay, Az, that is generated by the accelerometer.

So any acceleration that is measured by an accelerometer of this type is what they're referring to in column 11 starting at line 40 and the entire paragraph.

Q. That would include gravitational accelerations?

A. That could include gravitational acceleration and linear acceleration of a type.

Q. The linear accelerations would be

the accelerations due to movement of the device?

A. Linear acceleration is any kind of linear acceleration, which could be movement of the environment or the device itself. And you measure that with, for example, a parallel plate of capacitors and the force that comes through them.

Q. So when I have a device with an accelerometer at rest --

A. Yes.

Q. -- the only forces acting on it would be gravity, right?

A. What is the environment that you're looking at?

Q. Sitting on a table. My phone is at rest on the table. The only forces the accelerometers would be registering would be gravity in that example, right?

A. That's incorrect.

Q. Explain.

A. There are other things. There are rings. There are temperature changes that provides forces on your accelerometer, by way of example.

Q. Wind and temperature are picked up by accelerometers?
A. Wind, yes.
Q. I'm inside --
09:57AM A. Yeah.
Q. -- in a temperature-controlled environment with my phone on the table, what forces is my accelerometer registering?
09:57AM A. As I said, it all depends. There are microforces from the environment that the accelerometer can see. That's why I asked you to describe the environment very precisely.
09:57AM Q. When we put accelerometers into devices like smartphones, what is the force that we want to measure?
MR. LAURENZI: Objection. Form and scope.
09:57AM A. I don't follow you.
Q. When you use accelerometers in, say, sensor fusion, why? What is the point of the accelerometer? What does it do?
A. It depends on your application.
09:58AM Q. Well, it can measure gravity, for

example?

A. Accelerometers can measure gravity in some cases.

Q. And how do you isolate gravity?

09:58AM A. Your question doesn't make any sense.

Q. If I have an accelerometer reading and I want to try to isolate the gravity component of it, how would I do

09:58AM that?

A. Sorry, I don't understand your question.

Q. So you don't know how to isolate gravity from accelerometer readings?

09:58AM A. I don't understand your question.

An accelerometer has multiple forces acting on it. One of them is the gravity forces and among other things. And that's an approximation of it. You can

09:59AM certainly look at the gravity force that is acted on the accelerometer.

Q. And how would you go looking at the gravity force that is acted on the accelerometer?

09:59AM A. Look at -- I don't follow your

question. It doesn't make sense.

Q. So I've got my raw accelerometer data and I would like to try to tease out the portion of that that is gravity.

What would you do?

A. What do you mean by "tease out" in a technical term?

Q. What do you think I mean?

A. I don't know. We don't use the word "tease out" in technical literature.

Q. What would you use?

A. I don't know what you are trying to ask.

Q. Genuinely?

A. Sorry?

Q. You genuinely don't understand the question?

A. I don't understand the question. You are not using the right technical terms.

Q. I don't know the right technical terms. I'm not a doctor, but I'm trying to use the words that I know.

Could you maybe help bridge the gap since you are an expert?

A. So explain to me what is it that you want to do?

Q. I would like to get gravitational data out of an accelerometer.

Does that make sense to you?

A. You can get an approximation of gravitational data from an accelerometer, among other forces, in certain environments.

Q. What are some methods for getting an approximation of gravitational data from an accelerometer?

A. To use various filtering methodologies from the raw accelerometer data, by way of example.

Q. I want to come back to the word "predicted axial accelerations."

That is one of the claim elements at issue in this case, right?

A. The word "predicted axial accelerometer" --

Q. "Accelerations."

A. -- "accelerations."

Which claim are you looking at?

Q. Claim 1.

So if you look at column 31, line 34 to 35, I think is where it first appears in the claim.

Do you see where I'm talking about? It says, "Converting the measured angular velocities corresponding to time T, based on the previous quaternion into a current quaternion and predicted axial accelerations without using the measured axial accelerations corresponding to time T."

Do you see that?

A. I do. You read that correctly.

Q. So when you said that Bassompiere renders this claim unpatentable, you had to identify a predicted axial acceleration by Bassompiere, correct?

A. I did not say anything about "unpatentable." I don't remember that word in my declaration.

Q. So is it your opinion, then, that claim 1 is patentable?

MR. LAURENZI: Objection. Form.

A. I have not also used that word in my declaration.

Q. Well, what have you said about claim 1?

A. I have shown every elements of claim 1. And by way of example, I've shown that Bassompiere discloses that. It's a technical analysis.

Q. So in your technical analysis, you showed, in your opinion, that Bassompiere discloses a predicted axial accelerations, correct?

(Document review.)

MR. EVANS: For the paper transcript, I'm going to note that the expert is leafing through his declaration.

THE WITNESS: That's accurate.

A. So I have a stated, by way of example, that Bassompiere determines and a priori estimation of the acceleration measurement. That's the predicted axial acceleration based on the priori estimation of the state vector, which is the current quaternion that is in Bassompiere by way of example, page 19, line 4 through 5, also discussed in page 28, line 15 through 17.

And I have mentioned that this is a priori estimation of the acceleration measurement that is taken in times that K is calculated as follows, equation 22 of Bassompiere shows exactly that.

Q. How do you know the equation 22 is equivalent to the predicted axial acceleration discussed in the patent?

A. The patent talks about a predicted axial acceleration under certain conditions. Those conditions, for example, this converting the measure angular velocities corresponding to time T based on the previous quaternion into a current quaternion and predicted axial acceleration without using the measured axial acceleration corresponding to time T. That's the current measurement.

I have done a detailed analysis showing exactly that. I've shown that starting with where Bassompiere actually shows or suggests the current quaternion that's SK had with a bar on top, is calculated by adding the pitch and roll angle from previous iteration K minus 1

that's based on the previous quaternion, then to the gyroscope reading omega capital X, omega capital Y, omega capital Z. That's for converting the measurement
10:06AM angular velocities corresponding to time T.
I've also shown how you do that with quaternion, by way of example --
Q. We don't need to go over every instance right now. I'm not trying to cut you off. I just don't need that long an answer yet. We'll go through that in more detail later, if that's okay.
A. Of course.
MR. LAURENZI: Counsel, we're
10:06AM over an hour. Maybe it's a good time for a break?
MR. EVANS: Let me do a couple more questions, and then we can do a short break.
BY MR. EVANS:
Q. If you're okay, Doctor?
A. Of course, sir.
Q. Looking at that equation 22, in Bassompiere that is on page 19, so you're
10:07AM saying the Y-hat K-bar, that's the -- what

you're identifying as the predicted axial acceleration?

A. Correct.

Q. What is "Y-hat K-bar"? What does that represent?

10:07AM

A. That represents the predicted axial acceleration which is based on the priori estimation of the state vector. And it also shows that it is based on what is requirement in element 1E of claim 1 of the '846 patent.

10:07AM

Q. But what is it in Bassompiere. I'm not talking about our patent.

What is that calculation returning?

10:07AM

A. As Bassompiere clearly states, that is a priori estimation of the measurement. It states that in column 19. And the way you get -- Bassompiere gets that, it is by going to the rotation matrix and focusing on the last element of it.

10:08AM

Q. So is it rotating a vector from one reference frame to another reference frame?

A. It is the equation of the

10:08AM

measurement model, and it is the last element of that which Bassompiere calls it the Y measurement acceleration. And you obtain that by getting the rotation matrix and focusing on the last element of it along the gravity. That's a linear -- that's an estimated linear acceleration exactly as required by -- it's a predicted version of that exactly as required by the claim element 1E.

10:09AM

10:09AM

Q. What frame of reference is that vector in or that linear acceleration in?

A. So this is based on Theta and Psi, which are based on the capital X, Y, Z frame of reference in Bassompiere.

10:10AM

Q. So is that the device frame of reference or the sensor frame of reference?

A. So Theta and Psi, as Bassompiere states on page 4, are angles related to the pointing device, I believe 19 of page 4 of Bassompiere.

10:10AM

Q. Now the pointing devices where the sensors are located?

A. The sensors are in Bassompiere are in the pointing device. That's

10:10AM

correct.

Q. So if I said "sensor frame of reference" and "pointing device frame of reference," that would be the same thing essentially?

Do you agree or disagree?

A. This is the pointer frame of reference, and the patent '846 and Bassompiere discussed what that is. So it's the pointer reference frame.

Neither the patent nor Bassompiere talk specifically about a sensor frame of reference. It's the pointing device that Bassompiere talks about. It's the 3D pointing device that the patents talk about.

Q. I feel this is a good teaching moment. I was just trying to find out if all the sensors are in the pointing device, would it be fair to call "sensor frame of reference" and "pointing device frame of reference" as the same thing.

And I noticed how you went and started talking about the '846 patent and a bunch of other stuff that doesn't answer

the question. This's what is making things take a long time.

I just want to know if the sensors are in the pointing device. I'm trying to create a common vocabulary here.

So if I accidentally say "sensor frame of reference," would you understand that is essentially -- it's where the sensors are located, right?

10:12AM A. Don't say that. That is technically incorrect.

Use the pointing device exactly as Bassompiere uses it and exactly as the patent uses it. We don't need extra vocabulary since you have a basic one that works.

Q. So if I say "device" or "pointing device frame of reference," you understand I'm talking about the object that contains sensors?

10:12AM A. Let's use "the pointing device" or "the 3D pointing device," where I have been consistent throughout my declaration on those terms.

10:12AM Q. I don't want to talk about 3D

pointing devices because our claims don't encompass 3D pointing devices. So I think that is an inaccurate way to talk about them.

10:12AM We can talk about the electronic device containing the sensors. We can talk about a smartphone. But I don't -- I disagree with your point that it has to be a pointing device.

10:13AM So I'm going to refer to it as probably the "devices frame of reference," and will you understand what I'm talking about?

A. No.

10:13AM Q. Why?

A. It's the pointing device. Otherwise, vagueness is created because, say, figure 5 of the '846 patent has two parts. And I don't know what you are

10:13AM referring to. So --

Q. So let's talk about the sensors.

MR. LAURENZI: Objection to form.

BY MR. EVANS:

Q. Is that unclear?

10:13AM A. Just use whatever the term it is.

Use the label of that term.

Q. I don't believe it says that this on Bassompiere. I don't think it talks about pointing devices or I don't see it. It says "device."

So I will use Bassompiere's "device" language, if that's okay with you?

A. So you just want to say "the pointing device," as Bassompiere says it?

10:14AM Q. "Device."

A. Bassompiere says "pointing device." Look at page 4 line 19.

Q. This doesn't matter. That's fine.

10:14AM A. The very last two words.

MR. EVANS: We'll soldier on.

And I guess I will try to explain to you what I mean, and you cannot understand me if you would like, but we

10:14AM can also take a short break right now.

How long would you like, whoever wanted the break?

MR. LAURENZI: About ten minutes.

MR. EVANS: Ten minutes is fine.

10:14AM THE WITNESS: Thank you.

THE VIDEOGRAPHER: We are off the record. The time is 10:14 a.m. Pacific time.

(Recess is taken.)

10:25AM THE VIDEOGRAPHER: We are back on the record. The time is 10:25 a.m. Pacific time.

MR. EVANS: Can we pull up the petition? Preferably the '687, but the

10:26AM '846 is fine too and go to page 22.

MR. LAURENZI: Which one are we looking at?

MR. EVANS: It looks like the '687, page 22 of the petition of the

10:26AM '687, page 22.

Let's go look at the last paragraph that starts, other than.

BY MR. EVANS:

Q. The last paragraph on this page

10:26AM says, "Other than the 'spatial reference frame' term identified below, the Board need not construe any other claim terms as the claims are unpatentable under any reasonable construction."

10:26AM Do you see where I'm reading

from?

A. What is this document? This is not one of my declarations, is it?

Q. This is the inter partes review petition that your declaration was in support of.

A. Understood.

Please proceed.

Q. I'm looking at the last paragraph on 22 that starts, "Other than the spatial reference frame term identified below, the Board need not construe any other claim terms as the claims are unpatentable under any reasonable construction."

Do you see where I'm reading from?

A. I do.

Q. Do you agree with that statement?

MR. LAURENZI: Objection. Form. Scope.

BY MR. EVANS:

Q. Do you agree with that statement?

MR. LAURENZI: Objection. Form and scope.

A. I agree with the fact that for

the purposes of my opinion in this declaration, I have applied the plain and ordinary meanings as understood by a person of ordinary skill in the art at the time of the alleged invention.

10:27AM

Then in paragraph 40 of my report, of my declaration, I have construed the term spatial reference frame.

What you are showing me on the screen is not something that I wrote. So I need to look at the context of everything that is related to that statement.

10:28AM

Q. I think you just covered it.

So you agree that no claim constructions are required for any term other than "spatial reference frame"?

10:28AM

A. My declaration speaks for itself where I say for the purposes of my opinion in this declaration, I have applied the plain and ordinary meanings as understood by a person of ordinary skill in the art at the time of the alleged invention.

10:28AM

I have further construed the term "spatial reference frame," which is exactly what I say in paragraph 40 of my

10:29AM

declaration.

Q. Why was "spatial reference frame" the only term that required construction?

MR. LAURENZI: Objection. Form.

10:29AM A. I looked at the patent, the intrinsic evidence and anything along that as seen by one of ordinary skill in the art, and this is what I felt was needed to do as I have described in paragraph 39, 40 and beyond of my report.

Q. So you determined only spatial reference needed to be construed in this IPR?

A. In this --

10:29AM MR. LAURENZI: Objection. Form.

A. What I've said is that for the purpose of my opinion in this declaration, I've applied the plain and ordinary meanings as understood by a person of

10:30AM ordinary skill in the art at the time of the alleged invention.

I've said that claims 1 and 7 use the phrase "spatial reference frame."

My opinion is that the term means

10:30AM a reference frame associated with a 3D

pointing device which always has its origin at the same pointing device and which the axes are always fixed with respect to the device.

10:30AM Q. No, I understand all of that. Try to listen to my question.

You, Doctor, are the one that decided that the only term that required construction was "spatial reference frame," yes or no?

10:30AM A. This is more than a year ago. I don't know the origin since this decision was made.

My declaration in paragraph 39 and 40 is very clear on what the claim term and their ordinary meanings are being used.

10:31AM Q. I understand that.

I'm trying to figure out is who came up with these claim constructions. Was it you or was it Samsung's lawyers?

MR. LAURENZI: I caution you not to reveal any communications with counsel.

And objection to the form.

10:31AM A. Again, this was more than a year

ago, and some of it might be privileged communication.

My declaration in paragraph 39 and 40 lays out my thinking about the claim terms.

10:31AM

Q. Was all your opinions in your declaration come up with by you independent of anyone else?

MR. LAURENZI: And, again, I caution the witness not to reveal any communications with counsel.

10:32AM

A. What I have stated is that I declared that all the statements made herein of my knowledge are true and all the statements made on information and belief are believed to be true. And that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States code. I have signed that.

10:32AM

Q. That doesn't answer my question, though.

Did you come up with them? I

10:32AM

understand that you agreed with them and you believed they're true.

I'm asking, did you come up with them?

10:32AM MR. LAURENZI: Same question.

A. For one thing, I have 35 years of experience in research and teaching and a lot of things I've said in my declaration comes from that, from textbooks, from

10:33AM education, from supervising Ph.D. students working in industry --

Q. Which textbooks? I didn't see any listed in your materials considered.

A. Just -- there is actually.

10:33AM I've said in paragraph 17 that I'm familiar with the level of ordinary skill in the art regarding the '846 patent as of around November 11th, 2010, including late 2009 through early 2010.

10:33AM Q. I understand that.

But you just testified that you relied on textbooks and you're required to identify everything that you rely on in forming your opinions, and there is no

10:34AM textbooks listed in materials considered.

So I'm asking, what textbooks did you rely on that you were just referring to?

A. Thank you.

10:34AM If you did not cut off my answer, I was just about to get to that.

May I proceed?

Q. I would appreciate if you got to the point quicker without all the preambles, though.

10:34AM MR. LAURENZI: Objection to the colloquy.

A. I'm doing exactly that. I've said that I believe a person of ordinary skill in the art at the time of the alleged invention would have had an undergraduate degree in electrical engineering --

Q. No.

What textbooks did you consider in forming your opinions? Not what is the person of ordinary skill.

What textbooks did you consider when drafting this declaration, if any?

A. The textbook of what is studied by one of ordinary skill in the art who

would have an undergraduate degree in electrical engineering, computer engineering --

Q. What are those textbooks? Can you provide the names of them, though?

I don't know what they are and I'm the one that needs to know.

A. Any undergraduate degree, for example, looking at graphics or looking at control theory and that's what a POSA --

Q. Did you consider any textbooks in drafting --

MR. LAURENZI: Would you let him finish his answer please, Counsel?

Q. -- your declaration?

MR. LAURENZI: Please let him finish his answer.

MR. EVANS: If he would actually answer the questions, I would, Counsel.

MR. LAURENZI: He's answering the questions.

MR. EVANS: No, he's actually not even allowing us to have the cross-examination that we're entitled to by statute.

He's making this intentionally as useless as possible, Counsel.

MR. LAURENZI: He's permitted to give you full answers.

10:35AM Were you finished your answer, Doctor?

THE WITNESS: No.

The past three questions you did not allow --

10:35AM MR. EVANS: Objection. Nonresponsive.

BY MR. EVANS:

Q. Did you consider any textbooks when forming your opinions in this IPR, 10:36AM "yes" or "no"?

A. The textbook are what of ordinary --

Q. "Yes" or "no," sir?

A. The textbooks --

10:36AM Q. "Yes" or "no," sir?

MR. LAURENZI: Please let him finish.

Q. What textbooks did you rely on when forming these opinions?

10:36AM "Yes, I did" or "no, I didn't."

Those are the only acceptable answers.

And if you can't say any, just say neither.

A. I refer you to paragraph 17 of my report of what one of ordinary skill in the art knows.

Q. So there are materials that you relied on that you did not disclose in your declaration then?

10:36AM MR. LAURENZI: Objection to form.

A. That's not what I said.

Q. Well, that's the answer I'm trying to get to.

Are there additional materials that you looked at and relied upon in forming your opinion that aren't listed in your expert declaration, "yes" or "no"?

A. Looking at everything that is disclosed in my declaration, including paragraph 17, the answer would be no.

Q. Okay.

MR. EVANS: Andrew, we can pull down the exhibit, and I would like to pull up paper 14.

Let's go to page 4.

(Deposition Exhibit Paper014, Document titled "List of Exhibits," marked for identification, as of this date.)

10:37AM BY MR. EVANS:

Q. Looking at the last paragraph on this page, this is a pleading that Samsung filed in this case about claim construction.

10:37AM And the last sentence reads: "Samsung's position then and now was simply that the term 'axial acceleration' whether predicted or measured, has a meaning well-understood by those of ordinary skill, 10:38AM i.e., the term 'ordinarily' encompasses three types of acceleration.'"

Do you see where I'm reading from?

A. Yes.

10:38AM Q. Do you agree with that statement?

MR. LAURENZI: Objection. Form. Scope.

A. I don't know what Samsung's position then is.

10:38AM If you want to share me some

document related to that, I might be able to comment.

Q. This sentence right here, do you agree with it?

10:38AM MR. LAURENZI: Objection. Form and scope.

A. I don't know what Samsung's position then is. You are not showing --

Q. In the sentence it says, "then

10:38AM and now, i.e., the term 'ordinarily' encompasses three types of acceleration.'"

Is that accurate in your opinion?

MR. LAURENZI: Objection. Form and scope.

10:39AM A. I can tell you what I've analyzed is that axial acceleration is acceleration with respect to a given axis. That part is accurate, and that's what I've used in my declaration.

10:39AM The rest of it I need to think about it. I need to see what the previous position of Samsung is. So I cannot comment on that right now.

Q. Would the plain and ordinary

10:39AM meaning, as any POSITA would understand the

term, encompass linear centrifugal and/or gravitational accelerations or some combination from among the three?

A. Please repeat your question.

10:40AM Q. Well, would the term "axial acceleration," ordinarily encompass three types of acceleration, which would be linear, centrifugal or gravitational, or some combination of the three?

10:40AM A. Those are three examples of axial accelerations there on a given axis.

Q. Do you agree with this statement that Samsung made on page 4 here that we've highlighted?

10:40AM MR. LAURENZI: Objection. Form and scope.

A. Again, that's something that I need to consider. I need to look at the writing and position that Samsung took 10:40AM before as shown in here.

I can tell you and what I've applied is that axial acceleration is acceleration in a given identified axis.

Q. So your plain and ordinary 10:41AM meaning of "axial acceleration" is not this

sentence. Like you did not apply this sentence when you were analyzing Bassompiere; is that correct?

A. I have -- it might turn out to be the same thing. The term that I've used for axial acceleration is acceleration in a given axis. There are more than one ways to define --

Q. Does it ordinarily encompass three types of acceleration?

Do you agree with that statement?

A. There are, among other things, three types of acceleration that one could look at. But there are other things that you may look at. So in generality, axial acceleration is acceleration in a given axis.

Q. Well, has Samsung made a true statement to the PTAB here, or would you say that this is not true?

MR. LAURENZI: Objection. Form. Objection. Scope.

A. I have to read the entirety of this whatever document you are showing me. This seems reasonable, what I'm looking at.

What I've used is axial acceleration is acceleration in a given axis point.

Q. You say you're a person of ordinary skill in the art, correct?

A. Yes.

Q. Now if I look at the footnote 2.

MR. EVANS: Can we scroll down, Andrew?

BY MR. EVANS:

Q. It says, "To the contrary, Samsung expressly noted that a POSITA, person of ordinary skill in the art, would recognize that the axial acceleration could be any of linear, centrifugal or gravitational accelerations or some combination from among the three."

Do you see where I'm reading from?

A. Yes.

Q. Do you agree with that statement as a POSITA?

MR. LAURENZI: Objection. Form and scope.

A. As a POSITA?

Q. Yes.
A. Yes, one who would understand that there is linear acceleration. As an example of axial acceleration that I mentioned, you can have centrifugal acceleration and you can have gravitational acceleration.
Q. Is this the plain and ordinary meaning of the term "axial acceleration" that you applied in your declaration?
A. The plain and ordinary meaning that I applied is -- can you bring it down a bit so I can see the yellow?
(Document review.)
A. Thank you, sir.
That axial acceleration is acceleration in a given axis.
Q. Okay. Let's pull this down and I'd like to go to paper 20 now.
Let's go down to page 7, please. The last paragraph of page 7 specifically.
(Document review.)
BY MR. EVANS:
Q. This is another file that Samsung, these IPRs.

MR. EVANS: Can you scroll up a little bit, Andrew?

BY MR. EVANS:

Q. Do you see where it says, "Specifically patent owner contains that Bassompiere's gravity-only prediction does not disclose predicted axial accelerations that encompass three types of acceleration as petitioner's proposed construction requires"?

Do you see where I'm reading?

A. You read that correctly.

Q. Do you understand that sentence?

MR. LAURENZI: Objection. Form and scope.

A. Go a few paragraphs up. I need to read the entirety of it to see what the context is.

(Document review.)

A. I need to read the entirety of this document to be able to comment on that.

Q. Well, without that context, do you understand what patent owner is arguing?

MR. LAURENZI: Objection. Scope.
A. I have to read the entirety of this document to provide any opinion.
My declaration --
10:46AM Q. I provided you the context of what we're saying.
We interpret your Bassompiere read as identifying a gravity-only acceleration as the predicted axial
10:46AM acceleration and we're arguing that that does not meet Samsung's definition, from the document we just looked at, that says it should be three types of accelerations.
That's the argument we're making
10:46AM of why these claims overcome Bassompiere.
Does that make sense to you? Do you understand that argument?
I'm not asking you to agree with it.
10:47AM MR. LAURENZI: Objection. Form. Scope.
A. That's not something that I have opined on in my declaration. I have opined on --
10:47AM Q. I'm asking, can you understand

the argument I'm making? I have not asking if you opined on it.

I'm asking, do you understand what I'm saying?

10:47AM MR. LAURENZI: Same objections.

A. I have to think about any statement that I'm hearing for the first time. So I need to think about that and analyze it before I can say anything about it.

Q. Well, let's look at the last sentence of this paragraph.

A. Okay.

Q. Because we just needed that context so that -- so now Samsung says, "While it is true that axial accelerations can be one of three types of acceleration, there's no requirement that Bassompiere disclosed each of the three types of acceleration, as patent owner's argument appears to require."

Do you see where I'm reading?

A. I do.

Q. So what we're arguing about is, patent owner was saying that Samsung

interpreted, predicted axial accelerations to require three types of acceleration and now Samsung is responding that, no, it does not have to disclose all three types.

Do you understand that?

MR. LAURENZI: Objection. Form. Scope. Foundation.

MR. EVANS: There's only one objection that's proper in these depositions, please.

So let's stick to that.

A. Again, that's something that -- what I have opined on is what the predicted axial acceleration is by Bassompiere. I have discussed that in detail, for example, on page 71 of my declaration.

Q. Let me ask you. That's okay. I don't want to get into all of that right now.

I'm just asking, do you understand the distinction that I'm drawing here?

A. I have to think about it.

What I do understand is that the patent talks about predicted axial

acceleration and --

Q. I want to focus on --

A. -- any accelerations --

Q. I don't want --

10:49AM A. -- that is predicted, is going to satisfy that requirement, and that's precisely what I've done on paragraph -- on page 71 of my report.

Q. What does "predicted" mean?

10:49AM A. So if I have traveled hundred miles, if I look at the odometer, exactly hundred miles, if by way of another method I predict that to be 97 or 103, that is a predicted value.

10:49AM Q. How do I know what a predicted acceleration is?

A. It's a predicted value of acceleration. And as Bassompiere by way of example mentioned, it's a priori estimation

10:50AM of the acceleration measurement, and it provides example of that.

Q. Can you say that in a way that a normal human being can understand?

MR. LAURENZI: Objection. Form.

10:50AM A. I don't understand your question.

Q. You just keep restating the same thing using the same words.

But I'm asking you what those words mean, which requires different words.

10:50AM So if it's a predicted acceleration, is what I think I heard you say, any predicted acceleration can be a predicted axial acceleration, how do you know if it's predicted?

10:50AM A. Again, Bassompiere -- that's the whole idea of extended Kalman Filter that Bassompiere goes through in details.

Among other places, it talks about a priori estimation of the

10:51AM acceleration measurement. That's what you measure based on certain factors.

And those factors are described in detail, for example, on page 70, 71, 72, 73, et cetera, of my declaration.

10:51AM And Bassompiere --

Q. What is --

A. -- and Bassompiere provides an exact way of doing that, provides that.

I have provided that analysis and

10:51AM described how this prediction is done at

the right time in relation to claim element 1E.

Q. I understand that.

My question was a lot simpler.

10:51AM When you read the word "predicted in the patent, what does the plain and ordinary meaning of that word that you applied?

A. So you have a measurement

10:52AM normally in extended Kalman Filter and you have a prediction of the same item, the same quantity based on certain -- based on certain methodology.

And extended Kalman Filter shows

10:52AM us that this predicted value, when compared to measurements, tells you where you are in the system and guides you in the right direction.

Q. What is the measured value in

10:52AM Bassompiere?

(Document review.)

A. Bassompiere, by way of example in equation 23 and page 19, lines 8 through 9, also page 5, line 4 through 6, by way of

10:53AM another example page 29 through 4 talks

about Ax, Ay and Az at the time or step K. Those are the measured acceleration values.

Q. And what do those represent? What has been measured?

10:53AM A. Acceleration.

Q. Which accelerations?

A. Acceleration in the X, Y and Z direction as measured by accelerometer.

Q. And what is causing those

10:53AM accelerations?

A. Many things. The environment. The movements.

Q. What does Bassompiere want to measure?

10:54AM A. A number of things.

Q. Is gravity one of them?

A. Bassompiere, at the end of the day, is interested in...

(Document review.)

10:54AM A. ... measuring Dy and Dz.

Q. What's that?

A. If you look at Bassompiere...

(Document review.)

A. ... by way of example figure 2,

10:55AM the coordinate x, y, z is shown and Dy and

Dz is a vertical and horizontal displacement in the lower case x, y, z frame.

Q. You said in extended Kalman Filter you have a measurement vector, right?

A. Yes. It depends, of course, in general in certain comments, one of the application is, you have a state and you have a measurement vector where you regularly measure things.

Q. And then you have a predicted measurement vector as well as part of an extended Kalman Filter typically?

A. You could have a predicted value in some instances of extended Kalman Filter, that is correct.

Q. And then you compare that measured value with the predicted value in some way, right?

A. In some cases, you could do a comparison of -- in certain contexts of a measured value and a predicted value.

Q. Is that the type of EKF that is used in Bassompiere?

A. What is "PKF"?
Q. "EKF," Extended Kalman Filter, is that not a common way to refer to it?
A. I just didn't hear you.
10:57AM Q. My fault.
A. Yes, it is EKF, absolutely.
So Bassompiere talks about an EKF use a special kind of EKF, actually, Extended Kalman Filter, and it shows how
10:57AM you go about setting up your Extended Kalman Filter.
Q. I want to come back to the document on the screen, page 20.
A. Yes.
10:57AM Q. And I want to focus on the sentence, "While it is true that axial accelerations can be one of three types of acceleration, there is no requirement that Bassompiere disclosed each of the three
10:57AM types of acceleration, as patent owner's argument appears to require."
Do you see that, right?
A. You read that well.
Q. Is that the plain and ordinary --
10:58AM is that the same plain and ordinary meaning

that you applied in your declaration?

A. I have to see the entirety of the documents because the context does matter. I have not seen the document that you are showing only four pages of it to me.

What I have used is that the predicted axial acceleration that Bassompiere uses. I've provided the specific vector for that, and I've talked about the priori estimation of the acceleration measurement.

Q. And so in your opinion, an axial acceleration can be any type of acceleration?

A. The word "predicted axial acceleration" is a prediction of axial acceleration.

Q. My question was about axial acceleration.

And in your opinion, the plain and ordinary meaning of that can be any type of acceleration, correct?

A. My opinion is that the prediction that Bassompiere provides here, which is YK-hat bar, is a predicted axial

acceleration that he's using in the Extended Kalman Filter.

Q. Which of the three types of acceleration does that represent in Bassompiere?

10:59AM

A. So Bassompiere is specifically talking about a multiplication by the vector G0, which is 001.

Q. That's gravity, right?

11:00AM

A. That is a gravity vector. And that's the prediction that he's providing as shown in equation 22.

Q. So the predicted acceleration in equation 22 of Bassompiere is gravity?

11:00AM

A. Equation 22 is a gravity-based acceleration.

Q. Is the measured axial acceleration in Bassompiere also supposed to represent gravity?

11:00AM

A. The measurement is done by a 3D X or a multi-accelerometer. So whatever those acceleration values are in the sensors that Bassompiere talks about, those are the acceleration values shown as Ax, Ay and Az, on top of page 21.

11:01AM

Q. And that's what gets compared to the predicted gravity value, correct?

A. As we see in equation 23, the acceleration value Ax, Ay and Az gets compared with YK hat bar.

Q. Looking at this sentence on the screen again, there's no requirement that Bassompiere disclosed each of the three types of acceleration.

Is that consistent or inconsistent with your opinion?

MR. LAURENZI: Objection. Form.

A. I have to read the entirety of this document to think about it. I don't know the context of this document. I need to read it for myself and analyze.

What I have analyzed with respect to Bassompiere is that the YK vector shown in equation 22 as Bassompiere explicitly says is a priori estimation of the measurement, i.e., it's a predicted axial acceleration.

Q. So is that consistent or inconsistent?

MR. LAURENZI: Same objection.

A. I have to read the entirety of this document that you have in front of me, and you are showing a very small portion of it to me, for me to be able to analyze.

What I can tell you is that the acceleration estimation in Bassompiere is provided by equation 22.

Q. Well, gravity is one of the three types of acceleration that Samsung previously identified, right?

A. I don't know what Samsung has previously identified.

Q. We were just looking at it. It was the footnote that we looked at on the last page that said linear, centrifugal and gravity.

You don't remember that?

MR. LAURENZI: Objection to form.

A. I do recall those words. I need to read the entirety of that document, think about it before I can say anything about that.

Q. What is so difficult about this sentence that you can't form an opinion right now?

It's just saying that Bassompiere could be any of gravity, linear or centrifugal accelerations.

And I'm asking if your gravity-only read is consistent with that? Do you agree or disagree?

MR. LAURENZI: Objection. Form. Asked and answered.

A. Again, when you show me part of a document, there might be other parts in a document that makes clarification or explanation related to a sentence that you are showing me out of context.

Q. I agree with you 100 percent.

But just based on the information you have in front of you right now. What is your opinion?

I'm only asking for that. I'm not looking for a gotcha here. You're the expert. I know you understand this a lot better than me.

I'm just trying to determine if what Samsung said here is consistent with the opinions you have provided on Samsung's behalf?

MR. LAURENZI: Objection. Form. Scope.

A. Again, this document I really need to understand it, how they are explaining things, how it relates to the rest of it. I haven't had that opportunity right now or before to do that.

If you want to share me, with me, the entirety of this document, I'll be more than happy to go over it and provide opinion.

I, in terms of predicted axial acceleration, I've shown, for example, equation 22 of Bassompiere provides that.

And that's exactly what is needed in the analysis I've provided in the claim language.

Q. Why don't you download documents 14 and 20, that we just went over and we can take a short break. And you can read them to your heart's content, and then we can come back on the record.

Does that work?

MR. LAURENZI: He can read it on the record. We're not going to use

time off the record to do that.

BY MR. EVANS:

Q. Have you ever seen this document before?

A. I don't believe so.

Q. What did your attorney just tell you?

MR. LAURENZI: You can answer "yes" or "no."

MR. EVANS: What did you just say to him?

MR. LAURENZI: I said "hold on" is what I said.

(Simultaneous crosstalk.)

MR. EVANS: Why --

MR. LAURENZI: One thing --

MR. EVANS: You can't tell him to "hold on," sir. You are not supposed to tell the witness how to testify, and you are limited to objection forms. So please limit yourself as the rules require.

Can we have that agreement?

MR. LAURENZI: I am entitled to assert privilege. I asked you to hold

on and the witness while I decided whether I needed to assert a privilege before he responded to the question. That's all I did, Counsel.

11:06AM MR. EVANS: Well, I'm not in the room with you so it's hard for me to know. All I heard was muffled whispering as the question was --

MR. LAURENZI: I'm not --

11:06AM MR. EVANS: And it's on the videotape. So we can go back.

I'm not accusing you of anything. I'm just saying please don't instruct the witness how to answer.

11:06AM Can we agree that that is improper? I'm not saying --

MR. LAURENZI: Absolutely it is. That's not what I did.

MR. EVANS: That's fair. I'm not 11:06AM accusing you of that. Please limit yourself to the objections the rules require, and please do not tell the witness how to answer the questions.

MR. LAURENZI: Okay. Again, I 11:06AM told you I didn't do that. So I don't

need you to repeat again --

(Simultaneous crosstalk.)

MR. EVANS: I'm not deposing you. I'm just telling you how I would like you to comport yourself, and I'm going to continue with my deposition.

MR. LAURENZI: Again, I don't need you to tell me over and over.

MR. EVANS: Let's go off the record if you're going to talk on the record. Let's go off the record, and the witness can read the document.

MR. LAURENZI: You don't need to go off the record.

What is the question? Why don't you ask the question again.

BY MR. EVANS:

Q. Have you seen this document before?

A. Please go to page 1. I'm not sure if I've seen this document or not.

Q. Okay. Would you like to take a short break? I think we've been -- I don't know how long we've been going.

A. I'm okay to proceed.

Q. Okay.
A. Please proceed. If the court reporter is not tired, I'm okay to proceed.
MR. EVANS: We can pull that exhibit down.
BY MR. EVANS:
Q. Let's pull up your declaration, Exhibit 1002, and I want to go to paragraph 72. Can you see that paragraph?
11:08AM A. Yes.
Q. Paragraph 22 says, "Bassompiere explains that equation 22 is derived from multiplying a known rotation matrix for pitch and roll by the gravity vector."
11:08AM Do you see that?
A. Yes.
Q. And that's that G0 vector that you were referring to earlier, right?
A. I have talked about this vector G
11:08AM subzero which has coordinate 001.
Q. Now what this science is saying is that the predicted axial accelerations you're identifying in Bassompiere are a prediction of how gravity would be pointing
11:09AM in the devices reference frame based on its

current orientation, correct?

A. This is showing how you apply the gravity vector through a pointing device, a 3D pointing device, to be precise, and that's the predictive acceleration that you obtain, which is provided by equation, I believe, it's 22.

Q. But vector G0, is that in an earth reference frame?

(Document review.)

BY MR. EVANS:

Q. You can answer, Doctor.

(Document review.)

A. That is the reference frame related to capital X, Y, Z as Bassompiere talks about.

Q. Is that an earth reference frame?

A. Bassompiere classifies that as a reference frame related to capital X, Y and Z.

Q. What does that mean?

A. It means, if you look at, for example, figure 2 of Bassompiere and the corresponding discussion, he has a capital X, Y, Z reference frame and the rotations

Theta and Psi are discussed with respect to that frame. And, therefore, G001 is with respect to that frame.

Q. But Bassompiere has three reference frames, right?

A. At least.

Q. It's got the screen reference frame?

A. In figure 2, a screen reference frame as lower case x, y, z is shown.

Q. And then you have a device reference frame which is capital X, Y, Z?

A. There is a 3D pointer reference frame which is capital X, Y, Z also shown in figure 2.

Q. And then there is a carrier reference frame defined as "UV" and "W," right?

A. There is a carrier or user reference frame, which is lower case u, v and w.

Q. What is u, v and w?

A. Those are the carrier's reference frame.

Q. What are they?

A. The carrier's reference frame.
Q. What are they in reference to?
A. The carrier.
Q. And what's that?
11:12AM A. The carrier, exactly that.
Q. I don't know what a "carrier" is. I'm asking you because you're an expert.
A. Oh, let me see if I can find where you can refer to it.
11:13AM Q. And is it referencing the person carrying the device, or is it some other frame?
A. So, look, please, page 11 of Bassompiere it says, I'm not going to read
11:13AM the entire sentence, but more specifically it talks about the last reference frame u, v, w named the carrier reference frame, which is associated with the part of the body which creates the pointing motion.
11:13AM And throughout, I believe, consistently Bassompiere calls that the carrier reference frame.
Q. So when that vector G0 is 001, what direction is 1 going in?
11:14AM A. 1 is with respect to X, Y, Z. So

capital Z.

Q. Is that down?

A. It depends where capital X, Y, Z is. It's in the direction of Z.

11:14AM Q. So if the device was laying flat on the ground, that would be down?

A. Yes. Correct.

Q. And then if I rotated it by some angle, similarly, relative to the earth, it

11:14AM would still be down but now relevant to that device frame of reference, it would be at an angle?

A. I don't follow your example or your hand movements. Sorry.

11:14AM Q. Why does Bassompiere use a rotation matrix?

A. Use of rotation matrices is very popular in dealing with three dimensional movement. There is the cosign version that

11:15AM is being used. It's called the cosign version or other variations of it.

Q. When you multiply -- when they multiply the known rotation matrix for pitch and roll by the gravity vector, what

11:15AM is the result?

A. So by G0 matrix, what you get is the last coordinate of the rotation matrix are related to pitch and roll. And that provides an estimate of what the acceleration is. And that's what we call the predicted axial acceleration, or as Bassompiere called it, it's a priori measurement, a priori estimate, or whatever term he uses.

11:16AM Q. And as we just established, that predicted acceleration, in this instance here, in paragraph 72, is gravity?

A. That's predicted acceleration is in the direction of capital Z.

11:16AM Q. Is that gravity?

A. It's in the direction of capital Z. Wherever capital Z is.

Q. And what happened to the gravity vector?

11:16AM A. So that G could be a gravity vector, but more generally, it's in the direction of the Z vector.

Q. In paragraph 22, you are talking about a gravity vector, though, right?

11:17AM A. Yes. And as I said, in some

cases, the vector 001 can either be called the gravity vector because it's in the direction of Z.

So I'm calling it the gravity vector, but precisely, it's a vector in the direction of, if you look at capital X, Y, Z frame, it's in the direction of Z, capital Z.

11:17AM Q. Is the purpose of multiplying that gravity vector by the rotation matrix to project gravity into the device or pointing device's frame of reference?

A. Sorry, I don't understand your question.

11:17AM Q. Is this matrix, rotation matrix multiplication, is it taking that gravity vector and moving into a new frame of reference?

A. It's looking at the rotation in two angles, Theta and Psi and focusing on the last component of that rotation matrix. It's all about Theta and Psi angles.

Q. And Theta and Psi represent the device's orientation?

11:18AM A. They are angles related to the 3D

pointing device.

Q. And what do they represent about the 3D pointing device?

A. So as Bassompiere says, advantageously the Kalman Filter satisfies at least one of the following conditions: It states vector comprises at least one angle of torsion Theta and Psi of the pointing device and other things that it demonstrates or represents, I should say.

Q. That doesn't mean anything. I'm asking you what Theta and Psi represent in regards to the point device, and you're just saying they're Theta and Psi.

What are they? Are they angles of deviation representing how the pointing device is oriented? Like what are we talking about?

A. Please, do you have Bassompiere in front of you? Or later, look at the transcript, look at page 4 of Bassompiere, start with line 16.

It says, "The Kalman Filter satisfies at least one of the following conditions: Its state vector X that

comprises at least one angle of torsion of Theta and Psi of the pointing device."

This is in relation to capital X, Y, Z.

11:20AM Q. What are those angles being measured against?

A. You start with capital X, Y, Z at rest. And when you make a movement with respect to its original position of the 3D 11:20AM pointing device, those are the angles that you will get.

Q. And how does gravity play into this Extended Kalman Filter in Bassompiere?

A. So, again, when you take the Z 11:20AM direction of the vector and you take the rotation matrix multiplied with that, you get the acceleration in the third dimension. And that's how you get what you have in equation 22 of Bassompiere on page 11:21AM 19.

Q. What do you mean when you said "third dimension"?

A. So if you look at the rotation matrix, it's a 3 by 3 matrix, the last 11:21AM column of it, is what gets you equation 22.

Q. And what does that represent?
A. That represents the last column of the rotation matrix with respect to Theta and Psi angles.
11:21AM Q. I feel like we're talking past each other. I get that. I'm a human being that has not studied 30 years of sensor fusion like you.
What does that mean in the real
11:21AM world? Like, what are we talking about? "Theta" and "Psi," that means nothing to me.
What are we doing? Like, what are we actually figuring out? Can you say
11:22AM it in a way that makes sense to a layman?
A. I'll do my best.
Given that these are obviously technical concepts, so you start with the pointer in some position.
11:22AM You move that pointer. Your final and ultimate goal is to see the movement of pointer making a change on the screen. That's the final goal in the patent, '846, for example, and that's
11:22AM exactly what Bassompiere is teaching.

So as you move the pointer, in some angles by way of example, Theta and Psi, two angles, you don't need to remember the symbols.

11:22AM Is that going to be accurate angles or not? That's the whole point of Extended Kalman Filter.

So you represent these angles, Theta, Psi, some angle as a state. Then

11:23AM you perform measurement of the angular velocities, how fast they are moving, what their velocity is.

Then you represent the acceleration. You measure -- you estimate

11:23AM that. That's the whole equation 22.

Once you are done with all that, you do an actual measurement of acceleration and you see -- you compare them to see a difference. That tells you

11:23AM if where you are is in the correct place in the Extended Kalman Filter, and if not, you correct that by using equation 23 of Bassompiere.

So basically you measure, you

11:24AM make correction, you measure -- this

happens every day. When you are in your car trying to get a GPS value in order to know where you are and which direction to head, is that GPS value correct or not.

11:24AM The answer is no. You take it for granted, but it's not.

So Extended Kalman Filter in your car also used the physics. It uses your acceleration, how much you are moving your

11:24AM steering wheel to the left and right, and try to see if the estimate that you got before is correct or not; and if not, how far is it from being accurate. And you keep correcting yourself.

11:24AM That happens all the time as you are driving your car and looking at your GPS. So it's the actual measurements and estimation.

Q. And gravity is the vector that's

11:25AM used for that error correction from accelerometers, right?

A. It is the third dimension of the X, Y, Z coordinate.

Q. Are you saying that is gravity or

11:25AM are you saying that is a different thing

from gravity?

I don't know what you mean when you say that.

A. What I mean is, to be absolutely correct, you have to call that the Z direction. Because everything Theta, Psi, they are all defined with respect to the 3D pointing device, right?

Therefore, everything is with respect to that frame of reference.

And when you multiply that by 001, the actual value is in the Z direction. And that's how you get the estimate of the acceleration, i.e., equation 22 of Bassompiere.

Q. So the Z direction in Bassompiere is a direction toward the earth?

A. It is whatever the Z direction is. Wherever you start from.

Q. What did they select in Bassompiere?

A. The description in Bassompiere is more general with respect to frame of references. And the reason is, they want to be general in case you are in a general

situation.

One example is that they used the 001 vector, along the main axis.

Q. And that's gravity?

A. It can be gravity.

Q. Is it gravity?

A. And therefore I'm using the example of gravity just to say that's an example of what it could be.

Q. Is it gravity in Bassompiere?

A. It is in the direction of capital Z in the reference frame.

Q. So you're saying capital Z in the reference frame is the same direction as gravity?

A. No. I'm saying capital Z is a general direction, whatever it is.

Q. So why did you choose gravity?

A. One example is when Z is in the direction of gravity. That's just an example.

Q. So you just chose to do that?

A. That's an example. I provided an example, and I just provided to you the general setup of Bassompiere.

MR. EVANS: Let's pull this down, and I want to go to Exhibit 2026.

(Deposition Exhibit 2026, Responsive Declaration of M. Ray Mercer, Ph.D., marked for identification, as of this date.)

I don't know if anybody needs a break. This would be a decent time for one.

THE WITNESS: The court reporter?

COURT REPORTER: Can we take ten?

MR. EVANS: Sure.

THE VIDEOGRAPHER: We are off the record. The time is 11:28 a.m. Pacific time.

11:28AM

(Recess is taken.)

THE VIDEOGRAPHER: We are back on the record. The time is 11:39 a.m. Pacific time.

11:39AM

MR. EVANS: I'd like to pull up Exhibit 2026 now.

BY MR. EVANS:

Q. This is a declaration that was filed by Dr. Mercer on behalf of Samsung Electronics as part of the CyWee case on

11:39AM

March 19th, 2018?

Have you seen this before?

A. I might have in the previous case. I don't recall being six years or so from the date of -- or eight years from the date of this document.

Q. Sure.

But you haven't considered it as part of this lawsuit or this IPR?

A. Say that again?

Q. You haven't reviewed it as part of this inter partes review process?

A. I have not.

Q. And this isn't something you relied on when you were writing your declarations?

A. What I've relied on or considered, at least, is in my declaration.

Q. So if it's not listed there, you didn't rely on it?

A. That's fair.

Q. Let's go to paragraph 70.

Do you see where it says, "A POSITA would have understood the term 'axial accelerations' could have multiple

possible interpretations"?

A. I see that.

Q. Do you agree with that?

MR. LAURENZI: Objection to form.

11:41AM A. I have to look at this entire declaration to see how he's using the words "multiple possible interpretation."

Q. I'm just saying sitting here right now as a person of ordinary skill in

11:41AM the art, is that something that you would agree with?

A. I need to look at the context. Without looking at it, I cannot comment.

Q. Let me ask you this: Do you

11:41AM think the term "axial accelerations," as it is used in the patents, could have possible multiple interpretations?

A. What I've used is the acceleration in a given axis. And that's

11:42AM what I've used throughout my analysis in this case.

Q. If we go down to paragraph 72 it says, "In general, an accelerometer reports three different types of acceleration,

11:42AM linear acceleration, centrifugal

acceleration, and gravitational acceleration."

Do you see that?

A. You read that correctly.

11:42AM Q. Is that accurate?

MR. LAURENZI: Objection to form.

A. I have to look at the context. Certainly there are different types of accelerations.

11:42AM Q. Are there more than just those three?

A. It depends how you classify. You could have continuous acceleration. You could have discontinuous acceleration, you

11:43AM can have non-linear acceleration.

So it depends what purpose it is that you are doing the classification for.

Q. Just in general, as a person of ordinary skill in the art, do you think

11:43AM that sentence in paragraph 72 is true?

A. Can you at least show me the entirety of paragraph 72, or that's it? Okay.

Go back, please.

11:43AM (Document review.)

A. I have to look at the entirety of this declaration to see whether I agree with it or not. It depends on how he's using this term, what he's meaning by paragraph 72, which is part of a huge document, a 45-page document.

Q. So sitting here right now you don't know?

A. Sitting here right now as a scientist would do, I need to look at the entirety of a document before I can provide an opinion on one sentence in a 45-page document.

Q. So you lack sufficient information to know if an accelerometer reports three different types of acceleration?

MR. LAURENZI: Objection. Form.

A. As I said, an accelerometer can, for example, report a linear acceleration by way of example, but how he's using this sentence, I need to look at the entirety of the declaration before I can comment.

Q. So if I say you're not sure, is that an accurate representation of your

testimony right now?

A. An accurate representation will be that I need to look at an entirety of a document before I can make any comment about one sentence out of a 45-page document. That would be accurate.

Q. Let's go to paragraph 73.

It says, "The '438 patent does not disclose whether the axial accelerations are linear accelerations, centrifugal accelerations, gravitational accelerations, or one of several possible combinations of these three."

Do you see that?

A. You read that correctly.

Q. Is that, in your opinion, an accurate statement?

MR. LAURENZI: Objection to form.

A. Today I'm not providing an opinion about the '438 patent.

Q. Well, let's change it to the '687 patent.

Does that patent disclose whether the axial accelerations are linear accelerations, centrifugal accelerations,

gravitational accelerations or one of the several possible combinations of these three?

A. The '846 patent talks about acceleration in an accelerometer, and by way of example, an accelerometer can be a linear accelerometer measurement.

Q. So you would say the patent does disclose this information?

A. I did not say that.

MR. LAURENZI: Objection to form.

A. No --

Q. Are you saying that it does or does not disclose this information? That's all I want to know.

A. The patent talks about an accelerometer that, by way of example, can be a linear accelerometer measurement.

Q. When you read the patents, were you able to ascertain what the term "axial accelerations" meant?

A. Yes.

Q. And the scope of it wasn't uncertain to you?

A. The word "axial acceleration"?

Q. Yes.
A. It was clear what they mean by that.
Q. Is that a word that has a well-understood meaning by persons of ordinary skill?
A. Usually people are specific and use terms such as linear acceleration or acceleration in general. I have not seen the word "axial" in the literature often.
But reading the patent and the fact that it it's using by way of example an accelerator or accelerometer, I should say, then it's kind of clear what they mean by that.
Q. Do you know how to obtain the value of one or more of these individual component accelerations from accelerometer data?
A. Certainly there are filtering algorithm such as Blender where you can feed in an accelerometer values and it gives you different types of acceleration, for example --
(Reporter clarification.)

A. For example, it can give you the Y direction acceleration.

Q. Were you capable of doing that in the 2009 and 2010 time frame?

11:49AM A. In 2009, you could get values of different types of acceleration via various types of filtering algorithm. I've done that myself.

Q. So when paragraph 75 says, "If 11:49AM the axial accelerations are interpreted as the sum of the three accelerations described above, which is the case generally, it would have been unclear to a POSITA how to obtain the values of one or 11:49AM more of the individual component accelerations."

That is a false statement?

MR. LAURENZI: Objection. Form.

A. It really depends on the context.

11:49AM What I said is some components of acceleration, such as X, Y, Z can be extracted. For example, if you have a 3D accelerometer and you want to find movement in certain direction, that would be -- that 11:50AM was a possibility.

Q. Let's go to paragraph 165 --
A. My comment was not related to paragraph 73. It was general.
Q. Thank you for that clarification.
11:50AM A. Of course.
MR. EVANS: Scroll up a little bit.
BY MR. EVANS:
Q. Do you see where it says "predicted axial acceleration ambiguities"?
11:50AM A. Yes.
Q. And then you see paragraph 164 right under that it says, "A person of ordinary skill in the art would have understood that the term predicted axial accelerations could have multiple possible interpretations for the same reasons that axial accelerations can have multiple possible interpretations described above in the paragraphs we just looked at."
11:51AM Do you see that?
A. Yes.
Q. Do you agree with that statement?
MR. LAURENZI: Objection to form.
11:51AM A. This is in relation to, for

example, the '846 patent?

Q. Sure.

MR. LAURENZI: Objection. Form.

A. I need to look at the entirety of this document to see what this is all about. This is not clear what the context is. I cannot comment on it.

Q. Well, let's look at the next paragraph. It says specifically, "A person of ordinary skill in the art would not have known whether predicted axial accelerations were a prediction of linear acceleration, centrifugal accelerations, or gravitational accelerations or some combination of the three."

Do you see that?

A. I do.

Q. Is that accurate?

MR. LAURENZI: Objection. Form.

A. I need to see the entirety of this document before I can comment on it.

Q. Speaking for yourself, have you reviewed the patents-at-issue here, the '846 and '687 patents.

Are you able to determine whether

predicted axial accelerations were a prediction of linear accelerations, centrifugal accelerations, gravitational accelerations or some combination of the three?

A. That's not something that I needed to analyze for my report.

Q. It's asking whether you can understand the term axial accelerations meant, right?

A. Yes, and I provided an answer.

Q. Do you, as a person of ordinary skill in the art, understand what the term predicted axial accelerations means in the context of the patents-at-issue in this IPR?

A. The predicted axial acceleration, generally, is a prediction of acceleration around an axis.

Q. Is the ambiguity discussed in paragraph 165 something that was a problem for you?

MR. LAURENZI: Objection. Form.

A. I need to look at the entirety of the document, 45-page or so document,

before I can comment on that.

Q. Well, this is one person of ordinary skill in the art saying what another person of ordinary skill in the art wouldn't have been able to understand about the term predicted axial accelerations.

And all I want to know is, does that apply to you or not?

MR. LAURENZI: Objection. Form.

11:53AM A. I need to look at the entirety of the document in front of you to see how this person of ordinary skill in the art in the context is using the terms and the analysis of, for example, paragraph 165.

11:54AM Q. So you never made a determination of what type of accelerations the patents are talking about when they referred to predicted axial accelerations?

A. Predicted axial acceleration are prediction of acceleration with respect to a given axis.

Q. Do you agree with Dr. Mercer here that the term predicted axial acceleration does not have a plain and ordinary meaning?

11:54AM MR. LAURENZI: Objection to form.

A. I have to look at the entirety of his document to see what context he's using that.

Q. But based on paragraphs 164 and 165, he's saying that a person of ordinary skill in the art would not be able to understand the scope of this term, correct?

MR. LAURENZI: Objection. Form.

A. I cannot comment on one paragraph out of a 46-page document without reviewing, thinking and analyzing it.

Q. Why not? I mean, we do limited information problems all the time in science and engineering.

This is a word problem. This is all you were given.

The question is: Do you agree that a POSA could understand the term "predicted axial acceleration" or not?

MR. LAURENZI: Objection. Form.

Asked and answered.

A. As I mentioned, to do the proper scientific analysis and to respond to you, I need to look at the entirety of this 45-page document. I cannot in vacuum, from

one sentence or a couple of lines, make a determination.

Q. Why didn't you review this when you were providing your declarations in this case?

11:55AM

MR. LAURENZI: Objection. Form.

I caution you not to reveal any discussions with counsel.

MR. EVANS: Unless they're about facts that you relied on.

11:55AM

A. Again, this my declaration, by way of example, the example '846 patent, that's what I've relied on and worked on.

Q. But you don't think it would be important to understand how other persons of ordinary skill in the art have interpreted the claims of the related patents that shared specification to determine if what you were saying was correct?

11:56AM

11:56AM

MR. LAURENZI: Objection. Form.

A. I have reviewed the '846 patent and I have done my analysis of by way of example the '846 patent.

Q. Does Samsung agree with your

11:56AM

interpretations of the patents?
A. Same, you need to depose Samsung for that.
Q. Have you discussed it with anyone at Samsung?
MR. LAURENZI: Instruct the witness not to answer on privileged grounds.
MR. EVANS: People he's talked to is not privileged. That's not privileged information.
A. I have been instructed not to answer.
Q. Have you had any discussions with anyone at Samsung?
MR. LAURENZI: Answer "yes" or "no," if you know or remember.
A. In my life?
Q. As part of this case.
A. I don't believe so.
Q. Have you worked with anyone other than the attorneys in providing your opinions?
A. In this case?
Q. Yes.

MR. LAURENZI: Object to form.
You can answer yes or no.
A. I don't believe so.
Q. Was any information that you relied on in forming your opinions provided to you by those attorneys?
A. Every opinion that I have, as I stated in my declaration, are my opinion.
Q. That wasn't my question.
A. I'm not sure, then, what you're asking.
Q. Was any information that you relied on in forming your opinions provided to you by those attorneys?
A. I'm not sure how to answer that. I've had discussion with the attorneys, but the opinions provided are all mine.
Q. Do you know what I mean when I say rely on something in support of your opinions?
A. No. Everything I've relied on are my own opinion, background, knowledge, and the documents that I've looked at.
Q. Did the attorneys provide you with any claim construction positions in

this case?

A. Again, as I've stated, the claim constructions are shown in my declaration.

Q. Where did those come from?

11:59AM A. For the most part, they are plain and ordinary meaning.

Q. And who decided to apply the plain and ordinary meaning?

A. It's my opinion that, as I say on

11:59AM page 21 of my report, that I have applied the plain and ordinary meanings as understood by a person of ordinary skill in the art at the time of the alleged invention.

12:00PM Q. And were you told to do that by the attorneys that you're working with?

MR. LAURENZI: Objection. Form.

I caution the witness not to reveal any communications with counsel.

12:00PM A. As I've mentioned, it's my opinion that, and for the purposes of my opinion in these declarations, I've applied the plain and ordinary meanings as understood by a person of ordinary skill in

12:00PM the art at the time of the alleged

invention.

Q. Were you provided a shell to start writing your declaration?

MR. LAURENZI: I instruct the witness not to answer.

BY MR. EVANS:

Q. Did you write every word in your declaration?

MR. LAURENZI: Instruct the witness not to answer.

MR. EVANS: You can't do that.

MR. LAURENZI: Yes, I can.

MR. EVANS: How he wrote his opinion?

MR. LAURENZI: That's not what you've asked. It goes to drafts. It goes to privileged and protected.

MR. EVANS: How is a "yes or no, did you write every word in your declaration" in any way venture into work-product or attorney-client privileged communications?

MR. LAURENZI: Because they were drafts.

MR. EVANS: Privileged is waived

on drafts then.

MR. LAURENZI: No, it's not waived on drafts.

MR. EVANS: The existence of them. That's not a privileged thing, but you just admitted it.

MR. LAURENZI: I didn't admit --

MR. EVANS: You just said there were drafts. You said that in the record, right?

MR. LAURENZI: Let me see the record.

I said if there were -- Counsel --

MR. EVANS: Because there were drafts.

MR. LAURENZI: No, it's a privileged communication.

BY MR. EVANS:

Q. Let me ask you this, Professor, were there drafts of your report or did you do it in one go?

MR. LAURENZI: I instruct the witness not to answer.

BY MR. EVANS:

Q. Did you type up your report? Your declaration?

A. There were parts of it that I typed, yes.

12:02PM Q. Which parts?

A. It's more than a year. I don't remember.

Q. What substantively, like what did you write about?

12:02PM A. There were parts of the report that I wrote. It's, again, more than a year. And there were --

Q. So parts you didn't write?

MR. LAURENZI: I instruct the witness not to answer.

12:02PM BY MR. EVANS:

Q. You can answer, if you want.

A. I've been instructed not to answer.

12:02PM Q. What's your process for writing your declarations? Explain to me how these came to be in?

MR. LAURENZI: Instruct the witness not to answer.

12:02PM BY MR. EVANS:

Q. Did you review the patents before you wrote your declaration?

A. One of the first things that I did was prior to working on this case was to review the patents.

Q. What else did you do before you started writing?

A. I reviewed some prior arts. By way of example, I looked at the prosecution history of the '846 patent. This is related to the '846 declaration.

Those are some that come to mind.

And eventually, I did review what I've shown on page 4 of my '846 declaration.

And all these arguments, or all these discussions are for '846. And analogous discussion for the other patent.

Q. How many hours did you spend writing this declaration? Just ballpark.

A. It's more than a year. I don't remember.

Q. Like 20 hours? More or less?

A. My guess is more. But that's purely a guesstimate at this time.

Q. You think more or less than 50 hours?

A. It's more than a year. I don't remember.

12:04PM Q. Did you approach this declaration with the same rigor and methodology that you use when writing scientific papers?

A. I have used a rigorous approach in writing my declaration.

12:04PM Q. That's not the question I asked, though.

A. I think it implies, yes.

Q. Then just say yes.

So you did apply the same

12:05PM rigorous methodology you used for scientific papers to this declaration?

A. Methodology, yes.

Q. Do you regularly write scientific papers?

12:05PM A. I, along with my Ph.D. students, write scientific papers.

Q. So you write portions of them?

A. Sometimes. It all depends. I have 600 publications, many textbooks, so

12:05PM it kind of varies.

Q. Were you coauthors on those?
A. Many of my articles and textbooks have coauthors.
Q. What is your decision point for deciding if somebody should be a coauthor on one of your papers?
A. It varies case by case-by-case basis. By way of example, when I have a Ph.D. student with whom I spend several years working on a topic, that person is going to be a quoter on an article that we jointly authored.
Q. Would anybody be a coauthor on your declarations in this case?
MR. LAURENZI: Objection to form.
A. These are all my declarations. I wouldn't say anyone is a coauthor of my declarations.
Q. Let's go down to paragraph 199. This says, "A person of ordinary skill in the art would have understood that it is only mathematically possible to generate an orientation output based on axial accelerations and magnetism readings, if the axial accelerations are interpreted to

be based exclusively on the gravitational accelerations."

Do you see where I read that from?

A. Are you looking at paragraph 199?

Q. Yes.

A. Okay. Let me read it.

I see what you read.

Q. Do you agree with that statement?

MR. LAURENZI: Objection. Form.

A. I have to look at the entirety of the document to think about this particular paragraph.

Q. I'm just talking about when you're trying to do orientation outputs generally, is this statement correct? Just in general, not in the context of the patents?

MR. LAURENZI: Objection to form.

A. I have to look at the entirety of the document you are showing me before I can comment.

Q. So you don't have enough expertise to know sitting here right now whether that's true or not?

MR. LAURENZI: Objection. Form.

A. Sometimes in a large document requires clarification and justification and exceptions that are made. So I need to look at all of that before I can comment on paragraph 199 of the report you are showing me.

Q. Let me tell you there is no other reference to this anywhere else in the document. This is the only the time it's said, and there is no clarifications.

If you accept that that's true, if that is reality, what is your opinion on this statement?

A. I need, as a technical person, to verify all of that myself. There might be references and examples and exceptions that may be no one else or you have not realized. So I need to do that analysis for myself.

Q. Can you make orientation determinations using accelerations other than gravity?

A. Say that again?

Q. Can you make orientation

determinations using accelerations other than gravity?

A. That's not something that I have analyzed. I need to think about that.

Q. Was gravity a common acceleration used for determining orientations?

A. Say that again?

Q. Is gravity a commonly used when making orientation determinations?

A. In orientation analysis, for example, what Bassompiere does, gravity has been used to drive and come up with Theta and Psi angles, i.e., orientation of the 3D pointing device.

Q. Would you agree that an accelerometer can be particularly useful in determining the direction of gravity down acting on an object in three dimensions?

A. I need to look at the context of what you are reading from. I cannot --

Q. Paragraph 20 of your declaration in this case.

A. Of which --

Q. Your declaration.

A. Which?

Q. They're both the same in paragraph 20.

(Document review.)

BY MR. EVANS:

12:11PM Q. You've already opined on this. I'm not sure why you're unclear about what you've said.

Why do you need to read everything again?

12:11PM A. Right.

So in the context of this patent, '846 patent, what I've said in paragraph 20 is accurate.

Q. What about just generally, is an 12:11PM accelerometer useful in determining the direction of gravity?

A. There are so many general principals and examples and corner cases, I cannot provide a general comment on that.

12:11PM In the context of --

Q. In paragraph --

A. In paragraph 20 of my report, what I've said is absolutely accurate.

Q. Okay. Are you disagreeing with 12:12PM this paragraph 199 up on the screen, that

it is only mathematically possible to generate an orientation output based on axial accelerations and magnetism readings if the exact axial accelerations are interpreted to be based exclusively on the gravitational accelerations.

Is that true or false?

A. I need to look at the entirety of that document and think about it and analyze it before I can comment on paragraph 199.

Q. So this is a situation you've never encountered in your career? You've never dealt with this?

A. Again, to comment what, quote, unquote, the situation is, I need to read the entirety of that document.

I cannot comment on it in a vacuum.

Q. But I thought you were an expert in sensor fusion algorithms and orientation math, are you not?

A. I am.

And in certain -- that's why I'm being extra careful to say the context

matter.

We need to look at things --

Q. What context do you need?

A. -- in terms of patent analysis. We need to look at how patent defines certain terms and only then one can make an analysis and comment.

For example, when I provided my opinion in paragraph 20 of my report, I have thought about that quite a bit before writing it down.

Q. When you wrote that paragraph 20 in your report, is that the first time you've ever thought about those concepts in your career?

A. In relation to the '846 patent, yes.

Q. What makes the '846 patent different than just generally? Like, what context from that patent takes this into a space where you are comfortable opining on it versus not comfortable opining on it outside of that context?

A. Yes.

So, for example, another patent

may be talking about non-linear movement, non-continuous movement. It's very hard to make general statement in general environment. It really matters what the context is.

So one has to read the '846 patent, see what is it that they are exactly talking about, and then make a statement and analysis based on that.

12:14PM Q. What is your role in this IPR? Like, what is your purpose?

A. I don't follow your question.

Q. Why are you involved?

MR. LAURENZI: I caution you not to reveal any communications with counsel, but otherwise, you can answer.

12:15PM A. I've been asked to opine --

MR. LAURENZI: Explain what your understanding is in this.

MR. EVANS: Please don't tell the witness how to answer the questions, Counsel.

MR. LAURENZI: I'm giving him caution he so he doesn't reveal privileged communications. That's all.

MR. EVANS: It sounded like you told him how you wanted him to answer.

A. My opinion is that I've been asked to analyze certain patents and comment about them. That's my role.

Q. But why do we need you?

A. That's kind of above my pay scale. Ask the Board. Ask the attorneys. I'm not sure.

Q. So you don't know --

A. Why do you hire experts yourself?

Q. What is a teacher's role?

A. Sorry?

Q. What is a teacher's role?

A. At a university, for example? Or high school?

Q. Correct.

A. To teach certain topics.

Q. Explain things to people who don't understand them? Would that be in your scope?

A. Possibly, yes.

Q. And isn't that the role of an expert witness, to take expert concepts and translate them into ways that people that

lack your expertise can understand them?

Isn't your same role here?

A. That's above my pay scale.

What I understand is that I have provided these patents. I've analyzed them. I have looked at them. I have described and explained things.

Q. You're trying to make things more clear for the rest of us, right?

A. My declaration speaks for itself. I'm explaining things, and how I look at things, how one of ordinary skill in the art would look and analyze these patents.

Q. Just on a more fundamental role here, though, we're evaluating whether this patent, that people toiled and worked hard to come up with what they thought were inventions, is actually an invention or not.

That's what we're trying to figure out. That's the ultimate goal of this will proceeding, correct?

A. I'm not an attorney. I don't understand at a higher level what the proceeding and the legal aspect of it.

Q. You said this wasn't --
A. From a technical point of view, I have analyzed, for example, the '846 patent and provided my analysis in a declaration.
12:17PM Q. But you're trying to be helpful to the Board, right, to explain concepts to them that they may not otherwise understand because they lack your expertise, right?
A. I hope that I'm helpful to the
12:18PM Board. That's correct.
Q. And I would say that's the role of experts, is to be helpful both to a board or a jury or attorneys or judge, to impart their knowledge that we lack, right?
12:18PM MR. LAURENZI: I'm going to object to this colloquy.
A. That's your opinion. I'm not an attorney. I don't have an opinion on that.
Q. Was that what you were trying to
12:18PM do?
A. I tried to analyze the patents that were given to me, explain them and analyze them from a technical point of view.
12:18PM Q. And to bring clarity to what they

mean, right?

A. Hopefully some of my analysis will to make certain concepts clear and to explain them.

12:19PM Q. All right. We can put this exhibit down.

MR. EVANS: Let's pull up Exhibit 1021.

(Deposition Exhibit 1021, Claim Construction Opinion and Order, marked for identification, as of this date.)

BY MR. EVANS:

Q. So this is a claim construction order and opinion from the CyWee case 12:19PM against Samsung in the Eastern District of Texas that was entered by the judge on July 9th, 2018.

Have you seen this before?

A. This document is from eight years 12:19PM ago. I don't recall.

Q. Well, this is one of Samsung's exhibits in this case. But I take it, you have not reviewed it prior to this deposition?

12:20PM A. Not recently, no.

Q. Okay. Let's go to page 15. Let's zoom in on the axial accelerations portion there.

Again, this is the judge deciding what these terms mean after both parties have disputed it.

Do you understand that?

A. Which patent is this?

Q. This is the CyWee patents, the '438.

A. Oh, this is eight years ago. Got it. So not the patent that I have analyzed.

Please proceed.

Q. Correct. It's the patents that shared the same specification.

A. Okay.

Q. Do you see it says, "The patent is clear that axial accelerations refer to the acceleration vectors along three axes of the associated reference frame."

Do you see that?

A. Yes.

Q. And you seem to agree with that?

MR. LAURENZI: Objection. Form.

A. I have to look at the entirety of this document before I can comment.

What I've said is that axial acceleration is the acceleration along a given axis.

Q. And that's what the judge is saying too, right?

A. There are other words here. So what I've said is what I've used and agreed with. That's why I wanted to see the entirety of this document in order to see how terms are being used.

Q. The next sentence says, "Thus, regardless of whether the pointing device is undergoing linear, centrifugal, and/or gravitational acceleration, at any instant the acceleration of the device can be represented by vectors along axes of the chosen reference frame."

Do you see that?

A. I see that.

Q. And do you agree with that?

MR. LAURENZI: Objection to form.

A. I need to read the entirety of the patent, the claims of the

patent-at-issue before I can comment.

Q. But it doesn't conflict with what you've been saying, that the axial accelerations are along the axes, right?

12:22PM A. What I've been saying is that axial acceleration is acceleration along a given axis.

Q. Is this not also saying that?

A. There are other words in it. I

12:22PM have to think about it and analyze it and look at the rest of this document.

I also have to look at the patent-at-issue here. I'm sure it's not 100 percent the same as the patent I've

12:22PM looked at. The claims are different. I assume patents in general can be identical, only then I can provide an opinion.

Q. Well, you did review those patents or the materials that you

12:23PM considered?

A. Not with an eye toward this.

Q. We can sit here staring at this paragraph however long you need to make a determination of whether you agree with it

12:23PM or not.

So let me know when you're ready to testify.

A. Sure.

So in order for me to testify, I need to download this. I need to review this entire thing, and I also need to review the corresponding patent. I'll be ready to testify at that time.

Q. Well, I don't want to use my time on the record for that.

If you want to review these over the break, you're than welcome to and download them and read them.

Because based on this paragraph in front of you, let me know when you've had enough time to digest it and can tell me what you think it means, just using reading comprehension and your inherent knowledge as an expert.

MR. LAURENZI: Objection. Form.

A. That's not how we do science. We look at the entirety of a document to see how certain terms might have been used or defined earlier.

I'll also need to look at the

patent that this document is corresponding to. Only then I can provide any answer related to this paragraph.

Q. Let's take this out of patents.

12:24PM A. Okay.

Q. Just words in general as a scientist reading them, do you agree with them; and if not, why?

MR. LAURENZI: Objection. Form.

12:24PM A. What I can agree with is exactly what I said before.

In the context of the patents I have reviewed, in that axial acceleration, is the acceleration along a given axis.

12:25PM That part I agree with. That's something that I've used.

Q. All right. Based on this court's ruling here, and this is the only part in this whole opinion where the court

12:25PM commented on the meaning of this term, so based on this paragraph, do you agree the term axial acceleration encompasses the composite acceleration value linear, centrifugal, and/or gravitational that may

12:25PM be detected by an accelerometer at a

particular point in time?

MR. LAURENZI: Objection. Form.

A. I cannot comment on that without A, reviewing the corresponding patent because patents can modify terms to their liking.

Q. I'm not saying the patent. I'm just saying based on this order right here, just what the judge said right here. That's all I want you to rely on, nothing else.

MR. LAURENZI: Objection. Form.

A. Well, these terms are technical terms that apparently is used in some patents. So I do need to look at the corresponding patent, A, and I need to look at the entirety of this document before I provide any comment about the paragraph that you are showing me.

In terms of axial acceleration, I've said and I agreed, that is acceleration around a given axis, that is accurate.

Q. Well, based on this claim construction order, applying it to the

patents that you have analyzed in this case and opined on, do you agree that a predicted axial acceleration can only reasonably be interpreted as a prediction of a composite acceleration value?

MR. LAURENZI: Objection. Form.

A. A predicted axial acceleration is a prediction of the axial acceleration, based on a prediction method. That's accurate. And that's what I've used.

Q. Does it have to be a composite of linear, centrifugal and/or gravitational forces?

A. I have not opined on that in my declaration.

Q. Is that the way you applied it to Bassompiere?

A. In Bassompiere, the predicted axial acceleration is an acceleration that Bassompiere calls it and by via rotation of a rotation matrix of angle Psi and Theta to be a vector that I believe is in equation 22. That's how he used it and I agree with that. And I've used it in my charts, for example, and in my declaration.

Q. Well, if a predicted axial acceleration were required to be a composite value of linear, centrifugal and gravitational accelerations, would you agree that gravitational acceleration alone would not need it?

MR. LAURENZI: Objection. Form.

A. What Bassompiere shows is an acceleration along an axis Z. An example of that is gravitational. That Bassompiere is very clear on that, and that's what I've used as a predicted axial acceleration as required by the claims.

Q. All right. I'm going to read you a statement and a construction for the term predicted axial acceleration, and I want you to tell me if your application of Bassompiere to the patent claims would still apply if this were the construction: Gravitational, if predicted accelerations cannot be gravitational acceleration components isolated from the composite acceleration value?

MR. LAURENZI: Objection. Form.

A. That's a long sentence you just

read. Read it one more time, please.

Q. Well, let me make it a little simpler.

If predicted axial accelerations cannot be gravity alone, would your read of the patent claims onto Bassompiere still apply?

MR. LAURENZI: Objection to form.

A. Bassompiere talks about acceleration along a general axis Z. It's not just gravitational.

So gravitation is an example of that. So, yes, Bassompiere covers that.

MR. LAURENZI: Counsel, our lunch is here. Can we take a lunch break now?

MR. EVANS: Yes, sure this would be a good time for lunch. How long do you want to take?

MR. LAURENZI: Half hour? That works for everyone.

THE VIDEOGRAPHER: We are off the record. The time is 12:30 p.m. Pacific time.

(Recess is taken.)

A F T E R N O O N S E S S I O N

(Time noted: 1:00 p.m.)

THE VIDEOGRAPHER: We are back on the record.

01:00PM The time is 1:00 p.m. Pacific time.

* * *

M A J I D S A R R A F Z A D E H, Ph.D.,
resumed and testified as follows:

EXAMINATION BY (Cont'd.)

MR. EVANS:

Q. In the patents-at-issue here, when they use the term "predicted," are they talking about a future unknown value?

01:00PM (Document review.)

A. So by way of example, when the claims of the patents, the '846, talks about predicted axial acceleration, it's talking about converting the measured

01:01PM angular velocity corresponding to time T based on the previous quaternion into a current quaternion and predicted axial acceleration without using the measured axial acceleration corresponding to time T.

01:01PM So it's exactly that.

Q. Is time T present value?
A. Time T depends on when you are looking at it, time T is the time T.
At time T is present.
01:02PM Q. So the predicted axial acceleration is determined at time T, not time T, plus one?
(Document review.)
A. So if we look at figure 7 of the
01:03PM patent '846, it says calculate predicted axial acceleration based on current state at T. That's when you're calculating the predicted axial acceleration.
Q. So not T plus 1, just to be
01:03PM clear?
A. Figure 7 Box 73 says "Calculate a predicted axial acceleration based on current state at T."
It's based on the state at T.
01:03PM Q. I'm not trying to trick you, agreed?
I just want to confirm that T plus one is not when we're calculating predicted axial accelerations?
01:04PM A. Figure 7, Box 73 says "Calculate

predicted axial acceleration based on current state at T."

Q. So figure 7 does not show T plus 1?

A. The word "T plus 1" does not appear in figure 7. Although we understand that figure 7 is a loop.

Q. Right.

A. So it's all relative.

Q. Agreed.

But in the current iteration of the loop, we're calculating it at T, not T plus 1?

A. Box 73 says "Calculate predicted axial acceleration based on current state at T."

Q. So in your opinion, the term "predicted," as it's used in the patent, is not referring to the future?

A. Future, it's all relative with respect to what? With respect to certain event?

Q. In figure 7, is it being calculated in the future or at the present time?

A. Future of what?
Q. Based on --
A. It's on time T. Figure 7 says, "Calculate predicted axial acceleration based on the current state at T."
Q. We are trying to determine the current state, not a future state. For example, we are not trying to predict where the device will be, we're predicting where it is.
A. That's what Box 73 says. It says, Calculate predicted axial acceleration based on current state at T."
Then it says, "Obtain an updated state by comparing current state with measured states."
And that's where you figure out your error, where you multiply that in the extended Kalman Filter by the gain of the Kalman Filter, of the extended Kalman Filter.
Q. And then you use that to adjust your current orientation estimate, right?
A. Your angles, yeah. Bassompiere is clear, I've mentioned that, that you get

your new location based on everything that Bassompiere teaches, which is getting a prediction, getting a measurement, comparing them to see how far you are. And
01:06PM based on that, you will know your angles.

MR. EVANS: I'd like to pull up Exhibit 2033.

(Deposition Exhibit 2033, Rebuttal Declaration of Professor Majid Sarrafzadeh, marked for identification, as of this date.)

BY MR. EVANS:

Q. This is your rebuttal declaration from IPRs 2018-01257 and 01258, which are
01:07PM the CyWee IPRs we have been discussing at various times today.

A. Perfect.

Q. Have you seen this document before, presumably?

01:07PM A. I have provided that declaration about eight years ago.

Q. Okay. Do you remember that the primary reference in those IPRs was called Bachmann?

01:07PM A. Yes, I do recall Bachmann,

barely, eight years ago.

Q. Sure.

Let's go to paragraph 52. Do you remember Bachmann disclosed a sensor fusion algorithm that utilized quaternions?

01:07PM

A. I do recall that Bachmann talks about sensor fusion and does talk about quaternion.

Q. And unlike Bassompiere, its algorithm was natively in quaternions already, right?

01:08PM

A. Bassompiere is natively in quaternion, it teaches that.

Q. Well, right.

01:08PM

But the equations in Bassompiere that you identify are all written in Euler angles?

A. Euler.

Q. Euler. Thank you.

01:08PM

A. Thank you.

That's irrelevant. Bassompiere teaches how you have your equations in quaternion. It's very explicit about that, and I've provided examples of that.

01:08PM

Q. Sure.

That's not my question.

I'm just trying to compare and contrast Bassompiere with Bachmann by saying Bachmann had an algorithm that you guys relied on that was written entirely in quaternions, right?

MR. LAURENZI: Objection. Form.

A. Again, I think Bassompiere teaches how to write everything in quaternion.

Q. But that's not -- but he teaches how to convert to quaternions versus being in quaternions, right?

MR. LAURENZI: Objection. Form.

A. I don't -- from a technical point of view, I don't appreciate the difference.

If you are saying Bachmann and Bassompiere had differences, yes, there are different references. That I agree with.

Q. Let's go -- can you go to the top of page 26, the algorithm there.

Does that look familiar?

A. Barely from eight years ago.

Q. I understand.

A. So I say it does look familiar,

yes.

Q. Now Box 31 on Bassompiere, that's the measured accelerometer data, right?

A. Box 31 in Bassompiere?

Q. Yes.

A. Which page on Bassompiere?

Q. I'm just showing you the entire page here.

MR. LAURENZI: He's using Bachmann.

BY MR. EVANS:

Q. Bachmann. My mistake.

A. No worries.

Q. Too many "B" words.

A. I don't feel bad now. Okay.

So the question again?

Q. That Box 31 on the top left, that's representing the accelerometer measured data, right?

A. Can you make it larger?

(Document review.)

A. I really need to go back and look at Bachmann. But from the face of it, it seems so. But I cannot be 100 percent sure.

Q. Let's go down to paragraph 52. Let's try to get the whole paragraph on the screen at once, if we can. That's going to get really small.

01:11PM Why don't we start at the top.

A. I'm unable to read it.

Q. Let's zoom in so we can read it together.

MR. LAURENZI: Do you want to

01:11PM download the exhibit?

MR. EVANS: Or the two. That's right. We'll make it big enough to read it.

THE WITNESS: Okay. Go ahead.

01:12PM BY MR. EVANS:

Q. All right. So you're talking about that diagram of Bachmann here in paragraph 52 that we were just looking at, right?

01:12PM A. Sure.

Q. And you're identifying that some boxes show accelerometer and magnetometer measurements?

A. I use the word accelerometer and

01:12PM magnetometer in paragraph 52.

Q. And it says, that second sentence it says, in Box 34 of the accelerometer and magnetometer measurements are combined to form a 6 valued measurement vector Y0 which equals H1, H2, H3, B1, B2, B3 at time T.

Do you see where I'm reading?

A. No. I don't see time T.

Q. I don't know, or to the T power? I don't know.

A. That's transpose of a vector.

Q. Okay. Sorry, I didn't -- I didn't know that in English.

A. When you rotate a vector, so it looks vertical instead of horizontal, that's the transpose of a matrix or vector.

Q. Oh, I got you.

So that's a notation?

A. It is a mathematical notation in matrices. Yes.

Q. And is this talking about how those H1 H2 --

(Reporter clarification.)

MR. EVANS: I'm going to move on. It's not important.

BY MR. EVANS:

Q. Do you see where it says H1, H2, H3 represent -- and let's scroll down -- acceleration along the accelerometers X, Y, Z axis respectively and B1, B2, and B3 represent magnetism measurements along the magnetometers XYZ axes respectively.

Do you see that?

A. You read that correctly.

Q. And then in Boxes 35 and 35A, "A predicted 6 valued measurement vector, Y-bar, (Q-hat) is translated from a reference frame fixed with respect to the earth to the sensors reference frame."

What does that mean?

A. I have to read Bachmann again to see what he's referring to. This is eight years old. But normally, when you have a frame fixed to the earth's...

(Document review.)

A. ... it could possibly means the earth's reference frame. And I'm not sure what the sensor reference frame is here.

Q. Why would we be translating the predicted six value measurement vector from the earth to the sensor's reference frame?

A. I don't know what sensor's reference frame is. I'm not exactly sure in this example what the earth reference frame is referring to in Bachmann. Some patents or articles choose to use a different definition.

So without looking on Bachmann and the entirety of my declaration, I cannot comment.

01:15PM Q. You wrote these words, though.

A. Eight years ago, yes.

Q. What do you think they mean?

MR. LAURENZI: Objection to form.

A. I have to go back and analyze them and remind myself. These are highly technical terms. I haven't memorized them from eight years ago.

Q. How do you translate from a reference frame fixed with respect to the earth to the sensor's reference frame?

A. I don't know what sensor's reference frame is in this case.

Q. Do you do quaternion math for that?

A. I don't know what sensor

reference frame is here in this context.

Q. What do you mean you don't know what sensor reference frame is?

A. I don't know how either the patent or Bachmann defines the sensor reference frame.

Q. What's ambiguous about it?

A. There are many sensors usually. Which sensor are they talking about here or what I'm talking about here eight years ago. I need to go back and refresh my mind.

I knew -- I do know, if that's of any help, that what the reference frame of the 3D pointing device is, that's something I've used when I talk about the spatial reference frame in '846.

Q. But you used the word "sensors reference frame" here.

How come you don't understand it now?

MR. LAURENZI: Objection. Form.

A. I didn't say I don't understand it.

I said I don't remember the

citation Bachmann from eight years ago. So I don't know how I have defined the sensor reference frame eight years back.

Q. Well, we were just talking about accelerometer and magnetism data.

Does it seem likely we're talking about those sensors?

A. Do you see they are different. They could potentially be different chips in different locations, not the same thing.

And therefore, generally, it would be ambiguous to talk about a reference frame of two different devices.

Same issue that we have in '846 patent, the 3D pointing, and that's why I have defined the reference frame with respect to the 3D pointing device in these patents-in-suit.

Q. So sitting here today, you can't understand what you wrote in the CyWee declarations that you submitted to the IPR?

You are unable to interpret them from a year today; is that your testimony?

MR. LAURENZI: Objection to form.

A. I need to refresh my mind about

something that I wrote eight years ago.

Q. Specifically, what do you need to see to be able to comment on this sentence? What do you need to see?

01:18PM A. Sure.

I would need to see at the minimum, Bachmann, the patent that I have analyzed here. That will be a starting point.

01:19PM Q. Why do you need the patent? It's talking exclusively about Bachmann here?

MR. LAURENZI: Objection. Form.

A. Every analysis that I've performed in this IPR declaration is with

01:19PM respect to the patent. And the Bachmann reference. And this is all from eight years ago.

Q. When you read Bachmann without the patent, does it mean something

01:19PM different than when you read Bachmann in relation to the patent?

A. The term of the patent defines how one would interpret those terms. Therefore, there could potentially be some

01:20PM views that one would take into

consideration. And that's exactly what I did eight years ago. I read both of them.

Q. Let's go down to paragraph 53, the first sentence there.

01:20PM Let's keep that comparing sentence on there too.

So the first sentence of 53 says, The six valued error vector -- I don't know how to say those words -- represents the

01:20PM difference -- go ahead.

A. Epsilan maybe.

Q. Epsilan bar?

A. Yeah.

Q. Thank you.

01:21PM Represents the difference between the actual and predicted accelerometer and magnetometer measurements."

Does that provide you with any clarity?

01:21PM A. About what?

Q. About what the sensors we're talking about or what sensor reference frame might be?

A. No.

01:21PM Q. So you still don't understand?

A. I need to look at the patent.

And in this context, I need to look at Bachmann to see how sensor reference frame is defined. That's not a term that's used in the patent that I've analyzed for today.

The 3D pointing device reference frame is something that I have discussed.

Q. Could we scroll up to the diagram?

Do you see Box 35(a), it's minus Y-bar (Q-hat)?

A. Yes.

Q. Now that term is composed of some magnetometer or magnetic field directions?

A. I'm not sure.

Q. Well, what does Box 35 tell you?

A. By itself, it's just a transpose of a four dimensional -- it seems like a four dimensional vector.

Q. And what is the vector made up of?

A. I cannot tell by just looking at those symbols. I don't know what M Q-hat is.

Q. What does M usually denote?
A. It all depends on the context.
Q. What could it be in this context? What would you assume it means in this context based on your expertise?
MR. LAURENZI: Objection. Form.
Objection. Form.
A. I can't even tell if it's multiplying M by Q-hat or if M Q-hat has been defined in the patent. I guess this is Bachmann or if it has been defined in Bachmann as one term. I don't know. That's not how science and technical analysis works.
Q. If it's a multiplication, what would the M Q-hat mean?
A. I don't know. I don't do science blindly.
Q. What does "M" denote in your field?
A. It could be math.
Q. Does that make sense here?
A. I have to go back and look. In some context, acceleration and mass could potentially be related, so maybe. It could

be the magnetometer 1 or multiple dimensions of it and anything else.

Q. So if it's multiple dimensions of the magnetometer, what would M times Q-hat be doing?

A. I have to go back and review this reference from eight years ago. I don't know.

Q. What does "N" denote?

A. M?

Q. "N."

A. Where is N, at the end of 35?

Q. Yes.

A. I don't know. From a reference that I read eight years ago, I don't know.

Q. It doesn't have any common understanding in the scientific literature in your field?

A. It really all depends.

In many cases, "N" represents the number of things. So you say I have "N" pencils. That's the number of things.

Q. Does that assume like the most likely use of "N" in this instance?

A. I have no clue from eight years

ago what "N" is referring to.

And in my analysis for this IPR, I don't believe I came across that term.

Q. Could that "N" actually be an "H"?

A. I don't play guessing games. In science we don't do that. I don't know. Your guess is as good as mine, probably.

Q. You can just say "yes" or "no." You don't have to give me a soliloquy every time, you know.

A. I don't know.

Q. We're looking at accelerometer data and magnetometer data feeding into that Box 34, right?

A. Go further down so I can see magnetometer. All I can tell you that Box 31 inside it says writes accelerometers.

And Box 32 inside of it writes magnetometers.

And there are two arrows from Box 31 and 32 going to Box 34. That I can see.

Q. Is this how you teach your classes when people ask questions?

MR. LAURENZI: Objection to form.

A. It depends on the type of question. If they ask me something about eight years ago, that I haven't reviewed, what I would tell them, honestly, it's exactly what I told you. Give me time. Let me go back to this reference that I haven't reviewed for eight years. In the next class, I'll come back and teach you. So, yes.

01:26PM

01:27PM

Q. So sitting here today you can't tell me anything about Bachmann, is what I'm hearing?

MR. LAURENZI: Objection to form.

A. All I'm saying is that the scientific approaches for me to go back and review Bachmann so I can answer it.

01:27PM

Q. Let's go to paragraph 83 of your declaration. Maybe this will help.

A. Sure.

Q. It says, "Bachmann's quaternion is associated with three coordinate axes of the global reference frame associated with earth. More specifically, it represents that the rotation between the sensor (spatial pointer) reference frame in the

01:27PM

earth-fixed frame of reference. This can be seen from equation 7 of Bachmann, which use the inverse of the transformation described in paragraph 31 of my prior declaration, to rotate the gravitational and magnetism vectors which are in earth fixed frame into the sensor frame of reference, using the quaternion multiplications" -- that I'm not going to try to read.

Do you see where I was reading from?

A. Q inverse N Q.

Q. Thank you. And Q inverse N Q.

Based on that sentence, to me, I would assume the "M" is magnetism vectors and the "N" is gravitational vectors.

Would you agree?

A. Go back up to the beginning of, yeah, hold on here for a sec, please.

(Document review.)

A. Okay. Further down.

(Document review.)

A. I cannot say with certainty. That would be a guess, but, again, I need

to look at Bachmann to be sure.

Q. Based on the context, is that a reasonable guess? I'm not saying it's right, but is that reasonable?

01:30PM MR. LAURENZI: Objection. Form.

A. I cannot answer one way or the other without looking at Bachmann --

Q. Based on these, the references, what else do you think "M" and "N" could

01:30PM be?

A. Previously, you guessed that "M" might be magnetism. It doesn't seem to be. It's talking about the Earth's fixed frame and "N" we had no clue. It might be the

01:31PM sensor frame of reference. But without Bachmann, I cannot be sure of any of these.

Q. Was this declaration accurate when you wrote it eight years ago?

A. Yes.

01:31PM Q. Do you have any reason to believe it's not accurate today?

A. In the context of that declaration, no, it is accurate today. It was accurate eight years ago. Absolutely.

01:31PM Q. Okay. So it was your opinion

eight years ago that Bachmann rotates gravitational magnetism vectors into the sensor frame of reference using quaternion multiplications, right?

01:32PM A. This paragraph, among other things, says to rotate the gravitational or magnetism vector, which are in an Earth-fixed frame, into the sensor frame of the reference using the quaternion multiplication Q inverse NQ and Q inverse NQ. That's what I wrote. So that was obviously my opinion.

Q. So that's what Bachmann does?

A. The declaration, I just read the declaration. The declaration says from eight years ago says what it says.

And it was accurate back then and it's accurate today.

Q. In Bachmann, the output quaternion, as you stated here, represents a rotation between the sensor frame and the Earth-fixed frame, right?

A. The writing says to "rotate the gravitational and magnetism vectors which are in Earth-fixed frame into the sensor

frame of reference using the quaternion multiplication Q inverse NQ and Q inverse NQ." That's literally what it says.

The interpretation of it, I need to read Bachmann to be able to provide any interpretation of these words.

Q. But we can go by what you said, right? There's no reason to think this is wrong.

MR. LAURENZI: Objection. Form.

A. My declaration speaks for itself from eight years ago.

Q. So Bachmann uses the estimated quaternion to rotate known earth frame gravity and magnet field vectors into the sensor frame to create the predicted measurement vector, right?

A. Where are you reading from?

Q. I'm just interpreting what you said here.

A. Please don't interpret. That's what I need Bachmann for to interpret.

These words say what they say. That's all I can stand by.

Q. You can't provide me any

explanation or further context about anything you said in here?

A. As I said eight years ago, no, that's not how we do things.

01:34PM Q. Have you ever given an opinion on the spot when somebody brought you something, just provided an off-the-cuff expert opinion on anything in your entire life?

01:34PM A. Of course, but not when it's a 40-page very technical patent along with a very technical prior art.

Q. But this is your --

A. No, I wouldn't do that.

01:35PM Q. But this is a declaration that you wrote?

A. Eight years ago, yes.

Q. Yeah. But I've written stuff eight years ago that I have pretty good

01:35PM memory of, entire briefs that I can pretty much recite, you know, word and verse.

I remember this from eight years ago. I worked on this case eight years ago, too, and I remember it, and I'm not

01:35PM expert.

It seems it would be a lot more familiar to you, no?

MR. LAURENZI: Objection. To colloquy.

A. That's not how we analyze things in the scientific world.

Q. So you haven't thought about this since you wrote this declaration?

A. This particular Bachmann reference, I don't believe so.

Q. Is "M" the gravity? Maybe I made the wrong assumption. Would "M" be gravity in that formula?

A. That's exactly why I refused to answer because as you said something that looked obvious to you, now you are saying is wrong. That's why I don't want to make assumptions.

Q. Let's go down to paragraph 88.

A. Okay.

Q. So the third sentence starts "In fact, Bachmann discloses transforming the vector 'M,' which represents gravity in a fixed earth frame to the sensor frame which contains the accelerometer vector H1, H2,

H3.

Do you see that?

A. You read that correctly.

Q. So is "M" the gravity vector?

01:36PM A. This sentence says Bachmann discloses transforming the vector M which represents gravity in a fixed earth frame.

Q. So you agree with that?

A. I agree with the declaration that

01:37PM I wrote eight years ago. That's generally correct.

Q. And then the accelerometer vector is just a low-pass filtered version of the measured acceleration first signal set

01:37PM which means that the accelerometer vector and the measured acceleration must be in the same reference frame, the sensor frame.

Do you see that?

A. You read it correctly.

01:37PM Q. So what you're describing here is Bachmann takes gravity from an earth -- fixed earth frame and moves it into the sensor frame so that they can compare it to the accelerometer vector, right?

01:37PM A. The declaration says, which means

that accelerometer vector and the measured acceleration must be in the same reference frame, the sensor frame. That's what it says.

01:38PM Q. So they can be compared, right?

A. I don't see the word "So they could be compared."

Q. So if you wanted to compare gravity with your accelerometers data, you

01:38PM would need to have them be in the same reference frame, right?

A. You could certainly compare two vectors into different reference frames, that's a possibility by using translation

01:38PM and rotation and movement.

Q. But is that what you said is happening here?

A. If you have two general vectors, even when they are in two different

01:39PM reference frames, outside of these patents in general, you can certainly do a comparison.

Q. The accelerometer vector would be in what you're calling the sensor frame,

01:39PM right? Because it is gathering data in its

own frame of reference, right?

A. I don't know what a sensor frame is here. I know what, as I have stated, what the 3D pointing device frame is. That's what I've opined on.

Q. Well, the sensor frame is the same as the 3D pointing device's frame of reference, right?

A. Not necessarily --

Q. Look at the next sentence. Read your next sentence. That's what it says, "the sensor frame is the same as the 3D pointing device's frame of reference," right?

A. In this example, that's what I say.

But I have to see what the context of that is. Because if you have --

Q. Are you saying true things here? That's all I want to know.

A. Yes, everything I said in my declaration, eight years ago is true and accurate.

Q. So then the accelerometer vector is already going to be in the sensor frame

or 3D pointing device's frame of reference because that is where the data is collected, right?

It doesn't need to be converted into that frame of reference?

A. I need to go back and review these to refresh my mind.

Q. Well, what are you saying here?

A. This is from eight years ago. I need to have the opportunity to analyze and think about it.

Q. Read your words and think about what they mean and then tell me. That's all I'm asking.

MR. LAURENZI: Objection. Form.

BY MR. EVANS:

Q. It's all contained in this one paragraph. We can zoom out and scroll back up if you need to.

A. No, that's not how you do scientific analysis.

Q. We're not doing scientific analysis. We are doing a deposition to try to understand technology and explain it to people who aren't experts in the field.

It's a different endeavor.

I'm not looking for scientific rigor. I want you to explain what words mean that you have used in the past.

01:41PM Can you do that?

A. These words are with respect to Bachmann and the patent in hand.

Q. Sure. Tell me what you're talking about.

01:41PM MR. LAURENZI: Objection. Let him finish his answer.

BY MR. EVANS:

Q. In that context.

A. And I have looked at these 01:41PM patents and Bachmann about eight years ago.

In order to provide any opinion on that and interpret something that I wrote eight years ago, I need to have the opportunity to review both Bachmann and the 01:41PM patent. Then I would be able to interpret the words that I wrote eight years ago. It's been a while.

Q. Why didn't you review the declarations you wrote about related 01:42PM patents as part of this case?

A. I have reviewed the patents in hand here, and these are different patents, and my declaration speaks for itself.

Q. Wouldn't it have been helpful to go back and read that information to understand what your understanding was previously?

MR. LAURENZI: Objection. Form.

A. I believe what I did and I looked at was sufficient for the declaration that I provided in these proceedings.

Q. Was your goal to get to the ultimate truth here?

MR. LAURENZI: Objection. Form.

A. My goal was to analyze the patent and the prior art and provide a technical analysis of them.

Q. Was that an objective analysis?

A. It was a detailed technical analysis that I performed in my declaration that we are discussing today.

Q. But did you do it objectively?

A. Yes.

Q. And independently?

A. Yes.

Q. Because you're an independent expert?

A. I'm an independent expert, yes.

Q. And we're relying on you to provide an independent opinion of the facts in this case for us all to understand what is happening, right?

A. Correct.

Q. Let's go to paragraph 86.

Now you said, "Bachmann also represents the measured accelerations as a vector or set of acceleration signals along different axes. Bachmann denotes this vector as H1, H2, H3 and derives it by low-pass filtering the measured acceleration to remove fast accelerations."

Do you see where I'm reading?

A. Yes.

Q. What does that mean?

A. Again, I need to look at Bachmann.

But generally, when you have a signal outside of any of these patents, outside of this declaration, you can run it through some sort of a filter, by way of

example, low-pass filter, to get rid of frequencies that are -- to remove low frequency items from the signal.

This is something that you do, for example, in Blender, a well-known software that is used for signal processing, depending on the situation, you can get rid of -- you can use a low-pass filter, a high-pass filter or a mid-band filter or mid-pass filter.

Q. Why would you use a low-pass filter?

A. Low-pass filter, in general, outside of these contexts, allows you to only allow to remove high frequency signals, which could at times signal an error or a noise of some kind.

Q. What would be some examples of noise you're trying to eliminate from the data?

A. If I'm speaking to you right now and there is some background noise of air conditioning or what have you that makes a noise constantly, by filtering that, again, through a signal processing mechanism such

as Blender, I could be getting rid of that background noise.

Q. Now you said that they're using a low-pass filter to remove fast accelerations.

Why would they been doing that?

A. Sometimes, in general, outside of these patents, I need to look at Bachmann in order to say -- to see what exactly I meant in paragraph 86.

But outside of these patents, the noise and jitter sometimes would cause fast and useless acceleration. So you try to get rid of that.

Q. What are the useless accelerations?

A. Jitters.

Q. And what are the useful accelerations?

A. It depends on your application. By the way, sometimes jitters would be useful. So it all depends on your application.

Q. Sure.

But here, when they're low pass

filtering in Bachmann and they're trying to remove fast accelerations, what are they trying to isolate?

A. I have to look at Bachmann to be reminded. I don't recall.

Q. Are they trying to get to gravity?

A. I have to go back to Bachmann to be reminded.

Q. We already saw that you testified the predicted measurement is gravity rotated into the sensor's frame, right?

A. No.

Q. No? That was the -- I guess it was magnetic fields and gravity fields, right?

MR. LAURENZI: Objection to form.

A. I don't understand what you're saying. You're saying in this declaration?

Q. Right. We just read the paragraph where you said that what got transformed from the Earth-fixed reference frame to the sensor frame was the gravity vector, right? You remember that?

A. I said that I need to look at

Bachmann to know exactly what those words are and how one would interpret them in the context of the patent and Bachmann.

I just read those words.

01:48PM Q. In fact, Bachmann discloses transforming the vector M, which represents gravity in a fixed earth frame to the sensor frame which contains the accelerometer vector H1, H2, H3.

01:48PM Is that accurate or no?

A. I have to look at Bachmann to tell you. Those are words that I wrote, but I need to look at Bachmann to see how one would interpret that.

01:48PM Q. But you think you would have written correct words, right?

A. Absolutely.

Q. Okay. So let's assume that your declaration is correct.

01:48PM So if taking gravity and we've rotated into the sensor frame, right?

A. I'm not sure what you're referring to. Is it paragraph 86?

Q. I'm just saying, did we or did we

01:48PM not just talk about Bachmann transforming a

gravity vector into the sensor frame? Do you remember that conversation?

A. That was not a conversation. I read from my declaration, and I said for me to interpret that, I need to go back and review Bachmann.

Q. Let's exist in a world where your declaration is accurate and we don't need to prove that it's correct.

We're just trying to understand what it says, okay? Can we live in that world?

I don't need you to reinterpret this or refigure it out.

I want you to tell me the words that you wrote and explain the meaning of them to me.

Can we do that?

A. We can.

Q. Okay. So we already -- I mean, you agree that what you previously said is that Bachmann takes a gravity vector in the Earth-fixed frame and transforms it into the sensor frame, which is the -- or pointer frame, however you want to call it,

right?

A. I said I need to look at Bachmann in order to --

Q. Did you say that or not in your declaration?

A. Let's go to the paragraph.

Q. Let me ask you a different question.

I have a gravity vector already in the sensor frame. I would like to compare it to my accelerometer data to see if I need to do error correction. I have passed my accelerometer data through a low-pass filter.

So now is my measured data also considered to be a gravity vector?

MR. LAURENZI: Objection. Form.

A. I have no idea what you just said.

Q. Well, to determine if your estimated orientation is correct, don't you want to compare your measured gravity to your predicted gravity? Is that not how EKF work or can work?

A. Extended Kalman Filter, you have

a state, you do perform measurement, and you predict what the value of those measurements are. This is just one example and one use of extended Kalman Filter.

01:51PM And based on the difference, you correct the course.

Q. Right.

And the way you interpreted Bachmann onto our patents before is that you said this gravity vector that gets rotated into the sensor frame, is the predictive acceleration vector.

And then you took the measured accelerometer data. And those are the values that were compared for error correction.

Is that not a correct interpretation of what you said about Bachmann?

A. Where are you reading from?

Q. Your entire declaration, but most of the paragraphs we just looked at.

And if we scroll down, you can look at the diagram right there that also shows all of it.

MR. LAURENZI: Objection. Form.

A. I need to go back, review Bachmann that I reviewed eight years ago to be reminded of what it says and how I interpret them in the declaration that you have in front of us.

Q. Do you have any reason to believe that what I just described is incorrect?

MR. LAURENZI: Objection. Form.

A. First of all, in your sentence you changed a number of words with respect to what I've written. Every word matters.

Q. That doesn't answer the question.

A. The answer is, I cannot tell you without having your long sentence in front of me and reviewing Bachmann.

Q. Do you understand the diagram that's on the screen right now?

A. I can make guesses about this diagram. But without description of what each box is from Bachmann, I'm unable to do a detailed analysis.

So, no, just a diagram without any description is generally not understood, is at best, guess.

Q. Okay. Best guess, what's happening in this X right here, the circle with an X?

A. I don't see a pointer?

01:53PM Q. It's in between 35(a) and 34. It's where the measured data and the predicted data come together at the top where we just highlighted.

A. That looks like -- again, I need

01:53PM to look at Bachmann.

Just a guess, without looking at Bachmann, I can't be sure. That seems like a quaternion multiplication.

Q. And why would you be doing that?

01:53PM A. I have to look at Bachmann to be reminded. I don't know.

Q. What's your best guess?

A. I don't have a best guess. That's not how we do science.

01:53PM Q. Wasn't that how hypothesis are formed?

A. Yeah, but in this declaration in front of IPR, I'm not providing hypothesis. I'm providing technical analysis with

01:54PM accuracy.

Q. I mean, actually, all you're doing is telling me the meaning of words you wrote yourself, but you can't do that, and it's quite baffling.

01:54PM MR. LAURENZI: Objection. Form.

A. Is there a question pending?

Q. Why can't you understand your own declaration?

MR. LAURENZI: Objection. Form.

01:54PM A. Because it's based on a reference that I read eight years ago.

Given this --

Q. If I ask you questions about the declaration you submitted in this case, are

01:54PM you going to be able to answer them or -- because it's been a year and you don't know anymore?

A. Of course. I've been answering every question about the declaration that I

01:54PM wrote all day.

Q. Just because this one is old that you don't know what it means?

A. This is eight years ago. I don't recall all these things with Bachmann that

01:55PM was reviewed eight years back.

Q. And this is too complicated for you to figure out on the fly?

MR. LAURENZI: Objection. Form.

A. It's not that. That's not how you do science. You look at a reference. You review it. That's exactly what I did in the IPR declaration that I provided today.

Q. So you can understand your declaration we're looking at, you're just choosing not to answer my questions because you're not positive that they're going to be right? Is that what's happening?

A. No. For example, the figure that you are showing me, there are a number of symbols. I don't know how Bachmann has interpreted them.

Q. Why not? You wrote two declarations about it.

MR. LAURENZI: Objection to form.

A. I did that eight years ago. And the reason that one has to be careful is, you, yourself, within two minutes, made a mistake and misinterpreted the symbol M. That's what I tried to avoid.

Q. It's not my declaration, and I'm not an expert, though. That's why I'm asking you.

A. Exactly. I take a scientific approach.

Q. All right. Would it be fair to say the predicted axial accelerations in Bassompiere -- in Bachmann are just gravity?

A. I have to review Bachmann to respond to that.

Q. But you can't say that that's wrong?

A. I have to review Bachmann to say one way or another. It's been eight years.

Q. So you don't know?

MR. LAURENZI: Objection. Form.

A. I have to review Bachmann to provide any opinion on it today after eight years.

Q. Sitting here right now, do you know the answer to that question?

A. Which question?

Q. Would it be fair to say the predicted axial accelerations in Bachmann

are gravity?

MR. LAURENZI: Objection. Form. Asked and answered.

A. As I said, this is something I haven't reviewed in eight years. I cannot provide an opinion on the fly. That's not how a scientific process works.

Q. "Can't" or "won't"?

MR. LAURENZI: Objection. Form.

A. What won't? I don't understand your question.

Q. You can't? You're completely unable to provide an opinion or unwilling to provide it without doing more work?

A. Oh, it's not correct for me as a scientist to provide an opinion about an article that I've read eight years ago.

Q. I'm asking you an opinion about a declaration that you wrote eight years ago to understand what you meant by the words that you wrote.

Who could I ask about this to get an answer? The lawyers, did they write it?

A. No, you ask me, give me time. As I requested that multiple times today, to

review Bachmann, to review my declaration. And I'm the right person to -- and I'm the right person to answer your questions.

Q. How much time would you need to do that?

A. I don't know. Ten hour, five hours, three hours? I'm not sure.

Q. Okay.

A. Give me half an hour, I'll give you a better estimate after that.

MR. EVANS: All right. We can put this exhibit away.

Let's pull up the '846 patent. Let's go to claim 1.

(Deposition Exhibit 1001, U.S. Patent No. 10,852,846, marked for identification, as of this date.)

MR. LAURENZI: We're at an hour. Should we take a short break?

MR. EVANS: If anyone needs a break, we can take one.

MR. LAURENZI: Five minutes maybe?

MR. EVANS: Sure.

THE VIDEOGRAPHER: We are off the

record. The time is 2:00 p.m. Pacific time.

(Recess is taken.)

THE VIDEOGRAPHER: We are back on the record. The time is 2:06 p.m. Pacific time.

(Deposition Exhibit 2032, Declaration of Professor Majid Sarrafzadeh, marked for identification, as of this date.)

MR. EVANS: Let's pull up Exhibit 2032, which is a declaration you submitted on behalf of Google in the CyWee IPR in June of 2018.

A. Okay.

Q. You did write -- do you have any reason -- let me say that again.

Did you submit a declaration in this IPR? Does this look familiar?

A. I did submit one and it does look familiar from the face of it.

Q. I want to scroll down to paragraph 23.

This is your opinion on the level of ordinary skill in the art from that IPR,

right?

A. Yes, I see paragraph 23.

Q. In this declaration, it was your opinion that a person of ordinary skill in the art could have an undergraduate degree in computer science, electrical engineering, mechanical engineering, or other related technical field, and knowledge of sensor systems, right?

02:07PM A. That's what I wrote.

Q. And you believe you are that type of POSITA?

A. Yes.

Q. You still believe that?

02:07PM A. Yes.

Q. Do you still agree with this level of ordinary skill?

A. Generally, yes. But when I looked at the opinion that was provided in

02:08PM Exhibit 1011, 1012, and 1013 and how the Board has construed one of ordinary skill in the art, I believe also that they are correct.

So in paragraph 17, I have made a

02:08PM minor modification to what I have in

paragraph 23 in front of you.

Q. Why didn't you include anything else in this paragraph that we're looking at here, 23, of Exhibit 2032?

02:08PM A. Because one of ordinary skill in the art with degree in computer science, electrical engineering, computer engineering, would also have knowledge of sensor, sensor fusion, including Kalman

02:09PM Filters, quaternion math and mobile computing technologies.

So those are included in what I've provided as what one's degrees.

And the reason that I elaborated

02:09PM on it is because of the Board decision in the three documents, Exhibit 1011, 1012 and 1013 in their final written decision.

MR. EVANS: Could you put them side by side, Andrew.

BY MR. EVANS:

Q. It's a little bit small, but I think we have on the left we have your current person of ordinary skill paragraph 17 from your declaration in the '687 IPR.

02:10PM And on the right we've got the

level of ordinary skill in the art from paragraph 22. I believe that's actually from your Exhibit 2033, which was your rebuttal declaration that we were looking at previously but it has the same definition that we were just looking at in 2032.

A. Yes.

Q. And so in your new person of ordinary skill, you've added in a number of things.

You've expanded undergraduate degrees to include physics, right?

A. Yes.

Q. How come?

A. Okay. So 22, you see it says computer science, undergrad degree, electrical engineering, mechanical engineering and other related technical field.

So physics is one of those other related technical fields. So I have explicitly called it out.

Q. Now you keep that oral related field language in your new person of

ordinary skill in the art in paragraph 17 on the left, right?

A. Correct.

Q. But physics was the only thing you felt the need to add explicitly, right?

A. By way of example, there could be other related technical fields.

Q. Such as?

A. For example, many departments have different names for the degrees. They may call it information technology and alike. Those will be all in the part of the other related fields.

Q. Then you've added some more experience requirements, right? You've got work in the field of sensors, right?

(Document review.)

A. Correct.

Q. And then you've got sensor fusion algorithms?

A. Right.

Q. Including Kalman Filters?

A. Correct.

Q. And quaternion mathematics?

A. Correct.

Q. And mobile computing technologies?
A. Correct.
Q. Are you saying that the two years of work experience can be in any of those fields or it has to be in all of those fields?
(Document review.)
A. It has to be related to subject matter that covers sensor fusion algorithm, part of that is Kalman Filter quaternion math and mobile computing technologies.
Q. So are you saying that a person of ordinary skill has to have knowledge of sensors, sensor fusion algorithms, Kalman Filters, quaternion mathematics and mobile computing technologies, has to have all of those?
A. Exactly as it says, that other than the degrees, along with that is two years of work experience in the field of sensors, sensor fusion algorithms, example of algorithms are, or including in algorithms are Kalman Filter, quaternion math and mobile computing technologies.

Q. Okay. I'm not trying to be pedantic, I'm trying to be accurate like you are with your scientific opinions.

A. Sure.

02:14PM Q. And I'm just trying to understand what this sentence means.

So are you saying that a person of ordinary skill only needs to have an electrical engineering undergraduate

02:14PM degree?

A. No, they could have an undergrad degree in electrical engineering or computer engineering or computer science or physics or many other degrees that may go

02:15PM with different names as long as it's related.

Q. But just those degrees was enough to qualify you as a person of ordinary skill, or do you also have to have the work

02:15PM experience? That's what I'm trying to understand.

A. As I said, along with two years of work experience in the field of sensors, sensor fusions algorithms, including Kalman

02:16PM Filters, quaternion math and mobile

computing technologies.

Q. And, again, I'm a lawyer. So I apologize for how pedantic this is going to seem.

02:16PM But you say, or related field along with two years of work experience.

So to me, when I read that sentence it would be if you don't have one of those degrees, you could have a related 02:16PM field along with two years of these types of work experience.

Is that what that sentence means or am I reading it wrong?

A. Okay. Think of it as related 02:16PM field, period.

Q. So it should be a "comma and"?

A. So it's period and then you say, would also have along with two years of experience, which could be part of your 02:16PM degree, in the field of sensor, sensor fusion, et cetera.

Q. Okay. So one of those degrees or a related degree along with two years of work experience, right? That's what you're 02:17PM saying?

A. Exactly as it says. It would have one of these degrees, including the related field, different names in some departments. And you would have along with that, you will have two years of work experience in the field of sensors and other things that I have stated.

Q. So if I have a degree in computer science and I've worked for two years in the field of sensors using accelerometers, gyroscopes and magnetometers, am I a person of ordinary skill in the art?

A. Yes.

Q. Okay. If I have a degree in computer science and I worked in the field of sensor fusion algorithms but not those other things, am I a person of ordinary skill in the art?

A. So this is assuming that sensor fusion, that would include Kalman Filters, quaternion math and mobile computing technologies.

Q. Do I need to have two years of work experience in sensors, two years of work experience in sensor fusion

algorithms, including Kalman Filters, two years of work experience in quaternion mathematics and two years of experience in mobile computing technologies on top of my degree?

Is that what you're saying?

A. No. So when you start, let's say working in a field of mobile wearable watches, by way of example, you could be having experience in sensor fusion, sensors, Kalman Filter, quaternion math and mobile computing.

So it's not just two plus two, if that's what you're asking.

Q. So I just need to have two years of work experience that is some combination of all of those different fields?

A. Exactly as it says. You have two years of work experience in the field of sensors that also have sensor fusion algorithms, including Kalman Filters, quaternion math and mobile computing technologies.

Q. How much experience would quaternion mathematics do I have to have to

be a person of ordinary skill in the art?

A. You need to understand the basics of quaternion math, and in the case of work experience, have worked with them.

02:19PM Q. How much?

A. Enough to understand them.

Q. Two years? I mean, do I have to have two years of quaternion mathematics experience?

02:19PM A. You need to have enough as part of that two years to understand quaternion math.

Q. Let's say I worked on your example of a watch that's using sensors, 02:20PM Kalman Filter sensor fusion algorithms, quaternion mathematics is involved and mobile computing technologies are involved.

But I focus on the sensors, not the quaternion mathematics. Would I be a 02:20PM person of ordinary skill?

A. If you don't know anything about quaternion math, you would not understand the '846 patent.

Q. How advanced do I need to be in 02:20PM quaternion mathematics to be a person of

ordinary skill in the art?

MR. LAURENZI: Objection. Form.

A. By way of example, you need to have understanding of quaternion math to understand, let's say, Bassompiere reference or '846 patent.

Q. Where do you say that in here?

A. Sorry?

Q. Where is that in this paragraph?

A. You asked me for an example of how much, and this is an example that I provided.

Q. What I'm saying is this paragraph is ambiguous, and I can't understand how much quaternion mathematics experience I need. And now you're telling me the exact math, but I don't see that in your declaration. So you didn't put that in your declaration, I'm assuming?

MR. LAURENZI: Objection. Form.

A. I'm very clear that says you have to have two years of work experience in the field of sensors, sensor fusion algorithm, Kalman Filter, quaternion math and mobile computing.

Q. And how much of that time of that two years would I have had spent on quaternion mathematics for me to qualify as what you are saying a person of ordinary skill in the art at the time of the alleged invention is?

A. To understand quaternion math.

Q. How much time would that take?

A. It depends on a number of things. But if you have understanding of quaternion math through your work experience, that's what is needed based on what I've said in paragraph 17.

Q. What has changed from your declaration on the right from 2018, the level of ordinary skill to the declaration on the left from this IPR that has caused you to add all these additional requirements?

A. I have looked at the final written decision. I've shown those in Exhibit 1011, 1012 and 1013. I've looked at the Board's decision and definition of one of ordinary skill in the art, and I agreed with them. So I wrote that.

Q. So you're relying entirely on what the Board found to support your person of ordinary skill in the art, nothing else?

A. And my experience, many years of experience in the industry, in education, in research.

Q. But you have many years of experience in industry, education and research when you wrote paragraph 22 on the right, correct?

A. That's correct.

Q. The only thing you didn't have were the final board decisions, right?

A. So, yeah, I adopted what the Board has adopted in paragraph 17.

Q. So that's not your independent opinion. You're just adopting what the Board said?

MR. LAURENZI: Objection. Form.

A. And I agree with what the Board says.

Q. Why?

A. Well, as I said, considering the '846 patent, the technology, the educational level of experience of workers

in the field relating to the patent and problems and solution in the field, and drawing on my own experience, I believe a person of ordinary skill in the art has the following requirement, and that matches with what the Board in the written decision have said.

Q. What's the field relating to the patent?

(Document review.)

A. The patent is related, for example, electronic device that utilizes a non-access motion sensor modular capable of accurately outfitting a resulting deviation, including deviation angle in a 3D reference frame that the patent describes.

So, generally, it is about an electronic device for use in motion detection and method for obtaining resulting deviation of it.

Q. So that's what you meant when you said the field relating to the patent in paragraph 17 of your declaration?

A. So yes, the field is, for

example, what you see in the abstract, what you see in the title of the patent and once you read the patent, the kind of thing that it discusses.

02:25PM Q. Who are the workers in that field?

A. Sorry?

Q. Who are the workers in that field that you're referencing?

02:26PM MR. LAURENZI: Objection. Form.

A. By way of example, somebody who works on 3D pointing devices related to a smart TV, would be somebody who is working in this field.

02:26PM Q. Is that a real person, or did you just make that example up?

A. There are people who work on -- I don't know if you have recently bought a smart TV with a smart remote, there are

02:26PM people who actually work on that.

Q. And what time frame are you talking about right now?

A. For this particular example is a recent. But back in the date of the

02:26PM patent, somebody working on remote devices,

pointing devices, where you can point to a screen in general.

Q. And who was doing that in late 2009 to early 2010?

02:27PM A. People who are building 3D pointing devices in connection with the screen or in general.

Q. Do you know anybody that was doing that in that time frame?

02:27PM A. Are you asking for a name?

Q. Yes.

A. Oh, many of my students have worked on companies where they work with remote devices.

02:27PM Q. In 2009, 2010?

A. Remote devices such as pointers? Yeah.

Q. Okay. And what was their education level?

02:27PM A. They had a bachelor of degree normally in electrical engineering, computer science or computer engineering.

Q. Okay. And what type of experience did they have?

02:27PM A. So when they received their

bachelor, they had undergraduate degree, some of them have projects, most of them throughout their undergraduate degree studies.

02:28PM Q. Can you give me a name of anyone who fits -- has all the work experience that you list in this paragraph as of 2009 or 2010?

A. No specific name comes to mind sitting here today. It's been a while. I produce and work with a number of students in the past 35 years. Many of them had degrees and studied quaternion math and sensor fusion and Kalman Filter, and extended Kalman Filters.

02:28PM Q. Give me some examples. Who did that?

A. I cannot think of a specific name right now. I have to go back and check my notes.

02:29PM Q. So when you wrote this paragraph, you weren't thinking of any specific person and you weren't aware of any particular person that met these requirements?

02:29PM A. Of a specific person? No.

But a type of person that I know have been working on pointer devices of the type. By way of example, I can tell you a name, Wen Ya Xu (phonetically), who built a ring-based pointer device. I've mentioned that in my declaration, a ring-based pointer device around 2007 and 2008.

Q. Did that device use extended Kalman Filters?

A. We did use extended Kalman Filter in that device, yes.

Q. Did it have accelerometers and gyroscopes?

A. Both of them, yes.

Q. Okay. Did you use sensor fusion algorithms?

A. For sure. Otherwise things won't work. How would you combine -- or one way to combine gyro accelerometer is by means of sensor fusion.

Q. Who wrote that sensor fusion algorithm?

A. This gentleman, my Ph.D. student.

Q. So it wasn't you?

A. We collaborate together.

Q. How much of it did you do?
A. It's a collaboration. Back and forth.
Q. What did you focus on?
02:30PM A. All aspect of it. I'm a system designer so I work on every aspect of a system that we design and many tailored systems that we have designed in the past 35 years.
02:31PM Q. And how did you represent orientations in that system?
A. I have to go back and look. This is about 18 years ago.
Q. Was it quaternion math? Did you
02:31PM use quaternions?
A. I have to go back and look. This is roughly 18 years ago. I don't recall the details of it.
Q. So you don't know?
02:31PM A. Sitting here today, I need to go back and look. Sitting here today, I don't remember the details of a system that I designed 18 years ago.
Q. So we don't know if Xu has the
02:31PM requisite quaternion mathematics experience

to be a POSITA?

A. Oh, he has a lot of quaternion math, correct.

Q. But not from that project?

02:32PM A. I have to go back and check to see what he did or what we did in that particular project. But people working in my group, a large number of them have serious quaternion math background.

02:32PM Q. Today?

A. Including -- some of them, including today, yes.

Q. How many people?

A. I taught courses at the graduate

02:32PM level, at the undergrad level. I supervised many, many graduated students. Maybe close to hundred. Many of them have learned quaternion math. Especially to be able to deal with three dimensional

02:32PM movement.

Q. What courses did you teach that taught quaternion math?

A. By way of example, I taught a graduate course related to health

02:33PM analytics. And some of the examples that

we built was related to three dimensional devices. And as part of that, there was a teaching of quaternion math.

Q. Let's go back to your Exhibit 1002 and I'd like to go to paragraph 25.

Is that Health Analytics course a required course for an undergraduate degree?

02:33PM A. Some undergraduate take this health analytics. It is not -- this particular course wasn't required of them.

Q. Are you aware of any majors that require learning quaternion math at the undergraduate level?

02:34PM A. Many majors have courses in graphics where students learn about quaternion math.

Q. My question was are you aware of any undergraduate majors that require learning quaternion math?

02:34PM A. There are many undergraduate departments that are as part of the graphics and vision courses, and those are required courses. The students learn

quaternion math.

Q. Why do you have to learn quaternion math in graphics courses?

A. In order to perform rotation of graphic objects.

Q. Why don't you just -- don't you just make library calls and the software does the math?

A. You could do that, or what we do in our, in many undergrad degree, we try to understand how these software work. There are many softwares that do calculus for you, but we still require calculus of our students.

MR. EVANS: Could we go to 25, Andrew? Scroll down to 25.

BY MR. EVANS:

Q. All right. Now you said that your requirement for quaternion mathematic came from the Board's decision. And their requirement for it came from CyWee's expert, right?

A. I have to double-check that.

Q. Well, what does this paragraph say?

A. Paragraph -- sorry, just to make sure. We are looking at my new declaration, '846?

Q. Yes.

02:36PM A. Okay. Paragraph 25.

(Document review.)

BY MR. EVANS:

Q. Scroll down so we can see the parenthetical, too, because I believe this

02:36PM is what's being relied on.

So you're relying on a question to our expert that was: "Are quaternions, in fact, widely used in graphics applications," to which you said "yes."

02:36PM Right?

A. I see that, yes.

Q. That just means that graphic software had quaternion math in it, right?

It's not a trick question.

02:37PM A. So in undergraduate degrees, we just don't rely on existing software. We like the students to understand how these -- the inner working of the software is.

02:37PM Q. I understand. But I'm trying to

be very precise as a lawyer now.

You like to do your scientific method and carefully read everything and that's what I'm doing as a lawyer right here. So you have this highlighted sentence where you say, "A patentee's expert in IPR proceedings of the related '978 and '438 patent confirmed the common use of quaternions in graphics applications at least as early as 2009." 02:37PM

And your support for that statement is a question: Are quaternions, in fact, widely used in graphics applications to which our expert said: Yes. 02:38PM

And then a follow-up, "And that was also true in 2009?"

Again, the answer was, "yes."

That's the basis of your testimony there, right? 02:38PM

A. No.

The basis -- this is in support, additional support for my testimony, as I have quoted that.

This is also my belief, and the 02:38PM

Board has also found that quaternion math is needed by one of ordinary skill in the art.

Q. And that's entirely based on the fact that quaternions were commonly used in graphics applications, right?

MR. LAURENZI: Objection. Form.

A. No.

Q. So that's what it says in your declaration, does it not?

MR. LAURENZI: Objection. Form.

A. This declaration, paragraph 25, does not say my only support for what I came up with, what I have adopted is that question and answer, in fact.

Q. So the information --

A. I was trying to finish my answer.

In paragraph 17, I say, I'm familiar with the level of ordinary skill in the art regarding the '846 patent as of around November 11, 2010, including late 2009 through early 2010, considering the '846 patent, the technology, the educational level and experience of workers in the field relating to the patent and

problems and solution in the field and drawing on my own experience, I believe a person of ordinary skill in the art, then I described what that is.

02:39PM So it's all of that.

Q. But we already established that the only thing that changed between the prior version of what you said a person of ordinary skill in the art was and that one

02:40PM was the Board's opinion finding that they would have known about quaternions, right?

A. I have looked at the Board's opinion, yes.

Q. Yes. And that's why you added

02:40PM the quaternions into your person of ordinary skill?

A. I have looked at the Board's decision, and that's where paragraph 17 is considering.

02:40PM Q. And their basis for finding that was that quaternions were commonly found in graphic applications at least as early as 2009, right?

MR. LAURENZI: Objection. Form.

02:40PM A. An example of what that is is the

fact that quaternion were widely used in graphics application.

Q. But why would that mean that anybody would have knowledge of quaternion math? How does that correlate to people having knowledge of quaternion math?

I can use a graphics application with zero knowledge of quaternion math, right?

A. So in undergraduate degree in our graphics and vision courses, instead of teaching the student how to just use an application, we teach them how to do things.

Q. Do you have an example of that you can provide?

A. That's really valuable in the learning of a student. Just being able to use a package such as Blender is not sufficient. That's not the value of our students. It's being able to do things, is what really matters.

So that's why in our control theory graphics and vision, we do teach quaternion math in many undergraduate

courses.

Q. Do you teach students how to you convert Euler angle math into quaternion math or Euler angle math into quaternion math?

A. There are convergence and experts of CyWee himself, I believe Dr. LaViola says, and many of those are straight math.

In fact, just to make sure that you all agree with me that is a straightforward math, I've provided examples of that in my declaration. I've shown how you taken an Euler angle and convert that to quaternion. I provided a very detailed but straightforward math to perform exactly that.

Q. In the undergraduate classes where they're using graphic applications that you were discussing, where you teach quaternion math, is one of the things you teach in those classes how to convert Euler angles into quaternions?

A. There are sections of courses where the convergence does take place and the reason for doing that.

And as I've shown in my declaration, that's just simply a collection of multiplication. That's really all it takes. And more specifically, Bassompiere teaches that.

Q. Please listen to my question. Please listen to it.

Is that what you teach in the graphics applications classes?

02:43PM A. In graphics courses, conversion between Eulerian and quaternion representation are covered.

Q. And is that just the orientation conversion or is that a conversion of Euler mathematics or EKFs into quaternion EKFs?

02:43PM MR. LAURENZI: Objection. Form.

A. It is exactly what I've shown in my declaration. One could take Eulerian angles and convert that to quaternion. Bassompiere shows how to do that. And I've provided examples based on Bassompiere's equation by using simple add and multiplication for doing the conversion.

Q. When did you learn quaternion math?

A. Maybe just a guesstimate, 1980 or so.

Q. And where did you learn it?

A. In undergraduate.

02:44PM Q. What class?

A. I've taken a combination of them, probably in my graphics courses, in vision courses and control.

Q. How frequently have you used

02:44PM quaternion math in your career outside of expert witnessing?

A. In some of the systems that I have designed, I have used quaternion math in the past 30 years or so.

02:45PM Q. Which systems did you design with quaternion math?

A. By way of example, I've designed broadly based sensors that tried to circumvent going through the key port [sic]

02:45PM of famous exercising games such as soccer.

Q. And were those EKFs written using quaternions?

A. Those were EKF based algorithms because that's the natural thing for using

02:45PM the systems that we had in mind. And we

have used quaternion math and quaternion-based algorithms.

Q. And what did you use them for?

A. To do conversion from three dimension into two dimension.

Q. What does that mean?

A. Sorry?

Q. I don't understand what that means.

A. You don't understand what three dimension to two dimension is?

Q. I don't understand how you use quaternion math to do that or why.

A. So you use quaternion math in your extended Kalman Filter to keep track of rotation of the free body and three dimensional space.

And then after that, you do a conversion throughout the exercise that is being performed in a two-dimensional screen.

Q. And what is that conversion?

A. I don't understand.

Q. What are you converting it to?

A. Oh, to the movement of, let's

say, a soccer player on the screen.

Q. You convert the quaternion math into what?

A. You don't convert quaternion math. That's not what I said.

Q. What are you converting?

A. You're converting three dimensional movement of an individual to two dimensional points on the screen.

Q. And do you have to convert it back into Euler angles to do that?

A. At the very end, you do a conversion back to Euler in the examples that we did. There are probably many other ways of doing it.

Q. Let's go to paragraph 27.

A. Sure.

Q. This is basically what you were just saying that a person of ordinary skill in the art would know how to convert an angle from one form to another, for example, from Euler angle representation to a quaternion representation?

A. No.

Q. That's not what you said in this

paragraph?

A. Not in the discussion that you and I had.

Q. What's different?

02:48PM A. In the discussion of playing a game such as soccer, the conversion is between the last step of an angle into a two dimensional space. That's the conversion that I was referring to in our

02:48PM discussion.

Q. And that's to map it onto a screen or something?

A. To the mapping and movement on the screen.

02:48PM Q. That's the two dimensional surface that you're mapping onto, though, correct?

A. Correct.

Q. Some sort of display?

02:48PM A. Some sort of a display is correct.

Q. In 27, you're saying you can convert an angle from one form to another, right?

02:49PM A. So this is different from the

discussion you and I had.

Q. Right.

A. So this is saying a person of ordinary skill in the art would have known how to convert an angle from one form to another, for example, from Euler angle representation to quaternion representation.

That's what I'm saying in paragraph 27.

Q. So what you're saying is you're converting an orientation written in Euler angles into an orientation written in quaternion representation?

A. I'm saying a person of ordinary skill in the art would have known how to convert an angle from one form to another. For example, from Euler angle representation to quaternion representation.

I've provided a very specific example of that just to show you how it all works, starting in paragraph 57.

Q. I'm just trying to understand what you're saying here. I would just like

you to interpret your own words for me so we're on the same page.

A. Sure.

Q. We're just talking about a fixed angle being written either as an Euler angle -- or Euler angle?

A. Euler.

Q. So talking about an angle, a fixed angle either being written as an Euler angle or being written as a quaternion representation?

A. That's where you do the transformation. By way of example, I've shown that in paragraph 59 --

Q. Yes or no, sir? I just want to make sure I understand what this sentence is and then I'll ask a question.

A. So this sentence says, you can do transformation, convert an angle from one to the other from Euler angle representation to quaternion representation. That's --

Q. That's not saying anything about converting an EKF using an Euler angles to an EKF using quaternions, right?

A. It is. Because it depends on the context. If you look at Bassompiere where he talks about EKF and he shows, for example, how to do it with Euler angles, and he explicitly says you can do all of that with quaternion, then one understands how to take the own Euler angle representation of EKF by Bassompiere and transform that to quaternion.

02:51PM Q. But that's not what you said here. That's not what this sentence says, right?

A. This is a lot higher level than getting into that.

02:52PM What I just said about Bassompiere and EKF is discussed after this paragraph 27 throughout my declaration.

Q. But just to be clear, paragraph 27 has nothing to do with converting EKFs?

02:52PM A. Paragraph 27 by itself, it's a very general statement about Euler angle going to quaternion.

This concept is later used to transform EKF of Bassompiere to quaternion form.

Q. But those are different things.
A. Yes. One is general, you use the general concept to do something as specific related to EKF.
So the basis of translation of EKF of Bassompiere in quaternion form, the origin of it may goes back to paragraph 27.
Q. Would it be trivial to rewrite an extended Kalman Filter that uses Euler angles into one that uses quaternions?
A. So, Bassompiere, for example, on page 27, before that it shows how to do extended Kalman Filter using Euler angles.
And then it says, "Its state vector comprises at least one torsion representation, chosen from the group of Euler angle or quaternion."
So he's saying you can use either one of them. That's true.
One of ordinary skill in the art would know that.
And just to prove that to you by way of example, I've provided specific examples starting from paragraph 58 of my report. I've shown you exactly how to do

that using simple add and multiplication.

Q. Can I get a time check?

MR. EVANS: Anybody who knows how much time we've been on the record? Can I get a sense.

02:54PM

THE VIDEOGRAPHER: Yes, Counsel, it may take a couple minutes.

MR. EVANS: I wasn't sure if you heard me.

02:54PM

THE VIDEOGRAPHER: No, I apologize.

MR. EVANS: I appreciate it.

BY MR. EVANS:

Q. I'd like to go to paragraph 87 of Exhibit 1002.

02:55PM

A. The same declaration?

Q. Same declaration.

A. Okay.

Q. This is not the right one. Which declaration are we in right now?

02:55PM

A. '846.

Q. Hang on. Let's go down to 94.

A. Same declaration?

Q. Yes.

THE VIDEOGRAPHER: Counsel, we've

02:56PM

been going for approximately four hours and 57 minutes on record.

MR. EVANS: Thank you.

BY MR. EVANS:

02:56PM Q. So looking at 95, and you are distinguishing the provisional '558 application as not providing support for the current claims because it doesn't have any equations using quaternions.

02:56PM Is that an accurate summary of what you're saying?

A. I'm saying the provisional '558 doesn't provide written supports for several claim elements of the '846 patent.

02:56PM Q. One of which is quaternions, right?

A. I'm saying that the provisional makes no mention of and presents no equations using quaternions.

02:56PM Q. So you're saying it doesn't contain quaternions?

A. I'm saying provisional '558 doesn't mention or present no equation using quaternions, that's exactly what I'm

02:57PM saying.

Q. That's because all disclosures described with respect to only Euler angles, right?

A. Because it doesn't mention or present no equation using quaternions, that's the reason.

Q. But you could have converted those Euler angle equations into quaternion equations, right?

A. For example, from teaching of Bassompiere, I could do that, yeah.

Q. Why do you need Bassompiere's teaching?

A. I'm saying by way of example, that's what I've done in my declaration.

Q. Let me ask you this: In 2009, pretty much every person of ordinary skill knew that quaternions were computationally less expensive than using Euler angles for example, right?

A. It depends on the application.

Q. Sure.

But that was a common thing that you would have known in 2009?

A. Again, it depends on the

application. In some cases, quaternions performed easier type of math. In some cases, Euler will be easier to use. So it all depends.

02:58PM Q. But you know that -- let me scratch that.

In 2009-2010, a person of ordinary skill would know that quaternion math uses fewer trigonometry than Euler angle math, for example?

02:58PM A. Yes. There is typically sometimes no trig used in quaternion. It's just matrix, multiplication for the most part. Whereas Euler you need to do some

02:59PM sort of trig such as sign and cosign. That's a fact that was known long ago.

Q. And that's where the computational savings comes when you use quaternions usually, right?

02:59PM A. It depends on the situation.

Q. But that's not knowledge that you needed Bassompiere to know?

A. No. I said by way of example in my declaration, I've used what Bassompiere

02:59PM is doing to show an example of when he says

you could do either Euler and quaternion, I've shown exactly what he means using straightforward math. That's what I was saying. But the general knowledge was known before that.

Q. So you wouldn't have needed any additional resources to take the provisional '558 applications, Euler angle equations, to be able to convert them into quaternions, right?

MR. LAURENZI: Objection. Form.

A. I have not analyzed '558 for its exact form and what is needed. I have just noted that '558 doesn't mention or present no equations using quaternions. That's a fact.

Q. And that mean it doesn't teach anything about quaternions, right?

A. It means it doesn't mention quaternion, Bassompiere does. Bassompiere provides equation of how to go from Euler to quaternion. '558 doesn't. That's just a fact. I'm not --

Q. I understand.

But you could still convert the

'558 application exactly the same way you converted the Bassompiere application, or Bassompiere patent, right?

A. I have not performed that exercise. I need to look at it. That's not an analysis that I performed. The analysis that I performed is to observe that '558 doesn't mention and present any equation related to quaternions. That's a fact.

Q. Understood.

My question was different, though.

There's no reason you couldn't do the same exact transformation that you did in Bassompiere to the '558 application?

A. Assuming '558 Euler angle analysis is similar to what Bassompiere does, that would be a possibility. That's not something I've done.

Let's say if '558 just had one Euler angle, yes, you could use teaching similar to that of Bassompiere, not just Bassompiere, or the examples that I provided to do quaternion-based. That's

not what I'm saying in paragraph 95.

All I'm saying is that '558 makes no mention of and presents no equation using quaternions. That's all I'm saying in the first sentence of 95.

Q. Understood.

And any person of ordinary skill could do that same conversion like you did in Bassompiere to the '558 application, right?

A. I haven't -- I haven't looked at all the details that are involved in '558. Anything that is just Euler angle, yes, you could do the same map option that Bassompiere chose, which is basically add and multiply, that one of ordinary skill in the art knows how to do to go from Euler to quaternion.

Q. Are quaternions always associated with three coordinate axes?

A. There are generalization of quaternion in multi-dimension, i.e., more than three.

Q. So do you get to decide how many there are?

A. Generally speaking, yes. Just like a vector, you could have a two dimensional vector, a three dimensional or a hundred dimensional vector, generally, yes. But, of course, in both the patents here and Bassompiere, a three dimensional body is being used. That's the 3D pointing device. And therefore, a three dimensional, four dimension, really, one being the true and the other one are RJ and K are being used by Bassompiere.

Q. Are quaternions always associated in some way with a global earth frame?

A. They don't have to be, no.

Q. Are they usually?

A. It all depends on your application.

Q. It can be, though?

A. A quaternion can be related to the earth frame, but doesn't have to be.

Q. So does a quaternion encode how two different reference frames are aligned relative to each other?

A. Quaternion shows generally angles, by way of example, in three

dimension.

Q. One of the fundamental properties of quaternions is that they can be used to rotate vectors from one coordinate frame to another using multiplication?

A. You can rotate a vector, generally speaking. You can rotate the vector and represent that with quaternion. That's really the one use of quaternions.

Q. So if you have a known vector defined in an earth fixed frame like gravity, the quaternion makes it relatively straightforward to express that same vector in a different frame of reference?

A. Quaternion and Eulers, both of them, allow you to go from a one frame of reference to the other. They allow for rotation.

Q. So is that a yes?

A. One application of quaternion is to represent rotation of a given vector.

Q. How would you define a quaternion?

A. A quaternion is a vector of four by one in its basic form. It can represent

an angle in three dimensional space. It has a real part and three imaginary parts. The three imaginary parts are normally referred to as RJ and K component. Perhaps
03:06PM the closest thing that may come to mind is a complex number, which has a real part and an imagery part, such as three plus two I.

MR. EVANS: We can put down that exhibit, Andrew.

03:06PM BY MR. EVANS:

Q. What is your closest work experience to the inventions disclosed in the patents-at-issue here?

A. Many of them, by way of example,
03:07PM I've done a whole slew of exergaming systems. Those are some that are very close to the area of the alleged invention of the '846 patent.

Q. Where would I find information
03:07PM about that?

A. You can look at probably some of the articles that I have. Some of them may describe those in detail.

Q. That's what I meant. Which
03:07PM articles should I look at?

A. Just look for the word maybe exergaming. Trying to mimic some kind of a real game on a screen. Those would be decent keywords.

03:07PM Q. I can't understand what the word before gaming you're saying, exert?

A. Exer, combine the word "exercise" with "gaming." Exergaming.

Q. Exergaming. Got it.

03:08PM A. At the very first one was Wii. Have you ever worked with the Wii remote? The idea was not to make people to sit down and use the keyboard 24/7 knowing that kids on average would spend 40 hours a week just

03:08PM playing with their screen.

So the idea was to get them going while they are on the screen or playing some sort of a keyboard-based game which is really bad for their health.

03:08PM Q. I can confirm it worked. I had several sweaty kids using the Wii exergaming. It was very effective.

A. Wonderful.

Q. Also fun.

03:08PM How many times have you written

EKFs that used quaternion math?

A. For most of these exergamings, I've written -- design, analyze and written extended Kalman Filter that uses quaternion math. So several times in my career.

Q. Have you written any extended Kalman Filters that use Euler angles?

A. Yes.

Q. You sounded a little hesitant.

A. Because it goes some years back. So yes, no, I'm not hesitant. I have built smart shoes where we have used Euler angle to do certain representation and analysis of the shoes.

Q. Are Euler angles considered conventional in your field?

A. Euler and quaternion are conventional. People use them all the time.

Q. That was going to be my next question.

So they're considered conventional because they're used frequently?

A. That's fair to say, yes.

Q. And you just said --
A. Sorry. Just to complete.
And they've been around for a long time. I think quaternion goes back to 1850 or 1860, quite a while back. So that's old science. Old math discovered by Hamilton. So more than 150 years ago.
Euler, I believe goes back to 1600 or so. Although I have to double-check. So these are old maths, probably as old as calculus.
Q. But you considered both Euler angles and quaternions to be conventional?
A. They have been both, they both have been around for more than one hundred years, correct.
Q. And it's not always advantageous to use quaternions over Euler angles, right?
A. That's correct. Sometimes you may prefer Euler.
Q. It depends on the application, right?
A. Two things.
First of all, they are

interchangeable as Bassompiere shows and as I have shown in my example. So one could really convert from one to the other and back.

03:11PM So both mathematically intuitively they are interchangeable. I've shown examples of that in my declaration. Sometimes when one may decide to use Euler, but for the same system you may want to use 03:11PM quaternion, one or the other. They are really a straightforward transformations from one to the other, as I've shown by way of example, as Bassompiere has shown the various equations.

03:12PM Q. And you said in your declarations that a person ordinary of skill would be motivated to change things from Euler angles to quaternions, right?

A. That's fair, yeah.

03:12PM Q. Based on potential computational savings and the avoidance of singularities?

A. Singularities doesn't apply in the context of these patents. So that was a general statement.

03:12PM Q. And then, similarly, you also

said in your declaration that a person of ordinary skill would be motivated to change quaternions to Euler angles, right?

A. That might be a possibility depending on the application. That's general outside the context of these patents.

Q. And that's because Euler angles are more intuitive because they're human readable?

A. That's fair, yes.

Q. There's no normalization step required?

A. That's fair.

Q. And like Jacobians in an extended Kalman Filter using quaternions, can be more complex than the same thing done with Euler angles?

A. Yes and no. Complex in the sense that, yeah, you have a larger matrix to deal with, but at the end of the day, it's simple matrix multiplication to get the Jacobian and the covariance in quaternion.

So complex may be for looking at it, but since the computer is doing all the

computation, you don't care, the computer doesn't care what intuitive or non-intuitive is.

MR. EVANS: Would this be a decent time to take a quick 30 minute dinner break?

03:13PM

MR. LAURENZI: 30 minutes?

MR. EVANS: Is that all right with everybody it's 6:15. I'm starving.

03:14PM

MR. LAURENZI: All right.

THE VIDEOGRAPHER: We are off the record. The time is 3:14 p.m. Pacific time.

(Dinner recess is taken.)

* E V E N I N G S E S S I O N *

(Shawn Johnson is now videographer.)

THE VIDEOGRAPHER: The time is 3:47 p.m. We are back on the record.

BY MR. EVANS:

Q. Can you pull up your declaration, Exhibit 1002 that we've been talking about to paragraph 53?

A. Paragraph 53? Okay.

Q. Do you see that I've got 53 up on the screen or you're looking at it on your paper?

A. Yes.

Q. And this is your derivation of Bassompiere's EKF equation, right?

A. A simple substitution based on two equations of Bassompiere. I wouldn't really call it a derivation.

Q. But this is multiple equations in Bassompiere substituted together?

(Document review.)

A. There are a couple of equations from Bassompiere where I did a simple substitution, correct.

Q. And you did this to show how you're mapping the claim elements onto Bassompiere's EKF equation, right?

A. This is part of what I've used in doing the mapping of claim elements to Bassompiere, as I stated in paragraph 53.

Q. And if we look at the left-hand side of that equation, X-hat K, that's what you're identifying as the updated quaternion at time T?

A. That's correct.

Q. And then those first two parentheticals, are what you're labeling as the current quaternion at the time T?

A. Together they are. Although as I have stated, the first part is the previous quaternion at time T minus 1.

Q. Sure.

And the previous quaternion is defined in terms of Theta and Psi?

A. The state by Bassompiere is defined as Theta and Psi, and therefore when you do the quaternion substitution, those will be the state that you're looking at as I've done in example -- in one

example in my declaration.

Q. But just to be clear, everything we're looking at here in this equation right under paragraph 53 is written in Euler angles?

A. What you see in paragraph 53 is an Euler angle, although Bassompiere makes it very clear on page 27, line 14, that you could either use Eulerian angle or quaternions, and I have shown based on Bassompiere how to do the conversion.

Q. I'm just asking about what we are looking at the screen. Are there any quaternions on that formula underneath paragraph 53?

A. As I said, that state is in Euler form the way Bassompiere explains it. He also explains that it's a straightforward, or you could substitute quaternion for the terms here.

Q. Let's go down to paragraph 55. Do you see where I am?

A. Yes.

Q. And this is where you talk about replacing equations 21 and 23 in

Bassompiere with state vectors in quaternion form, right?

A. That's correct.

Q. So you're replacing those angles of torsion, Theta and Psi, by quaternion formulation of that same torsion?

A. Yes. Again, as Bassompiere explains in paragraph -- sorry, on page 27, you could replace the state and other Euler angles with quaternion. And that's what I'm trying to explain in paragraph 55.

Q. And the reason you're doing that is because performing operation with quaternion is more efficient than performing the same operation using Euler angles?

A. It all depends on a case. The reason I'm doing it is to say that they are interchangeable and exactly as explicitly Bassompiere states, you could use either Euler angles and quaternion, page 27, line 14.

Q. So you don't know which method would be more efficient in Bassompiere?

A. Efficient in terms of what?

Q. You're the one that used the word efficient.

A. So efficiency, there are multiple aspect. One aspect is the intrusion behind the angles, which we discussed earlier today about an hour ago.

The other one is being able to deal with sign and cosign. So in that sense with quaternion, you don't need to do three as we discussed earlier. You do matrix multiplication, addition and subtraction.

So in that sense, if you call that efficient, which is what I'm referring to here, yes.

Q. Why would you make this change from Euler angles to quaternions in Bassompiere?

A. Bassompiere states in page 27, line 14, that you can do either. So there are just alternative to the same extended Kalman Filter. You can use one or the other. It makes no difference, and the computational is actually fairly straightforward, as I have provided

examples throughout my declaration.

Q. Why would a person of ordinary skill want to make that change?

A. Several reasons. One is, if they don't want to deal with Eulers and trig and some of the round-off error, quaternion makes that somewhat easier. That's one reason.

Q. Is that why you did it?

A. I didn't do it. Bassompiere shows how to do it.

Q. But you did the conversion?

A. Which conversion?

Q. From Euler angles to quaternions?

A. Where?

Q. In your declaration.

A. I didn't. Bassompiere teaches you how to do it.

Q. So --

A. The following --

Q. He wrote your declaration for you? He did that math?

A. I think we are -- I don't follow you.

I'm following what Bassompiere

teaches. That's it. I haven't added any extra innovation to what Bassompiere does. I just show you how to add and multiply based on Bassompiere. That's it.

03:56PM Q. And Bassompiere teaches that you can do it either way?

A. It says it specifically page 27, line 14. And elsewhere in his patent.

Q. But the EKF formulas are all written in Euler angles?

03:56PM A. Examples that Bassompiere provides in some of his pages are in Euler, and elsewhere they are, indeed, in quaternion. For example, on page 20, he specifically uses quaternion and he uses differential equation of the state model in quaternion form.

So it's a misstatement to say that everything in Bassompiere is based on Euler. That's incorrect.

03:57PM Q. I'm sorry. The EKF equations that you mapped our patent onto in Bassompiere are all written in Euler angles?

03:57PM A. The equation in the paragraph 53

is in Euler. Bassompiere teaches you to how to also do things in quaternion, also examples of that is provided in general statement related to that, is provided by
03:57PM Bassompiere on page 27, line 14.

And for example, on page 20 he shows you specific ways of doing it. And I have taken actually his equation 25, and I've shown in my declaration an example of
03:57PM how you do conversion.

And if you follow my declaration, it's very straightforward math that just requires multiplication and addition.

Q. Sure.

03:58PM So let's look at paragraph 57. This is where you begin to explain how person of ordinary skill would use quaternions in place of equations 21 through 23 of Bassompiere, right?

03:58PM A. Paragraph 57 shows how you can take two angles, for example, Ti, Psi and Theta, and represent that in quaternion using the general equation 25 of Bassompiere. And I simply have provided an
03:58PM example of that starting with paragraph 58.

Q. What is equation 25? What does it do?

A. Equation 25 defines how you do -- shows how you define a quaternion when you do a rotation around an angle.

Q. Is that pretty basic quaternion information?

A. I don't follow your question.

Q. Did you learn that from Bassompiere or did you know it already?

A. No, this is basic math. Basic quaternion.

Q. This is just standard quaternion math that any person of ordinary skill would know?

A. Yes.

Q. Okay. Going down, the last sentence -- or I guess not the last, starting at the top of page 33 you say, "Bassompiere also describes the well-known quaternion operations such as how to calculate the conjugate of the quaternion."

Is that well-known, or did you learn that from Bassompiere?

A. Oh, these are basic math of

quaternion, including the fact that "I" times "J" is equal to minus "K," are basic complex number type of mathematics, which in this case is applied to quaternion.

04:00PM Q. Okay. So you didn't need Bassompiere to teach you that?

A. To teach me what?

Q. The quaternion conjugate?

A. No.

04:00PM Q. Or equation 25?

A. No.

Q. You said it would be a simple matter of plugging Euler angle values into equation 25 to calculate the quaternion.

04:00PM A. I have shown you an example starting with -- sorry, paragraph 59 going all the way to paragraph 63. And I have shown with simple multiplication and addition how you could do exactly that.

04:01PM I just noticed a typo -- sorry, if I may please make a correction?

I just noted a typo on page 35. The third equal sign, the last item, point 2I," that should be ".2."

04:01PM Q. I want to go back to paragraph

51.

So you're identifying this Y-hat K-bar as the predicted axial acceleration, right?

04:02PM A. YK-hat bar is the predicted axial acceleration, and Bassompiere says so.

Q. And that's from -- you said equation 21, but I believe it's equation 22 on Bassompiere on page 19?

04:02PM A. That is exactly equation 22.

Q. Okay. And then you're saying the measured acceleration is from the accelerometer, which is this variable Y equals Ax, Ay, Az?

04:02PM A. Sorry, where are you? Oh, you're in paragraph 51?

Q. Um-hmm.

A. Yes, that's correct.

Q. Okay. I'm going to go down to 72 now. Paragraph 72 -- actually, 73.

04:03PM So this is where you talk about converting that equation 22 into quaternion form, right?

A. 73 shows how to determine the top equation in quaternion form. And I'm using

C0B, that's from another citation came, that's correct.

Q. And paragraph 73 says, "A person of ordinary skill in the art would know to take a known rotation matrix in quaternion form and perform the same calculation."

A. Correct.

Q. That's not in Bassompiere.

A. That's what one of ordinary skill in the art would know. And as a collaborating evidence of what was known at the time, I have shown it in Kim reference. K-i-m.

Q. But Bassompiere does not disclose that information?

A. That's simple quaternion math of rotation matrices. There are two forms of it known in the literature. One is quaternion based that I'm showing at the bottom of page -- in paragraph 73. And one is what is known as the cosign form, which I've shown it on top of page 43.

Q. But Bassompiere doesn't disclose a rotation matrix in quaternion form, right?

A. That's basic math. You can use the teaching of Bassompiere to do the translation from sign and cosign to Q and Q0 and all that or you can just look at any literature for it.

Q. I appreciate that you're trying to be helpful, Doctor. But it would really go a lot faster if you answered the questions I asked.

Like I didn't ask you how you do any of that.

I simply asked: Are there quaternion rotation matrixes in Bassompiere?

I believe the answer is no.

Do you agree?

A. The answer is yes. It provides rotation matrices and Bassompiere shows how to go from Euler angle to quaternion.

Q. Is there a rotation matrix in quaternion form anywhere in Bassompiere?

A. If you look at page 12 of Bassompiere, he is showing a rotation matrix. He's showing that you can go from Euler angle to quaternion. So he's

basically stating that's something that is done in a straightforward manner.

Q. Where does he say that on page -- what page did you say?

04:07PM A. Page 12 is showing a rotation matrix R.

Q. Okay.

A. And then --

Q. But that's in Euler angles.

04:07PM A. In many places, including --

Q. Can you confirm that that's in Euler angles on page 12?

A. On page 12, the rotation is in Euler angles. That's correct.

04:07PM Q. Both equations 1 and equations 2 on page 12, right?

A. That's right.

Q. Okay. So there is no quaternion rotation matrix anywhere in Bassompiere?

04:07PM A. Again, by another example, looking at page 18 --

Q. Can you answer my question first before we go somewhere else? I just want you to answer: Is there anywhere in

04:08PM Bassompiere a rotation matrix using

quaternion?

A. Yes.

Q. Where?

A. Take the rotation matrix of page 18 and apply the teaching of Bassompiere.

Q. Where is the rotation matrix on page 18, equation 17?

A. Is it 17 or 18? Yeah, 17. R, Theta, Psi.

Q. Written in Euler angles, right?

A. That is in Euler angle. And Bassompiere teaches how to convert this and other equations to quaternion.

Q. Do you understand the difference between an explicit statement and the ability to convert something?

A. Yes. And your question was vague on that.

Q. So I'm asking explicitly, does Bassompiere contain a rotation matrix using quaternions? Just explicitly in there without requiring any conversions.

A. Bassompiere talks about previous work that has done in relation with extended Kalman Filter.

If you go to these previous work, you will see explicit equations related to quaternions, such as the one on page 43 of my declaration. He's not rewriting that rotation matrix in quaternion form in one of his pages. That's one of ordinary skill --

Q. So you agree that Bassompiere does not explicitly disclose a rotation matrix containing quaternions?

A. That quaternion rotation matrix is shown in Euler angle. One of ordinary skill in the art knows how to, A, look it up in the literature and look at it from a quaternion point of view, or use the teaching of Bassompiere to convert these rotation matrices, such as the one on page 18 into quaternion form.

And because it's a straightforward, Bassompiere doesn't teach you to do that. Also, the '843 patent --

MR. EVANS: Objection.

Objection.

A. -- does the same --

MR. EVANS: Objection.

Nonresponsive.

BY MR. EVANS:

Q. Doctor, I have limited time, and I have a lot of ground to cover. And I need short, succinct answers to my questions.

So, please, listen carefully and answer what I'm asking. You will have an opportunity to say whatever you want with your attorney when I'm done. Whatever you want.

This is my only chance to focus on the things I want to focus on. And it would be very unfair if I am not allowed to present to the Board what we believe is important. And the objective here is to get to the truth, and that requires everyone to have a fair say.

Would you agree?

A. Sure.

Q. To do that, I need you to answer my questions as succinctly as possible so that I can cover all the material I need to cover in the time I remain.

Can you agree to try to do that

for me?
A. I've been trying to do that all day long, and I will continue to do that.
Q. Well I would hope that you would try a little bit harder because I would not -- this does not seem that that has been your aim to me today.
MR. LAURENZI: Objection to the colloquy.
MR. EVANS: Objection to the improper objection.
BY MR. EVANS:
Q. So just for a clean statement, is there anywhere in Bassompiere, without doing any conversions, a rotation matrix that utilizes quaternions?
A. That's straightforward math, that one of ordinary skill in the art understands. Bassompiere shows how to do the conversion --
Q. Doctor, do you have any children?
A. Sorry?
Q. Do you have children?
A. Yes.
Q. Are you familiar with the term

rage-baiting?

A. No.

Q. I feel like you're rage-baiting me with these answers.

MR. LAURENZI: Objection. Form. Objection.

BY MR. EVANS:

Q. I'm asking yes or no answers, and you're dumping your entire declaration on me. And I just want you to explain very discreet parts of it.

So can we just focus on the small, bite size chunks that I'm talking about?

We are not all professors with 35 years of quaternion math and whatever experience, and this is not an easy topic.

So it would be very helpful if you can focus on what I'm asking and answer it as succinctly and accurately as possible without going off onto tangents or other places.

Again, you will have an opportunity to do that with your attorney. You had your opportunity to put whatever

you want in your declaration. This is my only opportunity to ask you the questions I want to ask, and I would like to focus them in the areas where I want to focus.

Is that fair?

A. That's what I've been trying to do all day long, and I'll continue to do that in a scientific manner.

Q. Is that how your attorney has instructed you to answer questions here today?

MR. LAURENZI: Objection. Instruct the witness not to answer. Privileged information.

BY MR. EVANS:

Q. Did he provide you with any instructions on how you should answer questions here today?

MR. LAURENZI: I instruct not to answer.

MR. EVANS: Are you serious?

MR. LAURENZI: Yeah, I am serious.

MR. EVANS: Okay.

BY MR. EVANS:

Q. Did you discuss -- have you talked to your attorneys at all during any of the breaks today?

A. Non-substantive in terms of what the temperature is outside and things of that nature, yes.

Q. You didn't discuss anything to do at all with this case at any of those breaks?

A. No.

Q. Okay. All right.

So you're saying that these rotation matrix in quaternion form is a knowledge that every person of ordinary skill in the art would have?

A. Correct.

Q. And to define one of those, you had to rely on the Kim reference here, right?

A. No.

Q. Well, you relied on the Kim reference for the rotation matrix that you were using in your declaration in paragraph 73, correct?

A. I'm just using Kim as one example

of where you can see these things. There are plenty of literature and reference that one of ordinary skill --

Q. It's not my question. It's not my question.

Do you understand why I'm getting frustrated, Doctor? None of that was what I asked.

Do you understand? Do you see the logic of the statements I'm stating here? I didn't need the rest of that soliloquy answer. Just please answer the question I asked, okay?

A. That's what I've been doing all day.

Q. Who found Kim?

A. Well, this is one of my areas of research. I have a big library of related articles. I don't recall if I first found it or the attorneys did.

Q. Did you search for any references in relation to this declaration on your own?

A. Yes.

Q. Okay. And which ones did you

identify?
A. It's been more than a year. I don't recall. I have my own personal library of related references, and I've also done other searches.
Q. So, again, you don't know what you did in your own declaration?
MR. LAURENZI: Objection. Form.
A. That's not what I said.
I said I don't remember if one of the references here came from my own library, from my own searches or other places. But I do know that I had these references in front of me, I analyzed them, then I wrote my declaration.
Q. Paragraph 74, if we can go down to that one, you state, "That the equations for predicted accelerations are the same set of known equations for predicted acceleration presented in equations 2 through 4 of the challenged '846 patent."
Do you see that?
A. Yes.
Q. Okay. Those equations are not in Bassompiere?

A. Not in that format, but they're extended Kalman Filter equation, one understands that '846, equation 2 through 4 is a general extended Kalman Filter, and that's exactly what Bassompiere talks about.

And in fact, it has those equation in a different format, similar format.

04:17PM Q. They're not in quaternion format.

A. Again, one of ordinary skill in the art would understand how to convert those to quaternion, and Bassompiere is specifically tells you that's one of your two options.

Q. Right.

So a person of ordinary skill in the art would have to convert Euler angle based formulas into quaternion based formulas to arrive at these in Bassompiere, right?

A. Bassompiere provides in a number of places, methodologies of doing that.

And also of one of ordinary skill in the art would understand that you could

do these in quaternion form because, as Bassompiere explicitly says in his page that you have referred to multiple times, I believe it's page 27, it says, your state representation can be either Euler angles or quaternion, line 14, page 27 of Bassompiere.

Q. How do you know a person of ordinary skill in the art knew how to do rotation matrices in quaternion form?

A. Say that again?

Q. Why do you believe a person of ordinary skill in the art would be familiar with rotation matrices in quaternion form?

A. So rotation matrices are basic matrices that is used in dealing with three dimensional bodies. And Euler and quaternion are interchangeable in terms of representation, as Bassompiere explicitly says that.

And, in fact, through a number of his equations, he shows you how to do that. By way of example of when you look at page 6 of Bassompiere --

Q. Professor, I'm sure you were

instructed to always answer these questions with a, but we could have easily converted it, and then go back to your decks.

But I don't need that.

04:19PM I just need the beginning of your statement where you answer my actual question. The rest of that is in your declaration. I can read it at my leisure. I don't need it now.

04:19PM Can we stick to the substance of my questions? I don't need all the additional information that you continuously try to provide.

A. Sometimes extra explanation is

04:20PM needed to put things in the right context, and that's what I've been doing all day.

Q. So what is your basis for saying that rotation matrices in quaternion form were known to persons of ordinary skill in

04:20PM the art? Like what evidence of that do you have?

A. A number of things. One is page 27 of Bassompiere, line 14, among many other places, says that you can either use

04:20PM Euler angles or quaternions. And that's

understood by one of ordinary skill in the art.

Page 20 of Bassompiere where he looks at quaternion and shows how you do the Euler angle in quaternion, also shows that any rotation matrix, any angle including the rotation matrix angle, can be done in quaternion.

04:20PM

Q. Bassompiere when he's talking about that on page 20 is only talking about the state vector, right?

04:21PM

A. Yes and no.

As I have a shown in the example that I provided in my declaration, starting with paragraph 58 going to paragraph 63, I've shown how the Euler angles, whether it's rotation or a simple angle rotation movement, can be done in quaternion.

04:21PM

I provided very specific example of that.

Q. But how do you know a person of ordinary skill in the art would know that? I get that you know it, but this hypothetical person of ordinary skill in 2009, why would they know it?

04:21PM

A. Because the equation on page 20 is a general equation for quaternion, that's not from Bassompiere. It actually shows a quaternion is defined by four elements. He's not driving that.

He says that one of ordinary skill in the art would -- basically, what he's implying is that one of ordinary skill in the art knows that this is the equation for quaternion based on Euler angles.

So if you know basic quaternion math and conversion to and from Euler, as I have stated earlier, you know how to go back and forth between the two.

Q. Let's go to paragraph 58.

A. Which paragraph?

Q. 58.

A. Okay.

Q. You assumed an initial orientation of 0 pitch angle and 0 roll angle. Is doing that disclosed in Bassompiere?

A. This example?

Q. Your initial -- your initial assumption of 0 pitch angle and 0 roll

angle, is that in Bassompiere?

A. That is not my assumption. That is an example that I'm providing.

Q. And how did you pick those angles?

A. I could have picked anything. I thought the multiplication simpler to follow, if I start from 0 to 0.

Give me five minutes, I can start from any angle to any other angle following what I've shown in paragraph 58 through 63.

Q. But those assumptions, those angles, that's not in Bassompiere?

A. That's an example of using Bassompiere.

Q. But that's a choice you made?

A. That's an example. Examples are based on choices. Examples --

Q. By you.

A. That's an example, yes. That's the very definition of an example.

Q. Let's go to paragraph 61.

It says in quaternion form, the new orientation for the roll angle would be determined by calculating the rotation

quaternion per equation 25 above as follows.

Do you see that?

A. Yes.

04:24PM Q. Is that information in Bassompiere?

A. Yes.

Q. Where?

A. By way of example, equation 25 that he has on page 20.

04:24PM Q. But I mean, how do you know that Alpha equals Pi over 8 and whatever that U equals I.00, where does that come from?

A. Do you follow what I'm trying to do in paragraph 58 through 64?

04:25PM I think perhaps not, and that's why you are asking those questions.

Do you want me to explain it to you?

04:25PM Q. No. I just want you to answer my questions.

A. That's an example. I picked an example to show how a straightforward of a math is to go from Euler to quaternion.

04:25PM Q. But math that's not in

Bassompiere.

You created that?

A. The math is in Bassompiere. The example is by me.

04:25PM Q. Right.

So this formula that you wrote here, Q0 equals cosign Pi over 8 divided by 2, all that, that's you created that?

A. That's Bassompiere. I'm simply

04:25PM doing an example, an instantiation of what Bassompiere teaches.

Q. Where do you see that in Bassompiere? That formula here we are looking at, where is that in Bassompiere

04:26PM with those numbers in it?

A. Page 20 of Bassompiere starting with line 10 going through line 17 or 18.

Q. I don't see that formula there.

A. Yes, you do.

04:26PM Q. I see --

(Reporter clarification.)

Q. The formula you wrote here is not on page 20.

A. Yes, it is.

04:26PM MR. LAURENZI: Objection to form.

A. The formula is there. I'm just providing an example.

Q. You have plugged numbers into a formula on page 20?

A. Exactly. But the formula is from page 20.

Q. But the formula is on page 20 don't have these numbers that you've added in them?

A. That's the very definition of an example.

Q. Okay. And so those are choices you made?

A. That's the very definition of an example.

Q. And those are the choices that are not disclosed in Bassompiere?

A. An example?

MR. LAURENZI: Objection.

BY MR. EVANS:

Q. That example is not disclosed in Bassompiere?

A. That example has been provided to be helpful to you and the Board of how straightforward it is to go from Euler

angle to quaternion, just don't take Bassompiere wrote for it, follow these couple of pages where I've done an actual transformation.

04:27PM Q. I'm trying to go through them. Let's go to paragraph 62.

A. Okay.

Q. It says, "To calculate the new quaternion representing the combined

04:27PM rotation, pitch then roll, applied to the original orientation, a person of ordinary skill in the art would know to multiply the individual quaternions in order of application from right to left."

04:28PM A. Correct.

Q. That is not in Bassompiere.

A. Well, what is not in Bassompiere, which part of it?

Q. "Would know to multiply the

04:28PM individual quaternions in the order of application from right to left"?

A. Well, you start from an angle --

Q. My question is simple. I'm not asking how to do it.

04:28PM Just is that information written

explicitly in Bassompiere?

A. Bassompiere and one of ordinary skill in the art knows that, and here I'm providing an example.

04:28PM Q. So, again, this is your intrinsic knowledge as a person of ordinary skill in the art, in paragraph 62, right?

A. No, that's basic quaternion math. That's when you want to do a rotation, for

04:29PM example, by Pi over 8, you multiply your original orientation by the quaternion related to the angle that you are trying to rotate by. This is from 1850. This is 150 years old.

04:29PM Q. Where does Bassompiere say any of that?

A. This is basic math of -- if you rotate something by ten degrees, you can rotate it by seven degrees and then by

04:29PM three degrees.

Q. Can you just -- can you confirm that that information is not contained in Bassompiere and instead comes from your intrinsic knowledge as a person of ordinary

04:29PM skill in the art?

A. That information is known by one of ordinary skill in the art and Bassompiere talks about extended Kalman Filter and the whole notion of rotation. Although that specific writing at the bottom of page 34 is not in Bassompiere, but it's very clear that's how you do rotation, and that's the basis of equation 25 of Bassompiere and also equation 26 of Bassompiere.

Q. Let's go down to the next, top of the next page.

None of that math above paragraph 63, with the numbers that you've put in there, is in Bassompiere either, right?

A. Yes, it is.

Q. Not in this form, though?

A. Yes, it is.

Q. Exactly like this?

A. This is an example of exactly what Bassompiere has.

Q. But it's your plugging numbers into and interpreting equations of Bassompiere using your intrinsic knowledge, is it not?

A. No. I'm not using my intrinsic knowledge. I'm multiplying two numbers and understand one of ordinary skill in the art --

04:31PM Q. Could you --

A. And that's one of ordinary skill in the art knows how to add numbers.

Q. Where is this math above paragraph 63 in Bassompiere? I would like

04:31PM to look at it.

A. Sure.

So look at the rotation where you say you can, instead of saying I want to rotate by ten degrees, that's equivalent to

04:31PM saying, I want to rotate by three degrees and seven degrees.

And I'm just using that example from teaching of Bassompiere. But more than that, from teaching that one of

04:31PM ordinary skill in the art would understand.

Q. Right.

But where is that in Bassompiere? I'm looking at it. I have it in front of me.

04:32PM A. Bassompiere, for example in

equation 26, shows how you go through a different state by doing that quaternion multiplication that you see in equation 26.

So that's where he takes a quaternion and multiply it by the angles, angular velocities, that is related to that.

Further it shows in equation 25 how you go from Euler to quaternion.

04:32PM Q. Let's go down to paragraph 66.

A. Okay.

Q. You say, "Equation 21 of Bassompiere can be expressed as the rate of change of an orientation quaternion based on the angular velocities from a gyroscope."

A. Correct.

Q. And then you say, "A person of ordinary skill in the art would understand this to be a quaternion kinematic equation."

A. Correct.

Q. Do the words quaternion kinematic equation appear in Bassompiere?

04:33PM A. The background that Bassompiere

talks about in 3D rotation, one would understand they are movement of objects in 3D. That is the whole thing about Bassompiere.

04:33PM I don't know if the actual word "kinematic" would understand, but that's irrelevant. It's really a 3D pointing device moving in three dimension. That's what I'm trying to say in paragraph 66.

04:33PM Q. So the answer would be "no"?

A. The concept of moving an object in 3D is in Bassompiere. It is the basis of what Bassompiere is doing. That --

Q. It's the concept that is in

04:34PM there. I gotcha.

A. It is the -- the whole thing about Bassompiere is having an object, a 3D pointer, in three dimensional space. That's what Bassompiere is.

04:34PM Q. Right.

And Euler angle base EKF tells you how to do it. And then it says it could be done in quaternions.

And then you went and did it in

04:34PM quaternions, right?

A. I didn't. Bassompiere shows you how to do it.

Q. It doesn't do any of these conversions. It just says you can do it.

04:34PM A. All you need to do is to apply by way of example equation 25. I have simply provided example trying to make it simpler for somebody to follow.

You don't need any of my example. 04:34PM I could have not had any of the examples in my declaration, it still would be as valid.

Sometimes it's helpful to provide examples to show how you work with an equation. That's what I do when I teach.

04:35PM Q. Let's go down to page 38, paragraph 67.

A. Okay.

Q. Underneath those equations you said, "This set of four equations describes 04:35PM how the orientation quaternion changes over time given the gyroscope's angular velocity readings."

A. Correct.

Q. You say, "To implement this, a 04:35PM person of ordinary skill in the art would

integrate these differential equations over Time, Step, Delta T, Q, K, approximately QK minus 1, plus QK minus 1, Delta T, or whatever that formula is, followed by a normalization by quaternion K to ensure it remains a unit quaternion."

Now, none of that is in Bassompiere?

A. Yes, it is.

04:36PM Q. Where?

A. Equation 23 of Bassompiere is exactly what I'm describing in paragraph 27 and the equation above it.

Q. But those are in Euler angles.

04:36PM A. No, equation 23 -- sorry, equation on page 20 is in quaternion form. That is the --

Q. Equation 23 is in Euler --

A. Sorry. Equation on page 20, 04:36PM equation 26.

Q. Okay. Equation 26?

A. Yes.

Q. Okay. Is that what you're deriving right now?

04:36PM A. What I have there is actually

equation 26 where you have --

Q. Equation 26 is the state model in Bassompiere, right?

A. Equation 26 is the differential equation based on an existing quaternion and changes in angular velocity in the capital X, Y, Z frame.

Q. And on paragraph 69, we'll go down, you say, "A person of ordinary skill in the art would understand that the matrix vector multiplication above is a way to represent the quaternion multiplication operation in a linear algebra format."

Bassompiere does not say that.

A. That's how you do quaternion multiplication.

Q. Right.

And that's what you -- you brought that knowledge to Bassompiere?

A. No. Anybody -- one of ordinary skill in the art would know that and Bassompiere, where he talks about basic quaternion math, would understand how to do it. And it provides a number of examples of that by way of example, equation 26.

Q. All this math that follows under paragraph 69, after that initial equation, is your work, not Bassompiere's, right?

A. That's matrix multiplication, that one of undergrad level would know how to multiply matrices. I assume that when you read Bassompiere, among other --

Q. Did you hear the question I asked you, though?

A. Yes.

Q. Is that not in Bassompiere? Did Bassompiere do this math that you did here in your declaration?

A. Yes.

Q. Exactly like this? Like I can find this exact math? It will be right here in Bassompiere one for one?

A. Maybe I don't understand your definition of math.

Do you want to define what you mean by math?

Q. Sure.

Does Bassompiere say anywhere that P circle with an X in it R, is that in Bassompiere?

A. Sorry, I don't --

MR. LAURENZI: Objection to form.

A. I don't follow you.

Q. I don't know the quaternion multiplication, P circle with an X, R for two quaternions, is that piece of information in Bassompiere anywhere?

A. So quaternion multiplication is one of the examples is equation 26 of Bassompiere and --

Q. Does Bassompiere teach you how to do your quaternion multiplication?

A. That's basic knowledge, using matrix multiplication.

Q. I'm just trying to filter out what is basic knowledge that you know and what is explicitly disclosed in Bassompiere. That's all I'm trying to do. I'm not trying to pass judgment.

I just want to know, you've taken teachings of Bassompiere and applied it in this way based on your knowledge, right?

A. I've used teaching of Bassompiere in terms of extended Kalman Filter, both in Euler and quaternion.

The rest of it is the very first step of learning quaternion math. So if one of the first thing, first day, that you learn about quaternion math, in addition to the fact that "I" times "J" is equal to minus "K," et cetera, is how you do multiplication.

Q. Do you have a syllabus from one of your courses that teaches quaternion math showing that you learned it on the first day?

A. My courses are on system design. Quaternion math is part of that.

But if what I meant was, if you are trying to learn just about quaternion, if you look at any textbook, any article, one of the first things that you learn is how you do quaternion multiplication.

Q. Which textbook?

A. Any textbook on quaternion.

Q. Tell me one. Give me one example.

A. I don't have the name of these textbooks. But way of example, look at some of the early work of Hamilton from

1850. Look at the initial articles of Hamilton. This is 150-plus years. Look at any of those and any article written on Hamilton math from 1850, a long time ago, you will see all these basic quaternion math information.

04:41PM

Q. When you say you learned these concepts on the first day of quaternion math, that's not based on an actual class syllabus that you are aware of right now?

04:42PM

A. It is based on, if I want to tell a student to go and learn about quaternion, whether they used the original article of Hamilton or many textbooks or many articles that has been written in the past 150-plus years, the basic algebra, linear algebra, of quaternion is being taught. And after defining what a quaternion is, these are the kind of things they learn.

04:42PM

Q. So the answer is no, I don't know the specific class but that's happening?

A. I have trained Ph.D. students where I have advised them how to go and look for quaternion math in case they don't have it, and these are the kind of things

04:43PM

they learn as the very first step.

Same thing when you deal with complex numbers, "A" plus 3, plus "I" times 2, that complex number.

04:43PM If you want to multiply that by another complex number, you take the first coordinate of the two numbers, multiply them. You take the first coordinate of the first number, multiply by that second 04:43PM coordinate of the second number.

You take the second coordinate of the first number, multiply that both by the first and second coordinate of the second number. That's the first thing you learn 04:43PM when you study linear algebra.

Here, it's really the same thing quaternion. It's a complex number which instead of "I," it has "I," "J," and "K." If you wish, three imaginary parts and one 04:43PM real part.

Q. Let's go down to paragraph 72.

A. Okay.

Q. We're looking at equation 72 of Bassompiere which is what you have 04:44PM identified as the predicted axial

acceleration, right?

A. Correct.

Q. You say a person of ordinary skill would know how to derive the predicted acceleration of Bassompiere from quaternion form, i.e., from X-hat K-bar in quaternion form.

Do you see that?

A. Yes.

Q. So you have to derive that because it's not explicitly disclosed in Bassompiere, right?

A. One of ordinary skill in the art knows how to do that. By way of example, Kim on page 43, paragraph 73 of my report shows how to you do exactly that. This is basic quaternion math.

Q. So you have to rely on Kim to know how to do that derivation?

A. I've used Kim just by way of one example. But, again, go back to the original work of Hamilton from 1850 or so and --

Q. Did you cite any of that work?

A. Sorry?

Q. I didn't see that work listed in your declaration anywhere.

Did you rely on that for your opinions here? It's not an exhibit in this IPR. I haven't seen any reference to it beyond your testimony today. So why do you keep bringing it up?

A. Just to state that these are old math quaternion, so is multiplication.

Q. So to find -- to get to our claims, you had to rely on other references besides Bassompiere, like Kim and this old 1850 Hamilton math and some textbooks and your intrinsic knowledge.

Is that fair?

A. It's not fair. And that's not what I've said.

Q. Well then why do you keep bringing it up?

A. Just provide you with examples.

Q. How -- could we focus on what you actually did do in this case and the things that you relied on?

A. Yes. I'm relying on basic math. I rely on the fact that we know how to

multiply two numbers, by way of example.

Q. It just seems like you keep pulling in more and more materials into your answers, and none of it is disclosed or been produced in this case so it is kind of baffling.

A. No. Anything I'm saying is to state that these are basic math, basic quaternion math. You know how to multiply two numbers. We know how to add two numbers. That's why I'm bringing it over and over.

What I've relied on are the articles that I have used as prior art in this case.

Q. If we go to the top of the page 43, you have the result of this calculation is the rotation matrix reduces to its last column.

Do you see that?

A. Yes.

Q. What you're saying is equivalent to Bassompiere formula 22?

A. Yes, that formula in equation 22 of Bassompiere, page 19.

Q. Again, you got that rotation matrix from Kim?
A. No.
Q. Well, that's what you say in paragraph 73.
A. I'm saying that Kim provides an example of that rotation matrix.
Q. And isn't Kim's example the one that you have been using here in your declaration?
A. No. This is --
Q. No?
A. This is general rotation matrices.
Q. Well, what does equation CBO in paragraph 73, where does that come from? That's not in Bassompiere.
A. That's general rotation matrices.
In fact, I've shown on page 46, I'm comparing Kim on the right and Exhibit 1001 on the left, showing that that's the equivalent.
Q. I'm on page 43, and the formula I'm looking at comes from Kim, right?
A. No.

Q. You cite to Exhibit 107, equation 7.

A. Correct. That's one example of where you can see this equation.

But this is the basic rotation matrix in quaternion form. And I've also discussed it elsewhere. And just showing what is known in the art, is also verified by Kim. But Kim is just an example.

04:49PM Q. Let's go down to paragraph 75.

The second sentence says, "The predicted accelerations found as part of the measurement vector FIMU, which uses the familiar direction cosign matrix to secure 04:50PM the rotation matrix from frame O to frame B of Y gravity."

What does that mean? What's happening?

A. That means -- so familiar, that's 04:50PM the matrix, the cosign matrix, that you see in all -- a large number of related literature to rotation three dimensional space.

So you take that rotation matrix 04:50PM C0B from 02B and you apply that to the

magnitude of gravity that you see at the bottom of paragraph 75 on page 45, and you add to that the noise of the system.

Q. So it's the gravitational force plus the noise?

A. There is a noise that, for example, Kim talks about, yes.

Q. So it's gravity?

A. "Zero, zero" and "magnitude of gravity," that's what the 2 means in the opposite direction. That's why you see minus in front of it.

Q. So, again, in Kim, when you are talking about what would be the predicted axial acceleration, you're focusing only on gravitational forces, right?

A. In this example, Kim is applying the opposite of gravity to its rotation matrix. I'm using Kim just by way of example.

Q. Okay. So you're talking about only the opposite of gravity?

A. That's what the minus in Kim is indicating.

Q. There's no other acceleration

forces in that predicted axial acceleration?

A. Well, the rotation matrix is multiplied by 00G2. That's applied to the gravity in the opposite direction.

Q. Does that result in any forces other than gravitational forces?

A. This is just a rotation matrix.

Q. And what is it rotating?

A. It's rotating from a 0 frame to a B frame.

Q. And what vector is it rotating?

A. It is rotating any vector from one frame to the other using the well-known either the quaternion form or cosign form, both of which are familiar to one of ordinary skill in the art.

And as you can see, I have a table provided there.

Q. That's not in Bassompiere, though?

A. What is not?

Q. That table.

A. That is the table of me comparing Kim with what is in --

Q. Our patent.
A. The patent, Exhibit 1001.
Q. So nothing on this table on page 46 is in Bassompiere?
A. This is comparison of using estimated acceleration from Kim. Bassompiere also teaches how to do that, as I've described. Also, one of ordinary skill in the art knows how to do it, and I'm showing that matches with what is in the patent.
So if you say, where did you get these equations? How do you know where they are? You are basically saying '846 is suffering from written description because that -- it doesn't show how you go -- how you get these accelerations. That's what one of ordinary skill in the art knows.
Q. So you don't know how to solve these equations?
A. I don't follow your question. It doesn't make any sense.
Q. The equations 2 through 4 and equation 13 from Kim on page 46, in those two boxes, you don't know how to solve

those equations?

A. If you have Q1, Q2, Q3, Q4, you just plug it in. You get the estimated or predicted acceleration.

04:55PM Q. What is the written description problem that you are talking about? Have you offered an opinion on that?

A. No. All I'm saying is that what is in the patent on the left of this table, 04:55PM that's from the patent.

Q. Right.

A. Why did they write that without driving anything? Because one of ordinary skill in the art knows these equations.

04:55PM Q. So there isn't a written description problem then?

A. No. But if you say, how did I derive these things, you are basically saying the patent has a written description 04:55PM problem.

Q. I'm just saying these equations aren't in Bassompiere.

Would you agree?

A. No.

04:56PM Q. Why not?

A. These are rotation matrices, and Bassompiere shows you how to do it, one of ordinary skill in the art knows how to obtain them. By way of example, Kim shows how to do it.

Q. Does Bassompiere teach you how to convert quaternions to Euler angles?

A. That's basic knowledge. Going back and forth within quaternion and --

04:56PM Q. The question is, does Bassompiere teach it? I'm not asking is it basic knowledge or do you know it.

I'm asking does Bassompiere teach it?

04:57PM (Document review.)

MR. EVANS: The witness is looking through Bassompiere.

(Document review.)

BY MR. EVANS:

04:59PM Q. It seems like you're not aware of anywhere where Bassompiere teaches it since we've been sitting here for about three minutes in silence while you review it.

A. By way of example, on page 6 of Bassompiere, it deals with Eulerian angles

of angular velocity, and it's showing how to get that from quaternions.

(Deposition Exhibit 1006, International Publication Number WO 2009/156499 A1, marked for identification, as of this date.)

MR. EVANS: Let's pull up Exhibit 106 and go to page 6.

BY MR. EVANS:

04:59PM Q. Let's look at this.

A. Sure.

Q. Or 1006, I should say.

(Document review.)

MR. EVANS: Let's go to 6,

05:00PM Andrew. Let's start at page 6.

BY MR. EVANS:

Q. All right. So right under line 5 there, that is a quaternion formula, right?

A. Correct.

05:00PM Q. And that is the state model, right?

A. That's correct.

Q. Okay. And then it says the measurement vector comprises at least the

05:00PM outputs of a second sensor, Ax, Ay, Az?

A. That's what it says.
Q. But it doesn't give you any type of quaternion formula for the measurement vector, right?
05:00PM A. Quaternion formula based on the measurement vector is based on equation that you have looked at a number of times, equation 25.
Q. You want to look at equation 25 on page 20.
05:01PM MR. EVANS: Can we go to page 20, Andrew?
BY MR. EVANS:
Q. So you're saying equation 25 is the measurement vector?
05:01PM A. No. Equation 25 is a quaternion form which shows how you can take angles and change that to quaternion form.
Q. Okay. And that's talking about the state vector?
05:01PM MR. LAURENZI: Objection. Form.
A. That is a general conversion from Euler angles to quaternion forms.
Q. This says the state vector is chosen X equals Q0, Q1, Q2, Q3, right?
05:02PM

A. Where are you reading from?
Q. Right below equation 25, at the very bottom where we're cutting off the screen on the page there. Around line 20.
05:02PM A. Oh, no, the state model, it is saying, go further down, it's differential equation, Q. which is half of Q0, Q1, Q2, Q3 quaternion multiplication by 0Wx, Wy, Wz. That's the state model.
05:02PM Q. That state model is determining the orientation based on those angular velocities, Wx, Wy, Wz, right, or updating?
A. That state model is what the state is, based on quaternion.
05:03PM Q. But that's not a measurement model?
Let's go to the next page to see what it tells us about the measurement model.
05:03PM So at the top of 21 it says, the measurement model is Y equals Ax, Ay, Az.
Do you see that?
A. That's correct, yes.
Q. And that's just the accelerometer
05:03PM outputs, right?

A. That's what the measurement of accelerometer is.

Q. That's not in quaternions?

A. Oh, that example of acceleration is whatever you get from the acceleration. It could be in quaternion or it could be in Euler, as Bassompiere explicitly tells you.

Q. So in this first variant, though, Bassompiere doesn't make a comment on whether that measurement model is in Euler angles or quaternions?

A. In fact, more specifically, Bassompiere tells you that for any of these, you can use either Euler angles or quaternions.

Q. Right below that measurement model it says, "The angular velocities Wv and Ww are then obtained through the equation 27," right?

A. Sorry, let me go back. Which page are we on?

Q. Looking at equation 27 at the top of page 21 of Exhibit 1006 by Bassompiere.

A. Okay. Please proceed.

Q. That equation 27 is not a

measurement model?

A. That equation is the angular velocity model based on quaternion in the user frame as it's converted from the 3D pointing device frame.

Q. So that's not the predicted axial acceleration?

A. That's not, no.

Q. In fact, on 2021, I don't see any quaternion-based calculations for a predicted axial acceleration, do you?

A. Yes. So if you look at, for example, page 19, equation 23, YK-hat bar is the predicted axial acceleration.

And through the common gain, you transform that into an Euler angle and Bassompiere tells you you can do the exact same thing in quaternion form.

Q. Does he give you any formulas for doing that?

A. Yes.

Q. Where?

A. The formula is formula of equation 25 where I have provided the very specific example of rotation, of one

example of how you would actually go about doing it, trying to demonstrate how simple the conversion is.

Q. Is equation 25 just a general quaternion equation?

A. More than that. Of course, the left part of it is a general quaternion which has four dimensions. But it also says how you deal with the angle Alpha in axis of rotation.

And so if you recall in the example that I provided, that was one of my motivation, starting in paragraph 58, going all the way to paragraph 63, I'm showing how to use this equation to go from an angle to quaternion.

Q. Which part of equation 25 would you identify as the predicted axial acceleration of our patent?

A. I would take equation 323 where we have the predicted axial acceleration. These are all --

Q. Let's go to equation 23. Let's go look at that.

A. Yeah.

Q. Okay.

A. Okay. So that equation is the state XK-hat which has angles Theta and Psi. You can see that, for example in equation 21.

Then As are the measured acceleration. YK-hat bar, is the predicted axial acceleration, as Bassompiere teaches.

Q. From equation 22, right?

A. For example, using equation 22.

So now everything in equation 23, the three terms that you have, the one to the left of equal sign, the one immediately to the right of it, and everything else are going to be in Euler formulation. You take these Euler formulation and plug it into equation 25. You will get the quaternion formulation of equation 23, which, among other things, has the predicted axial acceleration.

Q. But, again, that's something you had to do. It's not explicitly disclosed in Bassompiere?

A. Bassompiere explicitly says that on page 27. It says, you can choose from

the group of Euler angles and quaternion,
A. It also shows you the equation for doing that.
Furthermore, I showed you an example that it's really straightforward, just add multiplication to do exactly that.
Q. So Bassompiere knew that you could do his EKF either as Euler angles or quaternions, right?
05:09PM A. Correct. It teaches you that. Explicitly says so.
Q. But he chose to use Euler angle equations to disclose his EKF, right?
A. I disagree.
05:09PM Q. Where did he disclose his EKF in quaternion format?
A. By way of example, equation 26, he is showing the state.
Q. Let's go to 26.
05:09PM A. Yes.
Q. That's on page 20.
A. Correct.
Q. Okay.
A. He's talking --
05:10PM Q. The state model right there?

A. Exactly. So he's using the state model here, which is all -- which, again, is a differential equation, as it should be. And that is all in quaternion four. So Q dot, which is derivative of Q, is equal to half of Q0, Q1, Q2, Q3, which is again in quaternion four. And that symbol that you see with the circle and then X in it, that's quaternion multiplication.

05:10PM Q. Where is the predicted axial acceleration in that equation 26?

A. Sure.

So predicted axial acceleration -- so that is the state model. So the predicted axial acceleration comes from equation 23 and other places.

One example is equation 23. And you take that and apply the quaternion form equation 25 to it to get the predicted axial acceleration in quaternion form, in equation 23.

Q. So you have to derive it?

A. It's just plugging in, straightforward. If A equal to B, B equal to C, then A is equal to C.

Q. If this was a secret message, I would have to use my decoder ring to get to the ultimate message. It just doesn't say it plainly?

05:11PM A. This is read by one of ordinary skill in the art, so I disagree with your characterization as read by one of ordinary skill in the art.

MR. LAURENZI: Counsel, we have been going a while. Can we take a short break?

MR. EVANS: Yeah, let's take a short break.

MR. LAURENZI: Let's go off the

05:12PM record.

THE VIDEOGRAPHER: The time is 5:12 p.m. We are going off the record.

(Recess is taken.)

THE VIDEOGRAPHER: The time is

05:30PM 5:30 p.m. we are back on the record.

BY MR. EVANS:

Q. Let's go to equation 23 of Bassompiere, I think it's on page 19.

A. Yes.

05:30PM Q. Equation 22 is what I want to

look at.

A. Okay.

Q. Why did you identify equation 22 as the predicted axial acceleration?

05:31PM A. Because Bassompiere states on page 19 that in order to get a priori estimation of the measurement, you look at the last column of equation 17, the rotation matrix involving Theta and Psi.

05:31PM So Bassompiere explicitly says that.

Q. Why is that the predicted axial acceleration?

A. Because you are looking at the

05:32PM rotation matrix, multiplied by the vector 001. And again, because Bassompiere specifically says that's the priori estimation of the measurement.

Q. What were you looking for when

05:32PM you were looking for predicted axial acceleration? What is the indicator to you that something would meet that claim limitation?

A. A number of places. One example

05:32PM is, when you look at the correction of the

priori estimate state, for example, equation 23, you see the acceleration is subtracted. You have Ax, y, z, you subtract from that YK-hat bar, which is
05:32PM exactly equation 22. And that's the state model XK-hat. You multiply that -- you equate that to XK-hat from previously minus, and you take the difference between measured and to the axial acceleration and
05:33PM multiply that by the Kalman gain.

Q. But why are you focusing on Y-hat K-bar or equation 22 as a predicted axial acceleration? What features does it have that makes it a predicted axial
05:33PM acceleration?

A. Because that's precisely what Bassompiere teaches, and it shows, you subtract that from a real measurement. First of all, then you subtract something
05:33PM from real measurement, it means it's got to be of the same nature of the real measurement. That's one thing.

And you see that in equation 23 and other equations that I have quoted.

05:34PM Q. Quote one of the '687 patent for

example says, "Converting variables of the current quaternion into predicted axial accelerations corresponding to time T," about these formulas meets any aspect of that?

A. Sorry, I missed you completely. Where are you reading from?

Q. So claim 1 of the '687 patent says, "Converting variables of the current quaternion into predicted axial accelerations corresponding to time T."

So why do you think equation 22 meets that limitation?

A. So I'm looking -- which -- I'm looking at '846, claim 1, would that work? Or is that what you're looking at?

Q. I was looking at the '687, but I think it's in there, too.

A. Yes, because that's the one I have in front of me.

So, yeah, it's looking at quaternion and the predicted axial acceleration. Without using the measured axial acceleration, we see that the prediction here, YK-hat bar, is not using

the axial acceleration value. It's using the rotation.

And as I've shown and discussed on page 71 of my report, Bassompiere specifically says that is the a priori estimation of the measurement. What measurement is it? This is acceleration measurement that it's looking at.

Why is it acceleration? Because it's subtracting that from an actual measured acceleration. It doesn't make sense to subtract some other phenomenon of some other measurement from acceleration values.

05:35PM Q. Where is the quaternion that we're using to calculate that predicted axial acceleration in these formulas?

A. So by way of example when we look at page 27 of Bassompiere, it says for any of these you can use Euler angles or quaternion.

Furthermore, it shows you specifically how to do that, how to go from Euler to quaternion, for example, by way of equation 25. And in my declaration, I

provide an example of doing that, although the general equation is on page -- equation 25 of Bassompiere.

Q. Sure.

05:36PM And I want to go back to the '687 patent claim 1 because reads a little bit, I think, more understandably. It requires you to convert variables of the current quaternion into predicted axial

05:37PM accelerations corresponding to time T.

How does equation 22 do that? Where is that disclosed in equation 22? Where is there a quaternion being converted into a predicted axial acceleration?

05:37PM A. When you translate everything into quaternion form.

Q. So it's not -- the way it's written here, it doesn't meet that limitation?

05:37PM A. Yes, it does.

Q. Does the quaternion that's being converted into predicted axial accelerations in equation 22 as it's written in Bassompiere?

05:37PM (Document review.)

A. If we look at paragraph 53 of my report where I've shown how the state involving --

Q. I just want to see where it says it in Bassompiere, not in your report.

Like why did you focus on equation 22 when the patent requires predicted axial accelerations to be calculated from variables of the current quaternion? What about that would make you focus on equation 22?

A. Because equation 22, either in Euler form or in terms of the claim requirement in quaternion form, will give you a measurement which is A, an estimate, as you can see from equation 22. And that is subtracted from the actual measurement, so you know YK-hat bar is the predicted axial acceleration.

Q. You said Euler angle equations from the provisional applications are not sufficient to support our quaternion based claims. But now you're saying that even though our claim requires you to convert variables from a quaternion, explicitly

into predicted axial acceleration, now it's your opinion that this Euler angle based formula from Bassompiere somehow meets that limitation or discloses it just because you know a bunch of stuff as a person of ordinary skill in the art?

MR. LAURENZI: Objection. Form.

A. For that, let's go to the provisional, page 58 of my report to see exactly what I said.

Q. I don't want to do that.

I just want to know why here, using Euler angles, will anticipate a predicted axial acceleration that must be calculated from a quaternion whereas you said the provisional application, which discloses information in Euler angles cannot support -- is not written support for quaternion based claims?

How do you resolve that conflict?

MR. LAURENZI: Objection. Form.

A. The way you resolve that conflict is instead of changing my word, you focus on my word. My word says in relation to '558, that the provisional '558

applications makes no mention of and presents no equation using quaternion. That's what I'm saying.

Q. Right.

05:40PM But all the things that Bassompiere says about quaternion, you said you would have inherently known. So you had that knowledge when you read that application.

05:40PM So why can't you come to the same result there as you do here?

MR. LAURENZI: Objection. Form.

A. In '558 you mean?

Q. Um-hmm.

05:40PM A. I haven't come up with any result one way or the other. I'm stating a fact that provisional '558 applications makes no mention of and presents no equation using quaternion. That's a fact.

05:41PM Q. Equation 22 or equation 23 --

(Simultaneous crosstalk.)

A. I've been saying that to Mr. Evans, but it doesn't work.

So all I'm saying is that

05:41PM Bassompiere explicitly shows how to work

with quaternion and shows equation for that. '558 doesn't. That's all I'm saying.

Q. But you knew the equation that Bassompiere contains, right? You knew that inherently.

A. Some of the equation in Bassompiere was known, yes.

Q. So you didn't need them to be disclosed in the provisional to know those equations, right?

A. I didn't say if I needed them or not. All I'm saying is that provisional '558 application makes no mention of and presents no equations using quaternion. That's all.

Q. But all the reasons that you would want to switch the Euler angles in Bassompiere to quaternions would apply equally to that provisional application?

A. It may. I'm not making any comment about that. All I'm saying, in paragraph 95 is that the provisional '558 applications makes no mention of and presents no equation using quaternions.

That's all I'm saying here.

Q. It's interesting how you can say that so definitely about that application.

But when I ask you where is the quaternion in equation 22, you can't simply say there isn't one.

You point me to all the other pages in Bassompiere that you say inherently disclose how to derive it.

I think it's very interesting that you can so very casually, you know, comment on the provisional application and say "no, there's no quaternions in there" and "I can never get to them," but when you go to Bassompiere, every Euler angle, Euler angle formula is automatically a quaternion formula.

Is that your testimony here today?

MR. LAURENZI: Objection. Form. Objection. Colloquy.

A. Mr. Evans, please do not change my word. That's not appropriate. I never said with '558 you will never get there.

Do you see those words in my

declaration? No.

All I'm saying is -- all I'm saying is that the provisional '558 application makes no mention of and presents no equation using quaternions. That's all I'm saying. I'm not saying --

Q. You're trying to leave an impression with the Board that nobody would convert them to quaternions so we can't get back to that provisional's filing date right? I mean, that's why you provided that testimony?

MR. LAURENZI: Objection. Form.

A. All I'm saying is that the provisional makes no mention of and presents no equations using quaternion. That's a fact. That's all I'm saying.

Q. So you can -- so you could convert the provisional application into quaternion based formulas, right?

A. That's not some -- some Euler angles in the provisional can certainly be converted to quaternion. I haven't considered everything that is in the provisional. I'm not saying if you could

or could not. I'm not making any statement about that in paragraph 95.

All I'm saying is that the provisional makes no mention of and presents no equations using quaternion. That's a fact. You can read every line, every page of the provisional, and you will see the statement I made on page -- in paragraph 95. It's accurate.

05:44PM Q. But since you repeatedly testified that Euler angles and quaternions are equivalent, the disclosure of one is effectively the disclosure of both, right?

A. Generally, it depends. I cannot say in every aspect, every possibility. Certainly in Bassompiere, where A, he specifically talks about quaternion. He shows how to go from Euler to quaternion. That's a fact.

Some other patents, some other publication, when they talk about Euler angle, in general, you could transform that to quaternion.

Q. So all the provisional application would need to support the

current claims would be some statement that, like in Bassompiere, that you could convert Euler angles into quaternions?

MR. LAURENZI: Objection. Form.

05:45PM A. That's not an analysis I have performed.

All I'm saying, factual, there is no mention of and there is no equation using quaternion in '558.

05:46PM Q. Okay.

A. I'm not saying --

Q. Factuals: In Bassompiere, page 19, there's no mention of quaternions, factual?

05:46PM A. On page 19, you don't see the word quaternion.

Q. On page 18 of Bassompiere, there's no mention of the word quaternion?

A. The word "quaternion" is not, but

05:46PM page 27 makes it clear that you can convert all of these quaternion. It gives you a specific equation for doing it, and I've provided you examples for doing it.

MR. LAURENZI: Can I ask the

05:46PM videographer, please, for the time

check?
BY MR. EVANS:
Q. So the explicit --
MR. LAURENZI: Counsel, please, I think we're at the time. I'm just asking the videographer for a time check.
MR. EVANS: I want this time back, then.
05:46PM THE VIDEOGRAPHER: Seven hours.
MR. LAURENZI: We are at seven hours.
MR. EVANS: I still have 15 seconds because you wasted my last 15 seconds there. I have 7:46 when you interrupted me.
MR. LAURENZI: All right. 15 seconds.
BY MR. EVANS:
05:47PM Q. So your testimony is that anywhere in Bassompiere that discloses Euler angle based equations could be equally considered to be a quaternion disclosure?
MR. LAURENZI: Objection. Form.

A. In the context of Bassompiere and the state equation that he provides, those based on what Bassompiere explicitly says, can be done in quaternion. It provides equation for doing that.

I showed you examples of doing that, doing simple add and multiplies.

MR. LAURENZI: I think we're finished.

Can we go off the record?

MR. EVANS: Are you going to do a redirect?

MR. LAURENZI: I'm thinking about it. Can we go off the record? Give me five minutes.

MR. EVANS: Yes, that fine.

THE VIDEOGRAPHER: The time is 5:48 p.m. We are off the record.

(Recess is taken.)

THE VIDEOGRAPHER: I'm sorry. The time is 5:50 p.m. We are back on the record.

MR. LAURENZI: I have no questions.

THE VIDEOGRAPHER: Mr. Evans,

would you like your video synced to the transcript?

MR. EVANS: Andrew will decide.

MR. HUFFSTETLER: No.

05:50PM THE VIDEOGRAPHER: Mr. Laurenzi, would you like a copy of the video?

MR. LAURENZI: Yes.

THE VIDEOGRAPHER: Synced?

MR. LAURENZI: Yes.

05:50PM THE VIDEOGRAPHER: Okay.

Madam Court Reporter, anything else?

MR. LAURENZI: Let me take that back. I don't need that video.

05:51PM THE VIDEOGRAPHER: You don't need the video at all?

MR. LAURENZI: That's right.

THE REPORTER: Does anyone need a rough?

05:51PM MR. EVANS: Yeah, we'll take a rough.

MR. LAURENZI: No.

MR. EVANS: We may want a rush on it. We'll probably email you.

05:51PM THE VIDEOGRAPHER: This ends

volume one of the video deposition of the Dr. Majid Sarrafzadeh.

The time is 5:51 p.m. We are off the record.

05:52PM (Time noted: 5:51 p.m.)

* CERTIFICATE OF REPORTER *

I, ANNETTE ARLEQUIN, CA CSR, CCR, do hereby declare:

That prior to being examined, the witness named in the foregoing deposition was by me duly sworn pursuant to Section 30(f)(1) of the Federal Rules of Civil Procedure and the deposition is a true record of the testimony given by the witness.

That said deposition was taken down by me in shorthand at the time and place therein named and thereafter reduced to text under my direction.

_____ That the witness requested to review the transcript and make any changes to the transcript as a result of that review pursuant to Section 30(e) of the Federal Rules of Civil Procedure.

_____ Signature is waived.

_____ The changes made by the witness are appended to the transcript.

_____ No request was made that the transcript be reviewed pursuant to Section 30(e) of the Federal Rules of Civil Procedure.

I further declare that I have no interest in the event or the action.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Witness my hand this 4th day of March 2026.

Annette Arlequin

ANNETTE ARLEQUIN, CA CSR #15085

* CHANGES AND SIGNATURE *

Page No.____ Line No. _____
Change to:_____
Reason for
change:_____

Page No.____ Line No. _____
Change to:_____
Reason for
change:_____

Page No.____ Line No. _____
Change to:_____
Reason for
change:_____

Page No.____ Line No. _____
Change to:_____
Reason for
change:_____

Page No.____ Line No. _____
Change to:_____
Reason for
change:_____

* * CHANGES AND SIGNATURE (Cont'd.) * *

Page No.____ Line No. _____

Change to:_____

Reason for

change:_____

Page No.____ Line No. _____

Change to:_____

Reason for

change:_____

Page No.____ Line No. _____

Change to:_____

Reason for

change:_____

Page No.____ Line No. _____

Change to:_____

Reason for

change:_____

Executed this_____ day of _____, _____.

SIGNATURE:_____DATE:_____

DR. MAJID SARRAFZADEH

ACKNOWLEDGEMENT OF DEPONENT

I, _____, do hereby acknowledge that I have read and examined the foregoing testimony, and the same is a true, correct and accurate transcription of the testimony given by me, and any corrections appear on the attached errata sheet signed by me.

_____ _____

(DATE) (SIGNATURE)

Exhibits

Exhibit 1001 6:7 204:15 308:20,21 312:2

Exhibit 1002 5:18 11:18,22 99:8 226:5 243:15 259:8

Exhibit 1006 6:11 315:3 318:23

Exhibit 1021 6:3 147:8,9

Exhibit 2026 5:23 113:2,3,21

Exhibit 2032 6:9 205:7,12 207:4

Exhibit 2033 6:5 161:7,8 208:3

Exhibit PAPER014 5:21 74:1

$

$700 22:11

0

0 286:20,25 287:8 311:10

001 91:8 99:20 102:23 105:1 111:12 112:3 325:16

00G2 311:4

01258 161:14

02B 309:25

0wx 317:8

1

1 17:5 28:14 31:10 32:2 34:25 35:3,9,13,15 36:3,8,14 37:21 38:21, 23 39:2,12 52:25 53:22 54:2,4 55:25 57:10 66:22 98:20 102:24,25 158:14 159:4,5,13 175:1 204:14 260:17 272:15 298:3 327:8,15 329:6

1,052,846 15:12

10 289:17

10,852,846 204:16

100 94:14 150:14 164:24

100,000 23:3,7

1001 68:20 204:15 308:21 312:2

1002 11:18,22 99:8 226:5 243:15 259:8

1006 315:3,12 318:23

1009 42:16

1011 42:5 206:20 207:16 217:22

1012 42:5 206:20 207:16 217:22

1013 42:6 206:20 207:17 217:22

1021 147:8,9

103 84:13

106 315:8

107 309:1

1071 12:17

10:14 63:2

10:25 63:6

11 24:20 25:18 27:9,11 47:8,17 102:13 230:21

11,698,687 11:25 13:22 16:22

11:28 113:14

11:39 113:18

11th 69:18

12 271:22 272:5,12,13, 16

12-month 24:2

12:30 156:23

13 38:12 312:24

14 73:24 95:19 261:8 262:22 263:20 265:8 266:5 283:6 284:23

15 54:25 148:1 338:13, 15,18

150 255:7 292:13

150-plus 303:2,15

16 106:22

1600 255:9

164 122:12 126:4

165 122:1 124:21 125:14 126:5

17 28:13 54:25 69:15 73:4,20 206:24 207:24 209:1 217:13 218:15 219:24 230:18 231:18 273:7,8 289:17 325:8

18 68:21 224:13,17,23 272:21 273:5,7,8 274:18 289:17 337:17

1850 255:5 292:13 303:1,4 305:22 306:13

1860 255:5

19 54:24 56:24 57:18 58:20 62:12 86:23 107:20 269:9 307:25 319:13 324:23 325:6 337:13,15

1980 235:1

199 136:19 137:5 138:6 140:25 141:11

19th 114:1

1:00 157:2,5

1E 57:10 58:10 86:2

2

2 17:5 31:14 32:2 33:8, 24 34:18 36:4 37:21 39:2,6,12 78:7 87:24 100:23 101:9,15 268:24 272:15 281:20 282:3 289:8 304:4 310:10 312:23

20 11:7 79:19 89:13 95:19 134:23 139:21 140:2,12,22 142:9,12 265:14 266:6 285:3,10 286:1 288:10 289:16,23 290:4,6,7 298:16,19 316:10,11 317:4 322:21

2007 223:7

2008 223:7

2009 69:19 121:4,5 221:4,15 222:7 229:10, 17 230:22 231:23 245:16,24 285:25

2009-2010 246:7

2009/156499 315:5

2010 69:18,19 121:4 221:4,15 222:8 230:21, 22

2017 42:12

2018 41:12 42:12 114:1 147:17 205:14 217:15

2018-01257 161:14

2019 41:12

2021 319:9

2024 20:22

2025 20:22

2025-01023 13:15

2025-01071 7:16 13:13,23

2026 7:8 113:2,3,21

2032 205:7,12 207:4 208:7

2033 161:7,8 208:3

21 91:25 130:10 261:25 266:18 269:8 295:12 317:20 318:23 321:5

22 55:4,6 56:23 63:10, 14,15 64:10 91:12,14, 15 92:19 93:7 95:14 99:11,12 100:7 104:23 107:19,25 109:15 111:15 154:23 208:2,16 218:9 269:8,10,22 307:23,24 321:9,10 324:25 325:3 326:5,12 327:12 329:11,12,23

330:7,11,12,16 332:20 334:5

23 86:23 92:3 109:22 205:23 206:2 207:1,4 261:25 266:19 298:11, 15,18 319:13 320:23 321:11,18 323:16,17,21 324:22 326:2,23 332:20

24/7 253:13

25 226:6 227:15,16 228:5 230:12 266:8,23 267:1,3 268:10,14 288:1,9 293:9 295:8 297:6 316:8,9,14,16 317:2 319:24 320:4,17 321:17 323:19 328:25 329:3

26 163:21 293:9 295:1, 3 298:20,21 299:1,2,4, 25 301:9 322:17,19 323:11

27 237:16 238:22 239:10 241:17,19,20 242:7,12 261:8 262:8, 21 263:19 265:7 266:5 283:4,6 284:23 298:12 318:19,22,25 321:25 328:19 337:20

27th 7:8

28 54:25

29 86:25

2:00 205:1

2:06 205:5

2I 268:24

3

3 17:6 107:24 304:3

3-axis 28:11

30 108:7 235:14 258:5, 7

31 26:17 53:1 164:2,4, 17 176:18,22 178:4

32 176:19,22

323 320:20

33 267:19

34 53:2 166:2 176:15, 22 199:5 293:6

35 53:2 69:6 167:9 173:17 175:12 222:12 224:9 268:22 277:15

35(a) 173:11 199:5

350K 24:3

35A 167:9

38 297:15

39 18:9,14,20 19:1,2 66:9 67:14 68:3

3:14 258:13

3:47 259:5

3D 24:13,15 26:4,9,19 27:19 28:2,12,17 29:2 31:1,22 32:7,24 34:10 35:21 36:17,22 37:8 38:17,22 39:10,15,21, 23 40:2,9,14,21,23 59:15 60:22,25 61:2 66:25 91:20 100:4 101:13 105:25 106:3 107:9 111:7 121:22 139:13 169:15 170:15, 17 173:7 186:4,7,12 187:1 219:16 220:12 221:5 250:7 296:1,3,7, 12,17 319:4

4

4 28:15 42:1,13 54:24 58:19,20 62:12 73:25 76:13 86:24,25 106:21 134:14 281:21 282:3 312:23

40 19:17 24:11 47:18 65:6,25 66:9 67:15 68:4 253:14

40-page 182:11

41 24:21 25:19 27:9,11 28:7 47:9

43 270:22 274:3 305:15 307:17 308:23

438 43:15,25 44:10,12 118:8,20 148:10 229:8

45 26:17 310:2

45-page 117:6,12 118:5 124:25 126:25

46 308:19 312:4,24

46-page 126:10

49 28:14

5

5 9:19 25:22,23 26:5 27:14,18,24 28:9,13,25 29:1 36:4,7,11,21 39:2, 13 47:9 54:24 61:18 86:24 315:17

50 135:1

500 26:1,6,18 27:14

51 269:1,16

52 162:3 165:1,18,25

53 172:3,7 259:9,10,11 260:6 261:4,6,15 265:25 330:1

544 47:11

55 261:21 262:11

558 244:6,12,22 247:8, 12,14,22 248:1,8,16,17, 21 249:2,9,12 331:25 332:13,17 333:2,14,23 334:24 335:3 337:9

56 27:21

560 27:15,19,24 36:21

57 239:23 244:2 266:15,20

570 27:15,25 36:21

58 242:24 266:25 285:15 286:15,17 287:11 288:15 320:13 331:9

59 240:14 268:16

5:12 324:17

5:30 324:20

5:48 339:18

5:50 339:21

5:51 341:3,5

6

6 9:19 38:4,14 39:24 86:24 166:4 167:10 283:24 314:24 315:8, 14,15

600 135:24

61 287:22

62 291:6 292:7

63 33:24 268:17 285:15 287:11 293:14 294:9 320:14

64 288:15

65 28:14

66 295:10 296:9

67 297:16

687 12:17 13:4,14 14:9 15:10 16:24 43:18 63:9, 14,15 118:21 123:24 207:24 326:25 327:8,17 329:5

69 299:8 300:2

6:15 258:9

7

7 66:22 79:20,21 158:9, 16,25 159:3,6,7,23 160:3 178:2 309:2

70 85:18 114:22

71 83:16 84:8 85:18 328:4

72 85:18 99:9 104:12 115:22 116:20,22 117:5 269:19,20 304:21,23

73 85:19 118:7 122:3 158:16,25 159:14 160:11 269:20,24 270:3,20 279:24 305:15 308:5,16

74 281:16

75 121:9 309:10 310:2

7:46 338:15

8

8 86:23 288:12 289:7 292:10

8,441,438 42:15

8,462,109 16:16

8,552,978 43:1

83 177:17

843 274:21

846 12:5 13:5,15 14:9 15:4,13 18:10 24:20,23 25:7 27:21 28:10 34:15, 25 37:18 38:14 39:1,25 42:2 43:18 57:11 59:8, 24 61:18 63:10 69:17 108:24 119:4 123:1,24 127:12,22,24 134:10, 11,14,17 140:12 142:16,18 143:6 146:3 157:17 158:10 169:17 170:14 204:13 215:23 216:6 218:24 228:3 230:20,23 243:21 244:14 252:18 281:21 282:3 312:14 327:15

86 190:9 192:10 194:23

87 243:14

88 183:19

8:57 7:9

9

9 28:13 86:23

94 243:22

95 244:5 249:1,5 333:23 336:2,9

97 84:13

978 43:15,25 44:10,12 229:8

9th 147:17

A

a.m. 7:9 63:2,6 113:14, 18

A1 315:5

ability 273:16

absolutely 89:6 97:17 111:4 140:23 179:24 194:17

abstract 220:1

acceleration 45:17, 22,25 46:1,2,4,5,7,14, 19,22,24,25 47:15,23 48:3,4 53:16 54:19,21 55:2,8,10,15,17 57:2,7 58:3,7,12 74:12 75:16 76:6,7,22,23,25 77:6, 10,13,16 78:2,14 79:3, 4,6,7,9,16,17 80:8 81:9, 10 82:17,20 83:2,14 84:1,16,18,20 85:6,7,8, 15 87:2,5,7 89:18,20 90:7,11,13,14,16,17,19, 22 91:1,4,13,16,18,22, 24 92:4,9,22 93:6,9 95:13 100:5 104:5,6,11, 13 107:17 109:14,18 110:9 111:14 115:19, 24,25 116:1,2,13,14,15 117:17,20 119:5,25 120:8,9,23 121:2,6,21 122:10 123:12 124:17, 18 125:19,20,23 126:19 139:5 148:20 149:4,16, 17 150:6 152:13,14,22, 23 153:20,22 154:3,5,7, 8,19 155:2,5,9,12,16, 21,23 156:10 157:18, 23,24 158:6,11,13,17 159:1,15 160:4,13 167:3 174:24 184:14,16 185:2 190:12,16 192:13 197:12 269:3,6,12 281:20 305:1,5 310:15, 25 311:2 312:6 313:4 318:4,5 319:7,11,14 320:19,21 321:7,8,20 323:11,13,15,20 325:4, 13,21 326:2,9,13,15 327:23,24 328:1,7,9,11, 13,17 329:14 330:19 331:1,14

acceleration.' 74:16 75:11

accelerations 45:15 46:9,16 47:2,21, 25 48:1 52:17,22,23 53:9,10 54:10 76:2,11 78:16 80:7 81:13 82:16 83:1 84:3 87:6,10 89:17 94:3 99:22 114:25 115:15 116:9 118:10, 11,12,24,25 119:1,21 120:18 121:10,11,16 122:16,18 123:11,13,14 124:1,2,3,4,9,14 125:6, 16,18 136:24,25 137:2 138:22 139:1 141:3,4,6 148:2,19 150:4 155:4, 20 156:4 158:24 190:11,16 192:5,16,19 193:2 202:7,25 281:18 309:12 312:17 327:3,11 329:10,23 330:8

accelerator 120:13

accelerometer 31:14 47:11,14,16 48:10,24 49:8,12,23 50:7,14,16,21,24 51:2 52:4,7,12,14,21 87:8 115:23 117:15,19 119:5,6,7,17,18 120:13, 18,22 121:23 139:16 140:15 152:25 164:3,18 165:22,24 166:2 170:5 172:16 176:13 183:25 184:12,15,24 185:1,23 186:24 194:9 196:11,13 197:14 223:19 269:13 317:24 318:2

accelerometers 44:3 46:23 48:18 49:2, 15,21 50:2 110:21 167:3 176:18 185:9 213:10 223:12

accept 138:12

acceptable 73:1

accidentally 60:6

accuracy 199:25

accurate 19:12 40:17,18 45:8 54:16 75:12,18 109:5 110:13 116:5 117:25 118:2,6, 17 123:18 140:13,23 153:23 154:10 179:17, 21,23,24 180:17,18 186:23 194:10 195:8 211:2 244:10 336:9

accurately 219:14 277:20

accusing 97:12,20

acted 50:21,23

acting 48:12 50:17 139:18

action 7:5

actual 109:17 110:17 111:12 172:16 284:6 291:3 296:5 303:9 328:10 330:17

add 209:5 217:18 234:22 243:1 249:15 265:3 294:7 307:10 310:3 322:6 339:7

added 208:10 209:14 231:14 265:1 290:8

adding 55:24

addition 28:9 263:11 266:13 268:19 302:4

additional 73:14 217:18 229:23 247:7 284:12

adjust 160:22

administered 8:17

admit 132:7

admitted 132:6

adopted 218:14,15 230:14

adopting 218:17

advanced 215:24

advantageous 255:17

advantageously 106:5

adversarial 29:19

advised 303:23

agree 16:11 20:11 26:10 29:12,21 30:13

32:25 59:6 64:18,22,25 65:14 74:20 75:4 76:12 77:11 78:21 81:18 94:6, 14 97:15 115:3,11 117:2 122:23 125:22 126:17 127:25 137:9 139:15 148:24 149:22 150:24 152:7,10,15,21 154:2,23 155:5 163:19 178:18 184:8,9 195:21 206:16 218:20 233:10 271:16 274:8 275:19,25 313:23

agreed 69:1 149:9 153:21 158:21 159:10 217:25

agreement 96:23

ahead 35:12,25 165:14 172:10

aim 276:7

air 191:22

algebra 299:13 303:16 304:15

algorithm 16:2 120:21 121:7 162:5,10 163:4,21 210:10 216:23 223:22

algorithms 141:21 209:20 210:15,22,23,24 211:24 213:16 214:1,21 215:15 223:16 235:23 236:2

aligned 250:22

alike 209:12

alleged 18:25 19:9 65:5,22 66:21 70:15 130:13,25 217:5 252:17

allowed 275:14

allowing 71:23

Alpha 288:12 320:9

alternative 263:21

amazing 25:4

ambiguities 122:10

ambiguity 124:20

ambiguous 169:7 170:12 216:14

analogous 134:18

analysis 32:1 34:13, 23 43:21 44:23 45:7,8, 12 54:6,7 55:19 85:24 95:16 115:20 125:14 126:23 127:23 138:19 139:10 142:4,7 143:9 146:4 147:2 171:13 174:14 176:2 187:21,23 189:17,18,20 198:22 199:24 248:6,7,18 254:13 337:5

analytics 225:25 226:7,11

analyze 82:9 92:16 93:4 124:7 141:10 144:4 145:13 146:21,23 150:10 168:14 183:5 187:10 189:15 254:3

analyzed 31:5 32:14 33:22 43:12 45:4 75:15 92:17 139:4 145:5 146:3 148:13 154:1 171:8 173:6 247:12 281:14

analyzing 77:2 126:11

and/or 76:1 149:15 152:24 154:12

Andrew 8:5 11:19 12:15 34:24 41:2 73:22 78:9 80:2 207:19 227:16 252:9 315:15 316:12 340:3

angle 55:25 103:9,12 106:8 107:1 109:9 154:21 219:15 233:3,4, 13 237:21,22 238:7,23 239:5,6,17,18 240:5,6, 8,9,10,19,20 241:7,21 242:17 245:8 246:10 247:8 248:17,22 249:13 252:1 254:12 261:7,9 267:5 268:13 271:19,25 273:11 274:12 282:18 285:5,6,7,17 286:20,21, 25 287:1,10,24 291:1, 22 292:12 296:21 319:16 320:9,16 322:12 330:20 331:2 334:15,16 336:22 338:22

angles 58:19 105:20, 22,25 106:15 107:5,10 108:4 109:2,3,6,8 139:13 160:24 161:5 162:17 233:22 234:19 237:11 239:13 240:24 241:4 242:10,13 245:3, 19 250:25 254:7,15 255:13,18 256:18 257:3,8,18 261:5 262:4, 10,16,21 263:5,17 264:14 265:10,24 266:21 272:9,12,14 273:10 283:5 284:25 285:16 286:10 287:5,13 295:5 298:14 314:7,25 316:17,23 318:11,14 321:3 322:1,8 328:20 331:13,17 333:18 335:22 336:11 337:3

angular 53:6 55:12 56:5 109:10 157:20 295:6,15 297:21 299:6 315:1 317:11 318:17 319:2

Annette 8:14

annual 22:17 23:24

answering 71:20 200:18

answers 72:4 73:1 275:5 277:4,8 307:4

Anthony 16:4

anticipate 331:13

anymore 200:17

apologize 9:6 212:3 243:11

apparently 153:14

appearance 31:10

appears 53:2 82:21 89:21

application 49:24 88:9 155:17 192:20,23 232:2,7,13 244:7 245:21 246:1 248:1,2, 16 249:9 250:17 251:20 255:22 257:5 291:14,21 331:16 332:9 333:14,20 334:3,12 335:4,19 336:25

applications 228:14 229:9,14 230:6 231:22 233:18 234:9 247:8 330:21 332:1,17 333:24

applied 18:22 19:6 65:2,19 66:18 76:22 79:10,12 86:8 90:1 130:10,22 154:16 268:4 291:10 301:21 311:4

apply 37:12 41:6 44:14 77:1 100:2 125:8 130:7 135:14 155:19 156:7 256:22 273:5 297:5 309:25 323:18 333:19

applying 153:25 310:17

approach 135:5,8 202:5

approaches 177:15

approximately 9:16 24:3 27:21 244:1 298:2

approximation 50:19 52:6,11

area 252:17

areas 278:4 280:17

arguing 80:25 81:10 82:24

argument 81:14,17 82:1,20 89:21

arguments 134:16

Arlequin 8:14

arrive 282:20

arrows 176:21

art 18:24 19:8 27:18 45:19 65:4,21 66:8,20 69:17 70:15,25 73:6 78:5,13 115:10 116:19 122:14 123:10 124:13 125:3,4,12 126:6 127:16 130:13,25 136:21 145:13 182:12 189:16 205:25 206:5,22 207:6 208:1 209:1 213:12,18 215:1 216:1 217:5,24 218:3 219:4

230:3,20 231:3,9 237:20 239:4,16 242:20 249:17 270:4,10 274:13 276:18 279:15 282:12, 18,25 283:9,13 284:20 285:2,22 286:7,9 291:12 292:3,7,25 293:2 294:3,7,20 295:19 297:25 299:10, 21 305:13 307:14 309:8 311:17 312:9,18 313:14 314:3 324:6,8 331:6

article 136:11 203:17 302:16 303:3,13

articles 136:2 168:5 252:22,25 280:19 303:1,14 307:14

arts 134:8

ascertain 119:20

aspect 145:25 224:5, 6 263:4 327:4 336:15

assert 96:25 97:2

assume 10:10 150:16 174:4 175:23 178:16 194:18 300:6

assumed 286:19

assuming 9:10 213:19 216:19 248:17

assumption 183:12 286:25 287:2

assumptions 183:18 287:12

attention 23:9,19 24:6

attorney 7:20 29:13 96:6 145:23 146:18 275:10 277:24 278:9

attorney-client 131:21

attorneys 7:6,22 17:11,18 20:4,7,13 21:23 128:22 129:6,14, 16,24 130:16 144:8 146:13 279:2 280:20

authored 136:12

authors 16:4

automatically 334:16

average 253:14

avoid 37:5 201:25

avoidance 256:21

aware 42:22 222:23 226:13,19 303:10 314:20

Ax 47:13 87:1 91:24 92:4 269:14 315:25 317:21 326:3

axes 37:10 67:3 148:20 149:18 150:4 167:6 177:21 190:13 249:20

axial 45:14,17,22,24 46:1,4,5,9,14,16,18,22, 23,25 47:1 52:17,20 53:8,10,16 54:9,20 55:7,10,15,16 57:1,7 74:12 75:16 76:5,10,22, 25 77:6,15 78:1,14 79:4,9,16 80:7 81:9 82:16 83:1,14,25 85:8 89:16 90:7,12,15,16,18, 25 91:17 92:21 95:12 99:22 104:6 114:25 115:15 118:9,24 119:20,25 120:10 121:10 122:10,15,18 123:11 124:1,9,14,17 125:6,18,19,23 126:19 136:23,25 141:3,4 148:2,19 149:3 150:3,6 152:13,22 153:20 154:3,7,8,19 155:1,12, 16 156:4 157:18,22,24 158:5,11,13,17,24 159:1,15 160:4,12 202:7,25 269:3,5 304:25 310:15 311:1 319:6,11,14 320:18,21 321:8,19 323:10,13,15, 20 325:4,12,20 326:9, 12,14 327:2,10,22,24 328:1,17 329:9,14,22 330:8,19 331:1,14

axis 26:2 28:5 46:2 75:17 76:11,23 77:7,17 78:3 79:17 112:3 115:19 124:19 125:21 149:5 150:7 152:14 153:22 155:9 156:10 167:4 320:10

Ay 47:13 87:1 91:24 92:4 269:14 315:25 317:21

Az 47:13 87:1 91:25 92:4 269:14 315:25 317:21

B

B1 166:5 167:4

B2 15:12 16:16,22 166:5 167:4

B3 166:5 167:4

bachelor 221:20 222:1

Bachmann 161:24, 25 162:4,6 163:3,4,17 164:10,12,23 165:17 167:15 168:4,7 169:5 170:1 171:7,11,15,18, 20 173:3 174:11,12 177:11,16 178:2 179:1, 7,16 180:1,13,19 181:5, 13,22 183:9,22 184:5, 21 188:7,15,19 190:10, 13,21 192:8 193:1,4,8 194:1,3,5,11,13,25 195:6,22 196:2 197:9, 19 198:3,16,21 199:10, 12,15 200:24 201:16 202:8,10,14,18,25 204:1

Bachmann's 177:20

back 12:21 23:4,8 24:11 45:7 52:16 63:5 89:12 95:22 97:11 113:17 116:24 157:3 164:22 168:14 169:11 170:3 174:23 175:6 177:6,8,15 178:19 180:17 187:6,18 189:5 193:8 195:5 198:2 200:25 205:4 220:24 222:19 224:2,12,16,21 225:5 226:4 237:11,13 242:7 254:10 255:4,5,8 256:4 259:5 268:25 284:3 286:14 305:21 314:9 318:20 324:20 329:5 335:10 338:9 339:21 340:14

background 129:22 191:22 192:2 225:9 295:25

bad 164:15 253:19

baffling 200:4 307:6

ballpark 134:20

Bansal 8:10 18:7

bar 55:23 90:25 92:5 172:12 269:5 319:13 321:7 326:4 327:25 330:18

barely 162:1 163:23

base 296:21

based 22:2,4,21 53:7 54:21 55:13 56:1 57:7,9 58:13,14 85:16 86:12 94:15 99:25 126:4 136:23 137:1 141:2,5 143:9 151:14 152:17,21 153:8,24 154:9 157:21 158:11,17,19 159:1,15 160:2,5,13 161:1,5 174:5 178:15 179:2,8 197:5 200:10 217:12 230:4 234:21 235:18,23 256:20 259:17 261:10 265:4,19 270:19 282:19 286:10 287:18 295:14 299:5 301:22 303:9,11 316:5,6 317:11,14 319:3 330:22 331:2,19 335:20 338:22 339:3

basic 60:15 251:25 267:6,11,25 268:2 271:1 283:15 286:11 292:8,17 299:22 301:13,16 303:5,16 305:17 306:24 307:8 309:5 314:8,11

basically 20:17 109:24 237:18 249:15 272:1 286:7 312:14 313:18

basics 215:2

basis 22:7 136:8 229:19,22 231:20 242:5

284:17 293:8 296:12

Bassompiere 15:16,18 31:6 53:14,17 54:5,9,18,23 55:5,21 56:24 57:12,16,19 58:2, 15,18,21,24 59:9,12,14 60:13 62:3,9,11 77:3 81:7,15 82:18 83:14 84:18 85:10,12,20,22 86:20,22 87:13,17,22 88:25 89:7,19 90:8,24 91:5,6,14,18,23 92:8, 18,19 93:6 94:1 95:14 99:11,23 100:15,18,23 101:4 102:14,21 103:15 104:7 106:4,19,21 107:13,19 108:25 109:23 111:15,16,21,22 112:10,25 139:11 154:17,18,20 155:8,10, 18 156:6,9,13 160:24 161:2 162:9,12,15,21 163:3,8,18 164:2,4,6 202:8 216:5 234:5,20 241:2,8,16,24 242:6,11 245:11 246:22,24 247:20 248:2,3,16,18, 23,24 249:9,15 250:6, 11 256:1,13 259:18,21, 24 260:6,21 261:7,11, 17 262:1,7,20,24 263:18,19 264:10,17,25 265:2,4,5,11,19,23 266:1,5,19,24 267:10, 20,24 268:6 269:6,9 270:8,14,23 271:2,14, 18,21,23 272:19,25 273:5,12,20,23 274:8, 16,20 276:14,19 281:25 282:5,13,20,22 283:2,7, 19,24 284:23 285:3,9 286:3,22 287:1,13,15 288:6 289:1,3,9,11,13, 14,16 290:17,22 291:2, 16,17 292:1,2,15,23 293:3,6,9,10,15,21,24 294:9,18,22,25 295:13, 24,25 296:4,12,13,17, 19 297:1 298:8,11 299:3,14,19,22 300:7, 11,12,17,23,25 301:7, 10,11,18,21,23 304:24 305:5,12 306:12 307:23,25 308:17 311:20 312:4,7 313:22 314:2,6,10,13,17,21,25 318:7,9,13,23 319:17 321:8,23,24 322:7 324:23 325:5,10,16 326:17 328:4,19 329:3, 24 330:5 331:3 332:6, 25 333:5,8,19 334:8,15 336:16 337:2,12,17 338:21 339:1,3

Bassompiere's 62:6 80:6 234:21 245:12 259:16 260:3 300:3

begin 20:10 266:16

beginning 178:19 284:5

behalf 8:8 94:25 113:24 205:13

belief 68:15 229:25

believed 68:16 69:2

big 165:12 280:18

bigger 11:20

billing 21:4,6

binder 15:1,6,9 17:17, 21,24

bit 79:13 80:2 122:7 142:10 207:21 276:5 329:6

bite 277:13

Blender 120:21 191:5 192:1 232:19

blindly 174:18

board 63:21 64:12 144:8 146:6,10,13 206:21 207:15 218:2, 13,15,18,20 219:6 230:1 275:15 290:24 335:8

Board's 217:23 227:20 231:10,12,17

bodies 283:17

body 102:19 236:16 250:7

bottom 270:20 293:6 310:2 317:3

bought 220:18

box 158:16,25 159:14 160:11 164:2,4,17 166:2 173:11,17 176:15,17,19,21,22 198:21

boxes 165:22 167:9 312:25

break 11:8,13 56:16, 19 62:20,22 95:20 98:23 113:8 151:12 156:15 204:19,21 258:6 324:11,13

breaks 279:3,9

bridge 51:24

briefs 182:20

bring 79:12 146:25

bringing 306:7,19 307:11

broadly 235:18

brought 182:6 299:19

building 221:5

built 223:4 226:1 254:11

bunch 59:25 331:5

C

C0b 270:1 309:25

calculate 158:10,16, 25 159:14 160:4,12 267:22 268:14 291:8 328:16

calculated 55:4,24 159:24 330:9 331:15

calculating 158:12, 23 159:12 287:25

calculation 57:14 270:6 307:17

calculations 319:10

calculus 227:12,13 255:11

California 11:3

call 59:20 104:5 111:5 195:25 209:11 259:19 263:13

called 8:21 103:20 104:7 105:1 161:23 208:23

calling 105:4 185:24

calls 58:2 102:21 154:20 227:7

capable 121:3 219:13

capacitors 48:7

capital 36:14 56:2,3 58:14 100:15,19,24 101:12,14 103:1,3 104:14,16,17 105:6,8 107:3,7 112:11,13,16 299:7

car 110:2,8,16

care 258:1,2

career 141:13 142:15 235:10 254:5

careful 141:25 201:22

carefully 29:22 229:3 275:7

carrier 101:16,19 102:3,5,6,17,22

carrier's 101:23 102:1

carrying 102:11

case 7:12,15 9:24 13:11 20:15,16 22:7 39:5 41:4 42:18 44:16 45:1,13 52:19 74:8 88:2 101:10,20 111:25 113:25 114:4 115:21 121:12 127:5 128:19,24 130:1 134:4 136:7,14 139:22 147:14,22 154:1 168:22 182:23 188:25 190:6 200:14 215:3 262:17 268:4 279:8 303:24 306:22 307:5,15

case-by-case 136:7

cases 21:7 22:11 50:3 88:21 105:1 140:18 175:20 246:1,3
Casey 7:2
casually 334:11
caused 217:17
causing 87:9
caution 20:5 67:21 68:10 127:7 130:18 143:14,24
CBO 308:15
cellphone 39:23,24
centrifugal 76:1,8 78:15 79:5 93:15 94:3 115:25 118:11,25 123:13 124:3 149:15 152:24 154:12 155:3
certainty 178:24
cetera 17:6 85:19 212:21 302:6
challenged 281:21
chance 29:13 275:12
change 44:21 108:22 118:21 256:17 257:2 263:16 264:3 295:14 316:18 334:22
changed 198:11 217:14 231:7
changing 331:23
characterization 324:7
charging 21:18 22:6
charts 154:24
check 21:22 23:4,8 24:10 222:19 225:5 243:2 338:1,7
Chetan 8:10
children 276:21,23
chips 170:9
choice 287:16
choices 287:18 290:12,16
choose 24:13 112:18 168:5 321:25
choosing 201:11
chose 112:22 249:15 322:12
chosen 149:19 242:16 316:25
Christopher 7:21 8:1 9:2
chunks 277:13
circle 199:2 300:24 301:5 323:8
circumvent 235:19
citation 170:1 270:1
cite 27:5 305:24 309:1
cited 27:10
claim 19:10 32:2 34:25 35:3,8,13,15 37:5,21 38:21,23 44:13, 22 52:18,24,25 53:3,15, 22 54:2,4 57:10 58:10 63:22 64:12 65:14 67:15,19 68:4 74:8 86:1 95:16 129:25 130:2 147:9,13 153:24 204:14 244:14 260:2,5 325:22 327:8,15 329:6 330:13, 24
claims 61:1 63:23 64:13 66:22 81:15 127:17 149:25 150:15 155:13,18 156:6 157:17 244:8 306:11 330:23 331:19 337:1
clarification 10:16 24:16 94:11 120:25 122:4 138:3 166:22 289:21
clarifications 138:11
clarity 146:25 172:19
class 177:8 235:5 303:9,21
classes 176:24 233:17,21 234:9
classification 116:17
classifies 100:18
classify 116:12
classifying 46:13
clean 17:12 276:13
clear 23:5 26:22 67:15 120:2,14 123:6 145:9 147:3 148:19 155:11 158:15 160:25 216:21 241:18 261:2,8 293:7 337:20
close 225:17 252:17
closest 252:5,11
clue 175:25 179:14
CM 7:14 8:1 9:4
coauthor 136:5,13, 17
coauthors 136:1,3
code 68:21
collaborate 223:25
collaborating 270:11
collaboration 224:2
colleague 8:10
colleagues 8:5
collected 187:3
collection 234:3
colloquy 30:1 70:12 146:16 183:4 276:9 334:21
column 24:20 25:18 27:9,11 28:13 38:12 47:8,17 53:1 57:18 107:25 108:2 307:19 325:8
combination 34:21 36:20 37:2 76:3,9 78:17 123:14 124:4 214:16 235:6
combinations 118:13 119:2
combine 223:18,19 253:7
combined 166:3 291:9
comfortable 142:21,22
comma 212:16
comment 75:2,23 80:21 115:13 117:23 118:4 122:2 123:7,21 125:1 126:9 137:22 138:5 140:19 141:10, 15,18 142:7 144:5 149:2 150:1 153:3,18 168:9 171:3 318:9 333:22 334:12
commented 152:20
comments 88:8
common 36:23 60:5 89:3 139:5 175:16 229:8 245:23 319:15
commonly 139:8 230:5 231:21
communication 27:16 68:2 132:18
communications 67:22 68:11 130:19 131:22 143:15,25
companies 221:13
compare 88:18 109:18 163:2 184:23 185:8,12 196:11,22
compared 86:15 92:1,5 185:5,7 197:15
comparing 160:15 161:4 172:5 308:20 311:24
comparison 45:5 88:22 185:22 312:5
compensated 21:20 22:13
complete 27:2 30:5, 7 35:9 255:2
completely 203:12 327:6
complex 252:6 257:17,19,24 268:3 304:3,4,6,17

complicated 201:1
component 50:9 105:21 120:18 121:15 252:4
components 121:20 155:22
comport 98:5
composed 173:14
composite 152:23 154:5,11 155:3,22
composition 31:18
comprehension 151:18
comprise 27:15
comprises 106:7 107:1 242:15 315:24
comprising 35:18
computation 258:1
computational 246:18 256:20 263:24
computationally 245:18
computer 71:2 206:6 207:6,7 208:17 211:13 213:8,15 221:22 257:25 258:1
computing 207:11 210:1,12,17,25 212:1 213:21 214:4,12,22 215:17 216:25
concept 241:23 242:3 296:11,14
concepts 108:18 142:14 144:24 146:6 147:3 303:8
conditioning 191:23
conditions 55:11 106:6,25
confirm 158:22 253:20 272:11 292:21
confirmed 229:8
conflict 150:2 331:20,22
conjugate 267:22 268:8
Connect 12:13
connection 221:6
consideration 172:1
considered 31:23 41:25 69:13,25 114:8, 18 150:20 196:16 254:15,22 255:12 335:24 338:23
consistent 44:25 60:23 92:10,23 94:5,23
consistently 102:21
consists 36:11
constantly 191:24
construction 19:15 20:10 27:13 28:1 37:5 63:24 64:14 66:3 67:9 74:9 80:9 129:25 147:10,13 153:25 155:15,19
constructions 44:25 65:15 67:19 130:3
construe 63:22 64:12
construed 65:7,23 66:12 206:21
Cont'd 157:10
contained 187:17 292:22
contending 34:10
content 17:20 95:21
context 19:23 31:3 32:13 33:4,5,21 37:18, 20 38:3 39:11 45:4,12 46:13 65:11 80:18,23 81:5 82:15 90:3 92:15 94:13 115:12 116:7 121:19 123:6 124:15 125:13 126:2 137:17 139:19 140:11,20 141:25 142:3,20,23 143:5 152:12 169:1 173:2 174:2,3,5,24 179:2,22 182:1 186:18 188:13 194:3 241:2 256:23 257:6 284:15 339:1
contexts 88:22 191:14
continue 98:6 276:3 278:7
continuous 46:11 116:13
continuously 284:13
contracted 7:3
contrary 78:11
contrast 163:3
control 31:11 71:10 232:23 235:8
conventional 254:16,18,23 255:13
convergence 233:6,24
conversation 20:9 195:2,3
conversations 20:6
conversion 234:10, 14,23 236:4,19,22 237:13 238:6,9 249:8 261:11 264:12,13 266:10 276:20 286:12 316:22 320:3
conversions 273:22 276:15 297:4
convert 163:12 233:3,14,21 234:19 237:2,4,10,20 238:23 239:5,17 240:19 247:9, 25 256:3 273:12,16 274:16 282:12,18 314:7 329:8 330:24 335:9,19 337:3,20
converted 187:4 245:7 248:2 284:2 319:4 329:13,22 335:23
converting 53:5 55:12 56:4 157:19 236:24 237:6,7 239:12 240:24 241:19 269:22 327:1,9
coordinate 87:25 99:20 104:2 110:23 177:21 249:20 251:4 304:7,8,10,11,13
copies 14:14
copy 17:12 18:18 25:14 35:5 340:6
corner 140:18
correct 10:8 11:5 17:19 19:13 20:18 35:14 42:15,23 43:2 53:17 54:10 57:3 59:1 77:3 78:5 88:17 90:22 92:2 100:1 103:7 109:20,22 110:4,12 111:5 126:7 127:20 137:16 144:17 145:22 146:10 148:15 184:11 190:8 194:16,19 195:9 196:21 197:6,17 203:15 206:23 209:3,18,23,25 210:3 218:10,11 225:3 238:17,18,21 255:16,20 259:25 260:11 262:3 269:18 270:2,7 272:14 279:16,24 291:15 295:17,22 297:23 305:2 309:3 315:19,22 317:23 322:10,22
correcting 110:14
correction 109:25 110:20 196:12 197:16 268:21 325:25
correctly 53:13 80:12 116:4 118:15 167:8 184:3,19
correlate 232:5
cosign 103:19,20 246:15 263:8 270:21 271:3 289:7 309:14,20 311:15
counsel 14:13 56:14 67:23 68:11 71:14,19 72:2 97:4 127:8 130:19 132:13 143:16,22 156:14 243:6,25 324:9 338:4

couple 56:17 127:1 243:7 259:23 291:3
courses 225:14,21 226:16,24,25 227:3 232:11 233:1,23 234:10 235:7,8 302:9,12
court 8:13 99:2 113:10,11 152:19 340:11
court's 152:17
courtroom 10:8
covariance 257:23
cover 44:2 275:4,23, 24
covered 65:13 234:12
covers 156:13 210:10
create 60:5 181:16
created 61:17 289:2, 8
creates 102:19
cross-examination 71:24
crosstalk 96:14 98:2 332:21
current 53:8 54:22 55:14,18,22 100:1 157:22 158:11,18 159:2,11,15 160:5,7,13, 15,23 207:23 244:8 260:14 327:2,9 329:8 330:9 337:1
customary 22:10
cut 35:8,24 56:9 70:5
cutting 30:8 317:3
Cywee 9:22,25 41:5, 20,21 42:21 43:1 44:15 45:2 113:25 147:14 148:9 161:15 170:20 205:14 233:7
Cywee's 227:21

D

data 27:15 51:3 52:4, 7,11,15 120:19 164:3, 19 170:5 176:14 185:9, 25 187:2 191:20 196:11,13,15 197:14 199:6,7
date 12:2 21:14 74:4 113:6 114:5,6 147:11 161:11 204:17 205:10 220:24 315:6 335:10
day 14:10 16:6 18:2 30:19 32:18 87:18 110:1 200:20 257:21 276:3 278:7 280:15 284:16 302:3,11 303:8
deal 225:19 257:21 263:8 264:5 304:2 320:9
dealing 103:18 283:16
deals 314:25
dealt 141:14
decent 113:8 253:4 258:5
decide 249:24 256:8 340:3
decided 67:8 97:1 130:7
deciding 136:5 148:4
decision 67:12 136:4 207:15,17 217:21,23 219:6 227:20 231:18
decisions 218:13
decks 284:3
declaration 11:23 12:4,16 15:3,9 18:9,22 19:6 27:5,10 28:8 33:7, 24 40:6 41:18 42:1,7,14 45:10 47:5 53:20,25 54:15 60:23 64:5 65:2, 7,17,19 66:1,17 67:14 68:3,7 69:8 70:23 71:15 73:9,17,19 75:19 79:10 81:4,23 83:16 85:19 90:1 99:7 113:4,23 114:18 115:6 117:2,23 127:11 129:8 130:3 131:3,8,20 133:2 134:2, 11,15,20 135:5,9,16 139:21,24 145:10 146:4 154:15,25 161:9,13,20 168:8 171:14 177:18 178:5 179:17,23 180:14,15 181:11 182:15 183:8 184:9,25 186:22 189:3,10,20 190:24 193:19 194:19 195:4,8 196:5 197:21 198:5 199:22 200:8,14, 19 201:7,10 202:1 203:19 204:1 205:8,12, 18 206:3 207:24 208:4 216:18,19 217:15,16 219:24 223:6 228:3 230:10,12 233:12 234:2,18 241:17 243:16,17,20,23 245:15 246:24 256:7 257:1 259:7 261:1 264:1,16, 21 266:9,11 274:4 277:9 278:1 279:23 280:22 281:7,15 284:8 285:14 297:11 300:13 306:2 308:10 328:25 335:1
declarations 13:8, 11 14:6,14 20:17,25 21:16 41:20,22 42:10 64:3 114:16 127:4 130:22 133:21 136:14, 16,18 170:21 188:24 201:19 256:15
declared 68:13
decoder 324:2
define 36:18 40:23 77:8 251:22 267:4 279:17 300:20
defined 36:16 101:17 111:7 151:24 170:2,16 173:4 174:10,11 251:11 260:20,22 286:4
defines 142:5 169:5 171:22 267:3
defining 303:18
definition 19:25 20:3 24:12 35:19 81:11 168:6 208:6 217:23 287:21 290:10,14 300:19
degree 70:17 71:1,8 206:5 207:6 208:17 211:10,12 212:20,23 213:8,14 214:5 221:20 222:1,3 226:9 227:10 232:10
degrees 207:13 208:13 209:10 210:20 211:14,17 212:9,22 213:2 222:13 228:20 292:18,19,20 294:14, 15,16
Delta 298:2,3
demonstrate 320:2
demonstrates 106:10
denote 174:1,19 175:9
denotes 190:13
departments 209:9 213:4 226:23
depending 46:12 191:7 257:5
depends 40:10 49:10,24 88:7 103:3 116:12,16 117:3 121:19 135:23 158:2 174:2 175:19 177:1 192:20,22 217:9 241:1 245:21,25 246:4,20 250:16 255:22 262:17 336:14
depose 128:2
deposed 9:10
deposing 98:3
deposition 7:10,18, 21 8:2 9:5 11:9,22 17:25 18:5 74:1 98:6 113:3 147:9,24 161:8 187:23 204:15 205:7 315:3 341:1
depositions 83:10
derivation 259:15, 19 305:19

derivative 323:5
derive 305:4,10 313:18 323:22 334:9
derived 99:12
derives 190:14
deriving 298:24
describe 49:13 252:23
describes 219:17 267:20 297:19
describing 184:20 298:12
description 36:8 39:19 111:22 198:20,24 312:15 313:5,16,19
design 224:7 235:15 254:3 302:12
designed 224:8,23 235:13,17
designer 224:6
detail 47:5 56:12 83:15 85:18 252:23
detailed 44:9 55:19 189:19 198:22 233:15
details 43:12 85:12 224:18,22 249:12
detected 152:25
detection 219:20
determination 125:15 127:2 150:24
determinations 138:22 139:1,9
determine 94:22 123:25 127:19 160:6 196:20 269:24
determined 66:11 158:6 287:25
determines 54:18
determining 139:6, 17 140:15 317:10
deviation 106:16 219:15,21
device 24:13,15 26:1, 6,7,9,18,20 27:14,19 28:3,4,6,12,17,18,24 29:3 30:24 31:1,7,15, 22,23 32:3,8,24,25 33:9,18,25 34:2,5,12, 15,19,22 35:14,16,21 36:11,18,23 37:1,8,9, 11,14,17,19,23 38:1,5, 6,7,16,17,22,24 39:5, 10,15,21 40:3,9,14,21, 23 48:2,5,9 58:16,20,25 59:3,14,15,19,21 60:4, 12,17,18,21,22 61:6,9, 16 62:5,7,9,10,12 67:1, 2,4 100:3,4 101:11 102:11 103:5,11 105:11 106:1,3,9,13,17 107:2, 10 111:8 139:14 149:14,17 160:9 169:15 170:17 173:7 186:4 219:12,19 223:5,7,8,11 250:8 296:8 319:5
device's 105:12,24 186:7,13 187:1
devices 49:16 58:22 61:1,2,11 62:4 99:25 170:13 220:12,25 221:1,6,14,16 223:2 226:2
diagram 26:1 38:15 165:17 173:10 197:24 198:17,20,23
difference 109:19 163:16 172:10,15 197:5 263:23 273:14 326:8
differences 163:18
differential 265:16 298:1 299:4 317:6 323:3
difficult 93:23
digest 151:16
dimension 107:18, 22 110:22 236:5,11 250:9 251:1 296:8
dimensional 103:18 173:19,20 225:19 226:1 236:17 237:8,9 238:8,15 250:3, 4,6,9 252:1 283:17 296:18 309:22
dimensions 139:18 175:2,3 320:8
dinner 258:6,15
directed 35:13
direction 86:18 87:8 102:24 103:4 104:14, 16,22 105:3,6,7 107:15 110:3 111:6,13,16,17, 18 112:11,14,17,20 121:2,24 139:17 140:16 309:14 310:11 311:5
directions 173:15
disagree 59:6 61:8 94:6 322:14 324:6
disagreeing 140:24
disclose 73:8 80:7 83:4 118:9,23 119:9,14 270:14,23 274:9 322:13,15 334:9
disclosed 73:19 82:19 89:19 92:8 162:4 252:12 286:21 290:17, 21 301:17 305:11 307:4 321:22 329:12 333:10
discloses 31:7 54:5, 9 183:22 184:6 194:5 331:4,17 338:21
disclosure 336:12, 13 338:24
disclosures 245:1
discontinuous 116:14
discovered 255:6
discreet 277:11
discuss 41:17 279:1, 7
discussed 39:9,17 40:6,7 42:6 47:5 54:25 55:8 59:9 83:15 101:1 124:20 128:4 173:8 241:16 263:5,10 309:7 328:3
discusses 220:4
discussing 45:11 161:15 189:21 233:19
discussion 20:13 100:24 129:16 134:18 238:2,5,10 239:1
discussions 127:8 128:14 134:17
displacement 88:2
display 38:9,19 238:19,20
disputed 148:6
distinction 83:21
distinguishing 244:6
District 147:15
divided 289:7
doctor 8:16 12:7 29:7 32:17 33:16 35:3 51:22 56:21 67:7 72:6 100:12 271:7 275:3 276:21 280:7
document 12:18 13:25 15:8 17:10,13 24:18 25:1,5 36:2 47:7 54:11 64:2 74:2 75:1 77:24 79:14,22 80:19, 21 81:3,12 86:21 87:19, 23 89:13 90:4 92:14,15 93:2,20 94:10,11 95:3,9 96:3 98:12,18,21 100:10,13 114:6 116:25 117:6,11,13 118:4,6 123:5,21 124:25 125:11 126:2,10,25 137:12,21 138:2,10 140:3 141:9, 17 147:19 149:2,11 150:11 151:22 152:1 153:17 157:15 158:8 161:18 164:21 167:19 178:21,23 209:17 210:8 219:10 228:6 259:22 314:15,18 315:13 329:25
documents 14:19, 25 15:2,5 17:3,7,9 18:3 90:3 95:18 129:23 207:16
dot 323:5
double-check 227:23 255:10

download 12:8,12 25:2,11 95:18 151:5,13 165:10
drafting 70:23 71:12
drafts 131:16,24 132:1,3,9,16,21
draw 27:12
drawing 83:21 219:3 231:2
drive 139:12
driving 110:16 286:5 313:13
due 48:1
duly 8:21
dumping 277:9
Dy 87:20,25
dynamic 35:17
Dz 87:20 88:1

E

earlier 16:23 17:16 25:24 35:23 43:6,11 99:18 151:24 263:5,10 286:13
early 20:22 69:19 221:4 229:10 230:22 231:22 302:25
earned 23:6
earth 100:9,17 103:9 111:17 167:13,25 168:3,20 177:23 178:6 181:14 183:24 184:7, 21,22 194:7 250:13,20 251:11
earth's 167:18,21 179:13
earth-fixed 178:1 180:8,22,25 193:22 195:23
easier 246:2,3 264:7
easily 284:2
Eastern 147:15
easy 277:17
education 69:10 218:5,8 221:19
educational 218:25 230:24
effective 253:22
effectively 336:13
efficiency 263:3
efficient 262:14,24, 25 263:2,14
EKF 88:24 89:2,6,7,8 196:24 235:23 240:24, 25 241:3,8,16,24 242:4, 6 259:16 260:3 265:9, 21 296:21 322:8,13,15
EKFS 234:15 235:21 241:19 254:1
elaborated 207:14
elaborates 40:7
electrical 70:17 71:2 206:6 207:7 208:18 211:9,12 221:21
electronic 18:18 26:1,5,7,18 27:14 28:17,24 30:24 31:15, 23 32:3,8,25 33:9,18,25 34:2,4,12,15,19,22 35:14,16 36:10 37:1,13, 17,19,22 38:1,5,6,7,16, 23 39:5 61:5 219:12,19
Electronics 7:13 113:25
element 31:8 57:10, 21 58:2,5,10 86:1
elements 52:18 54:3 244:14 260:2,5 286:5
eliminate 191:19
elongate 31:12
email 340:24
embodiment 26:3 38:4 39:21,25
employee 7:5
encode 250:21
encompass 61:2 76:1,6 77:9 80:8
encompasses 74:15 75:11 152:22
encountered 141:13
end 29:15 87:17 175:12 237:12 257:21
endeavor 188:1
ends 340:25
engineering 70:17 71:2,3 126:14 206:7 207:7,8 208:18,19 211:9,12,13 221:21,22
English 15:21 166:12
enlighten 47:6
ensure 298:5
entered 147:16
entire 47:18 102:15 115:5 151:6 164:7 182:8,20 197:21 277:9
entirety 77:23 80:17, 20 81:2 90:2 92:13 93:1,20 95:9 116:22 117:1,11,22 118:3 123:4,20 124:24 125:10 126:1,24 137:11,20 141:8,17 149:1,11,24 151:22 153:17 168:8
entitled 30:7 71:24 96:24
environment 48:5, 14 49:7,11,13 87:11 143:4
environments 35:18 52:9
Epsilan 172:11,12
equal 268:2,23 302:5 321:13 323:6,24,25
equally 333:20 338:23
equals 166:5 269:14 288:12,13 289:7 316:25 317:21
equate 326:7
equation 55:4,6 56:23 57:25 86:23 91:12,14,15 92:3,19 93:7 95:14 99:12 100:6 107:19,25 109:15,22 111:15 154:22 178:2 234:22 244:23 245:5 247:21 248:9 249:3 259:16 260:3,8 261:3 265:16,25 266:8,23 267:1,3 268:10,14 269:8,10,22,25 273:7 282:2,3,8 286:1,2,9 288:1,9 293:8,9 295:1, 3,8,12,21,24 297:6,14 298:11,13,15,16,18,19, 20,21 299:1,2,4,5,25 300:2 301:9 304:23 307:24 308:15 309:1,4 312:24 316:6,8,9,14,16 317:2,7 318:19,22,25 319:2,13,24 320:4,5,15, 17,20,23 321:2,5,9,10, 11,17,18 322:2,17 323:3,11,16,17,19,21 324:22,25 325:3,8 326:2,5,12,23 327:12 328:25 329:2,11,12,23 330:7,11,12,16 332:2, 18,20 333:1,4,7,25 334:5 335:5 337:8,22 339:2,5
equations 162:15,22 244:9,19 245:8,9 247:9, 15 256:14 259:18,20,23 261:25 265:21 266:18 272:15 273:13 274:2 281:17,19,20,24 283:22 293:23 297:18,19 298:1 312:13,20,23 313:1,14, 21 322:13 326:24 330:20 333:11,15 335:16 336:5 338:22
equivalent 34:11 55:7 294:14 307:22 308:22 336:12
error 110:20 160:18 172:8 191:17 196:12 197:15 264:6
essentially 59:5 60:8
established 104:10 231:6

estimate 104:4,8 109:14 110:11 111:14 160:23 204:10 326:1 330:15

estimated 58:7 181:13 196:21 312:6 313:3

estimation 16:1 54:19,21 55:2 57:8,17 84:19 85:14 90:10 92:20 93:6 110:18 325:7,18 328:6

Euler 162:16,18,19 233:3,4,13,21 234:14 237:11,13,22 239:6,12, 18 240:5,6,7,10,20,24 241:4,7,21 242:9,13,17 245:2,8,19 246:3,9,14 247:1,8,21 248:17,22 249:13,17 254:7,12,15, 17 255:8,12,18,21 256:8,17 257:3,8,18 261:5,7,16 262:9,15,21 263:17 264:14 265:10, 12,20,23 266:1 268:13 271:19,25 272:9,12,14 273:10,11 274:12 282:18 283:5,17 284:25 285:5,16 286:10,12 288:24 290:25 295:9 296:21 298:14,18 301:25 314:7 316:23 318:7,10,14 319:16 321:15,16 322:1,8,12 328:20,24 330:13,20 331:2,13,17 333:18 334:15 335:21 336:11, 18,21 337:3 338:22

Eulerian 234:11,18 261:9 314:25

Eulers 251:15 264:5

evaluating 145:15

Evans 7:21,25 8:1 9:1,3 11:17 12:3,15,22 13:2,6 14:15,17 24:17 25:6 28:20 30:3 31:16, 20 33:3,11,13 34:24 35:2 41:1,3 54:12 56:17,20 61:23 62:16, 24 63:8,13,18 64:21 71:18,22 72:10,12 73:22 74:5 78:8,10 79:23 80:1,3 83:8 96:2, 10,15,17 97:5,10,19 98:3,9,17 99:4,6 100:11 113:1,12,20,22 122:6,8 127:9 128:9 131:6,11, 13,18,25 132:4,8,15,19, 25 133:16,25 140:4 143:20 144:1 147:7,12 156:17 157:11 161:6,12 164:11 165:11,15 166:23,25 187:16 188:12 204:11,20,24 205:11 207:18,20 227:15,17 228:7 243:3, 8,12,13 244:3,4 252:8, 10 258:4,8 259:6 274:22,25 275:2 276:10,12 277:7 278:15,21,24,25 290:20 314:16,19 315:7,9,14, 16 316:11,13 324:12,21 332:23 334:22 338:2,8, 13,19 339:11,16,25 340:3,20,23

event 159:22

eventually 134:13

evidence 38:25 66:6 270:11 284:20

exact 23:18 85:23 141:4 216:16 247:13 248:15 300:16 319:17

EXAMINATION 8:24 157:10

examples 33:6 76:10 138:17 140:18 162:24 191:18 222:16 225:25 233:12 234:21 237:13 242:24 248:24 256:7 264:1 265:11 266:3 287:17,18 297:10,13 299:24 301:9 306:20 337:23 339:6

exception 11:11

exceptions 138:4, 17

exclusively 137:1 141:5 171:11

Exer 253:7

exercise 236:19 248:5 253:7

exercising 235:20

exergaming 252:15 253:2,8,9,22

exergamings 254:2

exert 253:6

exhibit 11:18,22 12:25 13:3 42:5,16 73:23 74:1 99:5,8 113:2,3,21 147:6,8,9 161:7,8 165:10 204:12, 15 205:7,12 206:20 207:4,16 208:3 217:22 226:5 243:15 252:9 259:8 306:4 308:20 309:1 312:2 315:3,8 318:23

exhibits 74:2 147:22

exist 195:7

existence 132:4

existing 228:21 299:5

expanded 208:12

expensive 245:19

experience 69:7 209:15 210:5,21 211:20,23 212:6,11,19, 24 213:6,24,25 214:2,3, 10,16,19,24 215:4,9 216:15,22 217:11 218:4,5,8,25 219:3 221:24 222:6 224:25 230:24 231:2 252:12 277:17

expert 9:13 22:18,21, 24 23:7 51:25 54:14 73:17 94:20 102:7 141:20 144:24 151:19 182:8,25 190:2,3 202:2 227:22 228:12 229:7,14 235:11

expertise 137:24 145:1 146:8 174:5

experts 144:11 146:12 187:25 233:6

explain 48:21 52:1 62:17 133:21 143:18 144:19 146:6,22 147:4 187:24 188:3 195:16 262:11 266:16 277:10 288:18

explained 145:7

explaining 95:5 145:11

explains 28:10 99:12 261:17,18 262:8

explanation 28:8 36:6 39:3 94:12 182:1 284:14

explicit 162:23 273:15 274:2 338:3

explicitly 92:19 208:23 209:5 241:5 262:19 273:19,21 274:9 283:2,19 292:1 301:17 305:11 318:7 321:22,24 322:11 325:10 330:25 332:25 339:3

exploded 38:15

express 251:13

expressed 295:13

expressly 78:12

extended 85:11 86:10,14 88:4,14,16 89:2,9,10 91:2 107:13 109:7,21 110:7 160:19, 20 196:25 197:4 222:15 223:8,10 236:15 242:9, 13 254:4,6 257:15 263:21 273:25 282:2,4 293:3 301:24

extent 44:12

extra 44:21 60:14 141:25 265:2 284:14

extracted 121:22

eye 150:21

F

face 164:23 205:21

fact 43:14 64:25 120:12 183:22 194:5 228:13 229:13 230:5,15 232:1 233:9 246:16 247:16,23 248:10 268:1

282:7 283:21 302:5 306:25 308:19 318:12 319:9 332:16,19 335:17 336:6,19

factors 85:16,17

facts 127:10 190:5

factual 337:7,14

Factuals 337:12

fair 10:13,14 29:24 30:12,15 59:20 97:19 114:21 202:6,24 254:25 256:19 257:11,14 275:18 278:5 306:15,16

fairly 263:24

false 68:18 121:17 141:7

familiar 44:5 69:16 163:22,25 183:2 205:19,21 230:19 276:25 283:13 309:14, 19 311:16

family's 23:23

famous 235:20

fast 109:11 190:16 192:4,12 193:2

faster 271:8

fault 89:5

features 326:13

February 7:8

feed 120:22

feeding 176:14

feel 59:17 108:5 164:15 277:3

felt 66:8 209:5

fewer 246:9

field 173:15 174:20 175:18 181:15 187:25 206:8 208:20,25 209:16 210:21 211:23 212:5, 10,15,20 213:3,6,10,15 214:8,19 216:23 219:1, 2,8,23,25 220:6,8,14 230:25 231:1 254:16

fields 193:15 208:22 209:7,13 210:6,7 214:17

figure 25:22,23 26:5 27:14,18,24 28:9,25 29:1 31:9,14 33:8,24 34:18 36:3,4,7,8,11,13, 21 37:21 38:4,12,14 39:2,6,12,13,24 47:9 61:18 67:18 87:24 100:23 101:9,15 145:21 158:9,16,25 159:3,6,7, 23 160:3,17 201:2,14

figures 28:14 32:2 36:5

figuring 108:14

file 79:24

filed 7:14 74:8 113:24

filing 335:10

filter 85:11 86:10,14 88:5,14,17 89:2,9,11 91:2 106:5,23 107:13 109:7,21 110:7 160:19, 20,21 190:25 191:1,9, 10,12,13 192:4 196:14, 25 197:4 210:11,24 214:11 215:15 216:24 222:14 223:10 236:15 242:9,13 254:4 257:16 263:22 273:25 282:2,4 293:4 301:15,24

filtered 184:13

filtering 52:13 120:20 121:7 190:15 191:24 193:1

Filters 207:10 209:22 210:16 211:25 213:20 214:1,21 222:15 223:9 254:7

FIMU 309:13

final 16:21 108:21,23 207:17 217:20 218:13

financially 7:4

find 59:18 102:8 121:23 252:19 300:16 306:10

finding 231:10,20

fine 62:14,24 63:10 68:19 339:16

finish 29:5 71:14,17 72:22 188:11 230:17

finished 26:11 72:5 339:9

fits 222:6

fixed 28:5 37:10 67:3 167:12,18 168:19 178:7 179:13 183:24 184:7,22 194:7 240:4,9 251:11

flat 103:5

fly 201:2 203:6

focus 84:2 89:15 215:18 224:4 275:12,13 277:12,19 278:3,4 306:21 330:6,11 331:23

focusing 29:17 57:21 58:5 105:20 310:15 326:11

follow 32:5 49:20 50:25 103:13 143:12 264:23 266:11 267:8 287:8 288:14 291:2 297:8 301:3 312:21

follow-up 229:16

footnote 78:7 93:14

force 48:8 49:16 50:20,23 310:4

forces 48:12,17,24 49:8 50:17,18 52:8 154:13 310:16 311:1,6, 7

form 28:19 31:2,12,24 33:2 34:6 38:2,11 39:16 40:4,24 41:8 43:10 44:17 47:3 49:18 53:23 61:22 64:19,23 66:4,15 67:24 73:10 74:21 75:5, 13 76:15 77:21 78:23 80:14 81:20 83:6 84:24 92:12 93:18,24 94:7 95:1 115:4 116:6 117:18 118:18 119:11 121:18 122:24 123:3,19 124:23 125:9,25 126:8, 20 127:6,21 129:1 130:17 136:15 137:10, 19 138:1 148:25 149:23 151:20 152:9 153:2,12 154:6 155:7,24 156:8 163:7,14 166:4 168:13 169:22 170:24 171:12 174:6,7 176:25 177:13 179:5 181:10 187:15 189:8,14 193:17 196:17 198:1,9 200:5,9 201:3, 20 202:17 203:2,9 216:2,20 218:19 220:10 230:7,11 231:24 234:16 237:21 238:23 239:5,17 241:25 242:6 247:11,13 251:25 261:17 262:2 265:17 269:23,25 270:6,21,24 271:21 274:5,18 277:5 279:13 281:8 283:1,10,14 284:18 287:23 289:25 293:17 298:16 301:2 305:6,7 309:6 311:15 316:17,18,21 319:18 323:18,20 329:16 330:13,14 331:7,21 332:12 334:20 335:13 337:4 338:25

format 282:1,8,9,10 299:13 322:16

formed 199:21

forming 69:24 70:20 72:14,24 73:16 129:5, 13

forms 96:20 270:17 316:23

formula 183:13 261:14 289:6,13,18,22 290:1,4,5,7 298:4 307:23,24 308:23 315:18 316:3,5 319:23 331:3 334:16,17

formulas 265:9 282:19,20 319:19 327:4 328:17 335:20

formulation 262:6 321:15,16,18

found 218:2 230:1 231:21 280:16,19 309:12

Foundation 83:7

frame 19:16,22 24:14 26:5 28:2,11,12 35:20 36:13,14,15,19,24 37:2, 7 38:9,19,20 57:23,24

58:11,15,16,17 59:2,3, 7,10,13,20,21 60:7,18 61:11 64:11 65:8,16,24 66:2,23,25 67:9 88:3 99:25 100:9,14,17,19, 25 101:2,3,8,10,12,14, 17,20,24 102:1,12,16, 17,22 103:11 105:7,12, 17 111:10,23 112:12,14 121:4 148:21 149:19 167:12,13,18,21,22,25 168:2,4,19,20,22 169:1, 3,6,14,17,19 170:3,13, 16 172:23 173:4,8 177:22,25 178:1,7 179:13,15 180:3,8,21, 22,25 181:1,14,16 183:24 184:7,17,22,23 185:3,11,24 186:1,2,4, 6,7,12,13,25 187:1,5 193:12,23 194:7,8,21 195:1,23,24,25 196:10 197:11 219:16 220:21 221:9 250:13,20 251:4, 11,14,16 299:7 309:15 311:10,11,14 319:4,5

frame' 63:21

frames 101:5 185:13, 20 250:22

free 236:16

French 15:20

frequencies 191:2

frequency 191:3,15

frequently 235:9 254:24

front 14:20 18:16,17 93:2 94:16 106:20 125:11 151:15 198:6,15 199:23 207:1 281:14 294:23 310:12 327:20

frustrated 280:7

full 72:4

fun 253:24

fundamental 145:14 251:2

fusion 44:3 49:22 108:8 141:21 162:4,7 207:9 209:19 210:10, 15,22 212:21 213:16, 20,25 214:10,20 215:15 216:23 222:14 223:15, 20,21

fusions 211:24

future 157:14 159:19, 20,24 160:1,7

G

G0 91:8 99:17 100:8 102:23 104:1

G001 101:2

gain 160:19 319:15 326:10

game 238:6 253:3,18

games 176:6 235:20

gaming 253:6,8

gap 51:25

gathering 185:25

general 28:22 46:4 88:8 111:23,25 112:17, 25 115:23 116:18 120:9 122:3 137:17 140:17,19 143:3 150:16 152:6 156:10 185:18,21 191:13 192:7 221:2,7 241:21 242:2,3 247:4 256:24 257:6 266:3,23 282:4 286:2 308:13,18 316:22 320:4,7 329:2 336:22

generality 42:9 77:15

generalization 249:21

generally 46:21 104:21 121:13 124:18 137:16 140:14 142:19 170:11 184:10 190:22 198:24 206:18 219:18 250:1,4,24 251:7 336:14

generate 136:22 141:2

generated 47:14

generic 39:23

geniuses 30:22

gentleman 223:23

genuinely 51:14,16

give 11:10 25:10 35:23 72:4 121:1 176:10 177:5 203:24 204:9 222:5,16 287:9 302:21 316:2 319:19 330:14 339:14

giving 30:5 143:23

glass 14:23

glasses 14:23

global 177:22 250:13

goal 108:21,23 145:21 189:12,15

Golnaraghi 16:5

good 56:15 59:17 156:18 176:8 182:19

Google 9:22,25 41:5 205:13

gotcha 94:19 296:15

GPS 110:2,4,17

graduate 225:14,24

graduated 225:16

granted 110:6

graphic 227:5 228:17 231:22 233:18

graphics 71:9 226:17,24 227:3 228:13 229:9,13 230:6 232:2,7, 11,24 234:9,10 235:7

gravitation 156:12

gravitational 47:20, 22 52:3,7,11 76:2,8 78:16 79:6 116:1 118:11 119:1 123:13 124:3 137:1 141:6 149:16 152:24 154:12 155:4,5,10,20,21 156:11 178:5,17 180:2, 6,24 310:4,16 311:7

gravity 48:13,19 49:25 50:3,4,9,14,18, 20,23 51:4 58:6 87:16 91:9,10,14,19 92:2 93:8,16 94:2 99:14,24 100:3 103:24 104:12, 15,18,20,24 105:2,4,10, 11,16 107:12 110:19,24 111:1 112:4,5,6,8,10, 15,18,20 138:23 139:2, 5,8,11,17 140:16 156:5 181:15 183:11,12,23 184:4,7,21 185:9 193:7, 11,15,23 194:7,20 195:1,22 196:9,16,22, 23 197:10 202:9 203:1 251:12 309:16 310:1,8, 10,18,22 311:5

gravity-based 91:15

gravity-only 80:6 81:8 94:5

Great 25:16

ground 103:6 275:4

grounds 128:8

group 9:23,25 41:5 225:8 242:16 322:1

guess 20:21 62:17 134:24 174:10 176:8 178:25 179:3 193:14 198:25 199:1,11,17,18 267:18

guessed 179:11

guesses 198:19

guessing 176:6

guesstimate 9:19 20:23 134:25 235:1

guides 86:17

guys 163:5

gyro 223:19

gyroscope 31:14 56:2 295:16

gyroscope's 297:21

gyroscopes 44:4 213:11 223:13

H

H1 166:5,21 167:1 183:25 190:14 194:9

H2 166:5,21 167:1 183:25 190:14 194:9

H3 166:5 167:2 184:1 190:14 194:9

half 156:20 204:9 317:7 323:6

Hamilton 255:7 302:25 303:2,4,14 305:22 306:13

hand 103:14 188:7 189:2

hands 31:13

Hang 13:2 243:22

happened 104:18

happening 185:17 190:7 199:2 201:13 303:21 309:18

happy 11:10 95:10

hard 11:20 18:18 35:5 97:6 143:2 145:16

harder 276:5

Hastings 8:8 11:4

hat 92:5

head 110:4

health 225:24 226:7, 11 253:19

hear 89:4 300:8

heard 85:6 97:7 243:9

hearing 82:7 177:12

heart's 95:21

held 31:12

helpful 146:5,9,12 189:4 271:7 277:18 290:24 297:12

hesitant 254:9,11

hesitate 10:15

hierarchy 30:25

high 144:16 191:15

high-pass 191:9

higher 30:23,24 145:24 241:13

highlighted 76:14 199:8 229:5

highly 168:15

hire 144:11

hired 20:14

history 134:10

HK 7:14 8:1 9:4

hold 24:22 96:12,18, 25 178:20

honestly 177:4

hope 146:9 276:4

horizontal 88:1 166:14

hour 56:15 156:20 204:6,9,18 263:6

hourly 22:6,9,10

hours 21:2 22:4 134:19,23 135:2 204:7 244:1 253:14 338:10,12

house 11:6

Huffstetler 8:6 340:4

huge 117:5

human 84:23 108:6 257:9

hundred 84:10,12 225:17 250:4 255:15

hypothesis 199:20, 23

hypothetical 285:24

I

I.00 288:13

i.e. 31:15 34:18 37:22 74:15 75:10 92:21 111:14 139:13 249:22 305:6

idea 85:11 196:18 253:12,16

identical 150:16

identification 12:1 74:3 113:6 147:11 161:10 204:17 205:9 315:6

identified 34:3 40:15 63:21 64:11 76:23 93:10,12 304:25

identify 53:16 69:23 162:16 281:1 320:18 325:3

identifying 57:1 81:8 99:23 165:21 260:9 269:2

IEEE 15:25

imagery 252:7

imaginary 252:2,3 304:19

immediately 19:14 321:13

impart 146:14

implement 297:24

implies 135:12

implying 286:8

important 29:18 127:15 166:24 275:16

imported 35:20

impression 335:8

imprisonment 68:20

improper 97:16 276:11

inaccurate 61:3

include 47:20,22 207:2 208:13 213:20

included 207:12

includes 31:13 32:4 33:9 34:1,19 37:23 39:5

including 69:18 73:19 207:9 209:22 210:23 211:24 213:2 214:1,21 219:15 225:11,12 230:21 268:1 272:10 285:7

income 22:21 23:9, 13,14,15,16

incomes 23:20

inconsistent 92:11, 24

incorrect 48:20 60:11 198:8 265:20

independent 68:7 190:1,3,5 218:16

independently 189:24

indicating 310:24

indicator 325:21

individual 120:17 121:15 237:8 291:13,20

industry 69:11 218:5,8

Inertial 16:2

information 68:15 94:15 117:15 119:9,14 126:13 128:11 129:4,12 189:5 209:11 230:16 252:19 267:7 270:15 278:14 284:12 288:5 291:25 292:22 293:1 301:7 303:6 331:17

inherent 151:18

inherently 332:7 333:6 334:9

initial 286:19,24 300:2 303:1

innovation 265:2

inside 49:4 176:18,19

instance 56:9 104:11 175:24

instances 88:16

instant 149:16

instantiation 289:10

instruct 97:13 128:6 131:4,9 132:23 133:14, 23 278:13,19
instructed 128:12 133:18 278:10 284:1
instructions 278:17
integrate 298:1
intentionally 72:1
inter 9:14 11:24 64:4 114:12
interchangeable 256:1,6 262:19 283:18
interested 7:4 87:18
interesting 334:2,10
International 15:14 315:4
interpret 37:16 81:7 170:22 171:23 181:21, 22 188:17,20 194:2,14 195:5 198:5 240:1
interpretation 44:22 115:7 181:4,6 197:18
interpretations 115:1,17 122:17,19 128:1
interpreted 83:1 121:10 127:17 136:25 141:5 154:4 197:8 201:17
interpreting 181:19 293:23
interrupt 30:10
interrupted 338:16
intrinsic 38:25 66:6 292:5,24 293:24 294:1 306:14
introduce 7:23
intrusion 263:4
intuitive 257:9 258:2
intuitively 256:6
invention 18:25 19:9 26:4 65:5,22 66:21 70:16 130:14 131:1 145:18 217:6 252:17
inventions 43:23 145:18 252:12
inventors 15:16 16:16
inverse 178:3,13,14 180:10 181:2
invoice 22:1,2
involved 9:24 10:1 143:13 215:16,17 249:12
involves 13:14,15
involving 12:5 13:4 325:9 330:3
IPR 7:15 12:5,17 13:4, 13,14,22,24 41:17,23 66:13 72:14 114:9 124:16 143:10 170:21 171:14 176:2 199:23 201:7 205:14,19,25 207:24 217:17 229:7 306:5
IPRS 9:16,22 13:8,9, 12,18,19 20:18,19 22:14 41:21 42:5 45:2 79:25 161:14,15,23
irrelevant 162:21 296:7
Irvine 11:3
isolate 50:4,8,13 193:3
isolated 155:22
issue 13:9,21 37:6 42:21,25 44:14 52:19 170:14
item 86:11 268:23
items 191:3
iteration 55:25 159:11

J

Jacobian 257:23
Jacobians 257:15
jitter 192:12
jitters 192:17,21
Johnson 259:2
joined 8:9
Joining 8:4
jointly 136:12
judge 146:13 147:16 148:4 149:6 153:9
judgment 301:19
July 147:17
June 205:14
jury 146:13
justification 138:3

K

K-BAR 56:25 57:4 269:3 305:6 326:12
K-I-M 270:13
Kalman 85:11 86:10, 14 88:4,14,16 89:2,9,11 91:2 106:5,23 107:13 109:7,21 110:7 160:19, 20 196:25 197:4 207:9 209:22 210:11,15,24 211:24 213:20 214:1, 11,21 215:15 216:24 222:14,15 223:9,10 236:15 242:9,13 254:4, 7 257:16 263:22 273:25 282:2,4 293:3 301:24 326:10
key 235:19
keyboard 253:13
keyboard-based 253:18
keywords 253:4
kids 253:13,21
Kim 16:4,7,13 270:12 279:18,21,25 280:16 305:15,18,20 306:12 308:2,6,20,24 309:9 310:7,13,17,19,23 311:25 312:6,24 314:4
Kim's 308:8
kind 43:20 48:3 89:8 120:14 135:25 144:7 191:17 220:3 253:2 303:19,25 307:5
kinematic 295:20,23 296:6
knew 169:13 245:18 283:9 322:7 333:4,5
knowing 253:13
knowledge 45:9 68:14,17 129:22 146:14 151:19 206:9 207:8 210:14 232:4,6,8 246:21 247:4 279:14 292:6,24 293:24 294:2 299:19 301:13,16,22 306:14 314:8,12 332:8

L

label 62:1
labeled 17:5 27:24
labeling 260:13
lack 117:14 145:1 146:8,14
language 62:7 95:17 208:25
laptop 14:22
large 138:2 225:8 309:21
larger 164:20 257:20
late 20:21 69:19 221:3 230:21
Laurenzi 8:7 10:24 12:7,13,19,24 14:12 18:6 20:5 25:2,14 28:19 29:25 31:2,24 33:2 34:6 38:2,11 39:16 40:4,24 41:8 43:8,10 44:17 47:3 49:18 53:23 56:14 61:22 62:23 63:11 64:19,23 66:4,15 67:21 68:9 69:5 70:11 71:13, 16,20 72:3,21 73:10 74:21 75:5,13 76:15 77:21 78:23 80:14 81:1,

20 82:5 83:6 84:24 92:12,25 93:18 94:7 95:1,24 96:8,12,16,24 97:9,17,24 98:7,13 115:4 116:6 117:18 118:18 119:11 121:18 122:24 123:3,19 124:23 125:9,25 126:8,20 127:6,21 128:6,16 129:1 130:17 131:4,9, 12,15,23 132:2,7,11,17, 23 133:14,23 136:15 137:10,19 138:1 143:14,18,23 146:15 148:25 149:23 151:20 152:9 153:2,12 154:6 155:7,24 156:8,14,20 163:7,14 164:9 165:9 168:13 169:22 170:24 171:12 174:6 176:25 177:13 179:5 181:10 183:3 187:15 188:10 189:8,14 193:17 196:17 198:1,9 200:5,9 201:3, 20 202:17 203:2,9 204:18,22 216:2,20 218:19 220:10 230:7,11 231:24 234:16 247:11 258:7,11 276:8 277:5 278:12,19,22 281:8 289:25 290:19 301:2 316:21 324:9,14 331:7, 21 332:12 334:20 335:13 337:4,24 338:4, 11,17,25 339:8,13,23 340:5,7,9,13,17,22

Laviola 233:7

lawsuit 114:9

lawyer 212:2 229:1,4

lawyers 67:20 203:23

laying 103:5

layman 108:15

lays 68:4

leafing 54:14

learn 226:17,25 227:2 234:24 235:3 267:9,24 302:4,15,17 303:12,19 304:1,14

learned 225:18 302:10 303:7

learning 226:14,21 232:18 302:2

leave 335:7

left 110:10 164:17 207:22 209:2 217:17 291:14,21 308:21 313:9 320:7 321:13

left-hand 260:7

legal 145:25

leisure 284:8

level 30:23 69:16 145:24 205:24 206:17 208:1 217:16 218:25 221:19 225:15 226:15 230:19,24 241:13 300:5

library 227:7 280:18 281:4,12

life 23:12,16,22,23 128:18 182:9

liking 153:6

limit 96:21 97:20

limitation 35:21 325:23 327:13 329:19 331:4

limited 9:4 96:20 126:12 275:3

linear 46:3,6,10 47:23,25 48:3,4 58:6,7, 12 76:1,8 78:15 79:3 93:15 94:2 115:25 117:20 118:10,24 119:7,18 120:8 123:12 124:2 149:15 152:23 154:12 155:3 299:13 303:16 304:15

lines 27:5,8,9 28:14 35:11 86:23 127:1

list 74:2 222:7

listed 69:13,25 73:16 114:19 306:1

listen 29:9,21 30:21 67:6 234:6,7 275:7

literally 181:3

literature 51:10 120:10 175:17 270:18 271:5 274:14 280:2 309:22

live 195:11

located 11:1 58:23 60:9

location 161:1

locations 170:10

logic 280:10

long 32:18 56:10 60:2 62:21 98:24 150:23 155:25 156:18 198:15 211:15 246:16 255:4 276:3 278:7 303:4

looked 33:6 42:8,10, 19 43:5 44:8 45:3 66:5 73:15 81:12 93:14 122:20 129:23 134:9 145:6 150:15 183:16 188:14 189:9 197:22 206:19 217:20,22 231:12,17 249:11 316:7

loop 159:7,12

lot 29:11 69:8 86:4 94:20 183:1 225:2 241:13 271:8 275:4

low 191:2 192:25

low-pass 184:13 190:15 191:1,8,11,13 192:4 196:14

lower 30:25 88:2 101:10,20

lunch 156:14,15,18

M

M.F. 16:5

Madam 340:11

made 22:23 67:13 68:13,15,17,19 76:13 77:18 125:15 138:4 173:21 183:11 201:23 206:24 287:16 290:13 336:8

magnet 181:15

magnetic 173:15 193:15

magnetism 136:24 141:3 167:5 170:5 178:6,16 179:12 180:2, 7,24

magnetometer 165:22,25 166:3 172:17 173:15 175:1,4 176:14, 17

magnetometers 167:6 176:20 213:11

magnitude 310:1,9

main 23:10 112:3

maintained 44:25

Majid 7:18 11:23 161:9 205:8 341:2

majority 23:14

majors 226:13,16,20

make 11:20 24:7 29:10 36:17 44:21 50:5 51:1 52:5 81:16 107:8 109:25 118:4 127:1 138:21,25 142:6 143:3, 8 145:8 147:3 150:23 156:2 164:20 165:12 174:22 183:17 198:19 220:16 227:7 228:1 233:9 240:16 253:12 263:16 264:3 268:21 297:7 312:22 318:9 328:11 330:10

makes 16:9,25 94:11 108:15 142:18 191:23 244:18 249:2 251:12 261:7 263:23 264:7 326:14 332:1,17 333:14,24 335:4,15 336:4 337:20

making 60:1 72:1 81:14 82:1 108:22 139:9 333:21 336:1

manner 272:2 278:8

map 238:11 249:14

mapped 265:22

mapping 238:13,16 260:2,5

March 114:1

marked 12:1 74:3 113:5 147:10 161:10 204:16 205:9 315:5
mass 174:24
matches 219:5 312:10
material 275:23
materials 17:24 41:24 43:4 69:13,25 73:7,14 150:19 307:3
math 141:22 168:23 174:21 207:10 210:12, 25 211:25 213:21 214:11,22 215:3,12,22 216:4,17,24 217:7,11 222:13 224:14 225:3,9, 18,22 226:3,14,18,21 227:1,3,8 228:18 230:1 232:5,6,8,25 233:3,4,5, 8,11,15,20 234:25 235:10,13,16 236:1,13, 14 237:2,5 246:2,9,10 247:3 254:1,5 255:6 264:22 266:12 267:11, 14,25 270:16 271:1 276:17 277:16 286:12 288:24,25 289:3 292:8, 17 293:13 294:8 299:23 300:1,12,16,19,21 302:2,4,10,13 303:4,6, 9,24 305:17 306:9,13, 24 307:8,9
mathematic 227:19
mathematical 166:18
mathematically 136:22 141:1 256:5
mathematics 209:24 210:16 214:3,25 215:8,16,19,25 216:15 217:3 224:25 234:15 268:3
maths 255:10
matrices 103:17 166:19 270:17 271:18 274:17 283:10,14,15,16 284:18 300:6 308:14,18 314:1
matrix 57:20 58:4 99:13 103:16,23 104:1, 2 105:10,15,21 107:16, 24 108:3 154:21 166:15 246:13 257:20,22 263:11 270:5,24 271:20,24 272:6,19,25 273:4,6,20 274:5,10,11 276:15 279:13,22 285:6,7 299:10 300:4 301:14 307:18 308:2,7 309:6,14,15,20,24 310:19 311:3,8 325:9, 15
matrixes 271:13
matter 62:13 90:3 142:1 210:10 268:13
matters 143:4 198:12 232:22
meaning 18:23 19:7, 12,21 37:13 44:15 45:14,23 74:13 75:25 76:25 79:9,11 86:7 89:25 90:21 117:4 120:5 125:24 130:6,8 152:20 195:16 200:2
meanings 41:7 65:3, 20 66:19 67:16 130:11, 23
means 66:24 100:22 108:11 124:14 151:17 167:20 174:4 184:15,25 200:22 211:6 212:12 223:19 228:17 236:9 247:2,19 309:19 310:10 326:20
meant 119:21 124:10 192:10 203:20 219:22 252:24 302:14
measure 48:6 49:17, 25 50:2 55:12 85:16 87:14 88:11 109:14,24, 25
measured 47:16 53:5,9 55:16 74:13 86:19 87:2,4,8 88:19,23 91:17 107:6 157:19,23 160:16 164:3,19 184:14,16 185:1 190:11,15 196:15,22 197:13 199:6 269:12 321:6 326:9 327:23 328:11
measurement 16:2 54:20 55:3,18 56:4 57:18 58:1,3 84:20 85:15 86:9 88:5,10,13 90:11 91:20 92:21 104:8 109:10,17 119:7, 18 161:3 166:4 167:10, 24 181:17 193:11 197:1 309:13 315:24 316:3,6, 15 317:15,18,21 318:1, 10,16 319:1 325:7,18 326:18,20,22 328:6,7,8, 13 330:15,17
measurements 86:16 110:17 165:23 166:3 167:5 172:17 197:3
measuring 47:2 87:20
mechanical 206:7 208:18
mechanism 191:25
meet 18:4 81:11 325:22 329:18
meets 327:4,13 331:3
memorized 168:16
memory 43:7 182:20
mention 244:18,23 245:4 247:14,19 248:8 249:3 332:1,18 333:14, 24 335:4,15 336:4 337:8,13,18
mentioned 16:23 17:16 31:6 33:7 55:1 79:5 84:19 126:22 130:20 160:25 223:5
Mercer 113:5,24 125:22
message 324:1,3
met 18:6 222:24
method 84:12 154:9 219:20 229:3 262:23
methodologies 52:14 282:23
methodology 86:13 135:6,15,17
methods 44:2 52:10
Michael 8:5
microforces 49:11
mid-band 191:9
mid-pass 191:10
miles 84:11,12
mimic 253:2
mind 14:8 15:17 16:7 18:2 25:17 134:12 169:12 170:25 187:7 222:9 235:25 252:5
mine 129:17 176:8
minimum 171:7
minor 206:25
minus 55:25 173:11 260:17 268:2 298:3 302:6 310:12,23 326:8
minute 258:5
minutes 11:7 62:23, 24 201:23 204:22 243:7 244:2 258:7 287:9 314:23 339:15
misinterpreted 201:24
missed 327:6
misstatement 265:18
mistake 164:12 201:24
mobile 31:8 39:18 40:5,8,19 207:10 210:1, 12,16,25 211:25 213:21 214:4,8,12,22 215:17 216:24
model 58:1 265:16 299:2 315:20 317:5,9, 10,13,16,19,21 318:10, 17 319:1,3 322:25 323:2,14 326:6
modification 206:25
modify 153:5
modular 219:13

module 26:2
moment 25:10 35:4 59:18
months 24:1
motion 26:2 102:19 219:13,19
motivated 256:17 257:2
motivation 320:13
move 108:20 109:1 166:23
movement 48:1,5 103:19 107:8 108:22 121:23 143:1,2 185:15 225:20 236:25 237:8 238:13 285:18 296:2
movements 35:17 87:12 103:14
moves 184:22
moving 105:17 109:11 110:9 296:8,11
muffled 97:7
multi-accelerometer 91:21
multi-dimension 249:22
multiple 50:16 114:25 115:7,17 122:16,18 175:1,3 203:25 259:20 263:3 283:3
multiplication 91:7 105:16 174:15 180:10 181:2 199:13 234:3,23 243:1 246:13 251:5 257:22 263:11 266:13 268:18 287:7 295:3 299:11,12,16 300:4 301:5,8,12,14 302:7,18 306:9 317:8 322:6 323:9
multiplications 178:9 180:4
multiplied 107:16 311:4 325:15
multiplies 339:7
multiply 103:22,23 111:11 160:18 249:16 265:3 291:12,19 292:10 295:5 300:6 304:5,7,9, 12 307:1,9 326:6,10
multiplying 99:13 105:9 174:9 294:2

N

named 102:17
names 17:1 71:5 209:10 211:15 213:3
Nasiri 16:17,19 39:18, 19,20 40:5,16,20,22
natively 162:10,12
natural 235:24
nature 279:6 326:21
necessarily 186:9
needed 31:25 34:14, 22 66:8,12 82:14 95:15 97:2 124:7 217:12 230:2 246:22 247:6,13 284:15 333:12
nine-month 24:2
noise 191:17,19,22,24 192:2,12 310:3,5,6
non-access 219:13
non-continuous 46:12 143:2
non-intuitive 258:3
non-linear 46:10 116:15 143:1
Non-substantive 279:4
nonresponsive 31:17 33:12 72:11 275:1
normal 84:23
normalization 257:12 298:5
notary 7:3
notation 166:17,18
note 27:4 54:13
noted 78:12 157:2 247:14 268:22 341:5
notes 17:8,14 222:20
noticed 14:18 59:23 268:20
notion 293:4
November 69:18 230:21
NQ 180:10,11 181:2,3
number 13:25 14:22 15:1 18:13 21:2 22:4 39:3 87:15 175:21,22 198:11 201:15 208:10 217:9 222:11 225:8 252:6 268:3 282:22 283:21 284:22 299:24 304:4,6,9,10,12,14,17 309:21 315:4 316:7 325:24
numbers 13:16 17:15 23:19 289:15 290:3,8 293:14,22 294:2,7 304:3,7 307:1, 10,11

O

oath 8:17 10:7
object 31:16 33:11 60:19 129:1 139:18 146:16 296:11,17
objection 28:19 29:25 30:4 31:2,24 33:2 34:6 38:2,11 39:16 40:4,24 41:8 43:8,10 44:17 47:3 49:18 53:23 61:22 64:19,23 66:4,15 67:24 70:11 72:10 73:10 74:21 75:5,13 76:15 77:21,22 78:23 80:14 81:1,20 83:6,9 84:24 92:12,25 93:18 94:7 95:1 96:20 115:4 116:6 117:18 118:18 119:11 121:18 122:24 123:3,19 124:23 125:9, 25 126:8,20 127:6,21 130:17 136:15 137:10, 19 138:1 148:25 149:23 151:20 152:9 153:2,12 154:6 155:7,24 156:8 163:7,14 168:13 169:22 170:24 171:12 174:6,7 176:25 177:13 179:5 181:10 183:3 187:15 188:10 189:8,14 193:17 196:17 198:1,9 200:5,9 201:3,20 202:17 203:2, 9 216:2,20 218:19 220:10 230:7,11 231:24 234:16 247:11 274:22, 23,25 276:8,10,11 277:5,6 278:12 281:8 289:25 290:19 301:2 316:21 331:7,21 332:12 334:20,21 335:13 337:4 338:25
objections 82:5 97:21
objective 189:18 275:16
objectively 189:22
objects 227:5 296:2
observe 248:7
obtain 58:4 100:6 120:16 121:14 160:14 314:4
obtained 318:18
obtaining 219:20
obvious 183:16
odometer 84:11
off-the-cuff 182:7
offered 313:7
Office 7:15
offices 11:4
omega 56:2,3
one's 207:13
operation 262:13,15 299:13
operations 267:21
opine 143:17
opined 81:23 82:2 83:13 140:5 154:2,14

186:5

opining 142:21,22

opinion 19:5 20:11 39:22 53:21 54:8 65:1, 18 66:17,24 73:16 75:12 81:3 90:12,20,23 92:11 93:24 94:17 95:11 117:12 118:16,20 129:7,8,22 130:9,21,22 131:14 138:13 142:9 144:3 146:17,18 147:10,14 150:17 152:19 159:17 179:25 180:12 182:5,8 188:16 190:5 202:19 203:6,13, 16,18 205:24 206:4,19 218:17 231:10,13 313:7 331:2

opinions 9:17 18:21 68:6 69:24 70:20 72:14, 24 94:24 128:23 129:5, 13,17,20 211:3 306:4

opportunity 95:6 187:10 188:19 275:9 277:24,25 278:2

opposite 310:11,18, 22 311:5

option 249:14

options 282:15

oral 208:24

order 37:5 110:2 147:10,14 149:11 151:4 153:8,25 188:16 192:9 196:3 227:4 291:13,20 325:6

ordinarily 74:15 75:10 76:6 77:9

ordinary 18:23,24 19:7,8,12,20 27:17,22 37:13 41:6 45:13,18,23 65:3,4,20,21 66:7,18,20 67:16 69:16 70:14,21, 25 72:16 73:5 74:14 75:24 76:24 78:5,13 79:8,11 86:7 89:24,25 90:21 115:9 116:19 120:6 122:14 123:10 124:12 125:3,4,12,24 126:5 127:16 130:6,8, 11,12,23,24 136:20 145:12 205:25 206:4, 17,21 207:5,23 208:1, 10 209:1 210:14 211:8, 18 213:12,17 215:1,20 216:1 217:4,16,24 218:3 219:4 230:2,19 231:3,9,16 237:19 239:4,15 242:20 245:17 246:8 249:7,16 256:16 257:2 264:2 266:17 267:14 270:4,9 274:6, 12 276:18 279:14 280:3 282:11,17,24 283:9,13 284:19 285:1,22,24 286:6,8 291:11 292:2,6, 24 293:2 294:3,6,20 295:19 297:25 299:9,20 305:3,13 311:17 312:8, 18 313:13 314:3 324:5, 7 331:6

orientation 16:1 100:1 105:24 136:23 137:15 138:21,25 139:9,10,13 141:2,21 160:23 196:21 234:13 239:12,13 286:20 287:24 291:11 292:11 295:14 297:20 317:11

orientations 139:6 224:11

oriented 106:17

origin 28:4 37:9 67:1, 12 242:7

original 15:20 17:7 107:9 291:11 292:11 303:13 305:22

outfitting 219:14

output 136:23 141:2 180:19

outputs 137:15 315:25 317:25

overcome 81:15

overlap 43:20 44:16

owner 80:5,24 82:25

owner's 82:20 89:20

owners 9:4

P

p.m. 156:23 157:2,5 205:1,5 258:13 259:5 324:17,20 339:18,21 341:3,5

Pacific 7:9 63:2,7 113:14,19 156:23 157:5 205:1,6 258:13

package 232:19

pages 90:5 265:12 274:6 291:3 334:8

paid 21:13

paper 14:14 54:12 73:24 79:19 259:13

Paper014 74:1

papers 135:7,16,19, 21 136:6

paragraph 18:9,13 19:1,16 24:11 28:7 47:19 63:17,19 64:9 65:6,25 66:9 67:14 68:3 69:15 73:4,20 74:6 79:21 82:12 84:7 99:8, 9,11 104:12,23 114:22 115:22 116:20,22 117:5 118:7 121:9 122:1,3,12 123:9 124:21 125:14 126:9 136:19 137:5,13 138:6 139:21 140:2,12, 21,22,25 141:11 142:9, 12 150:23 151:14 152:3,21 153:18 162:3 165:1,2,18,25 172:3 177:17 178:4 180:5 183:19 187:18 190:9 192:10 193:21 194:23 196:6 205:23 206:2,24 207:1,3,23 208:2 209:1 216:9,13 217:13 218:9, 15 219:24 222:7,21 226:6 227:24 228:1,5 230:12,18 231:18 237:16 238:1 239:10,23 240:14 241:17,18,20 242:7,24 243:14 249:1 259:9,10 260:6 261:4,6, 15,21 262:8,11 265:25 266:15,20,25 268:16, 17,25 269:16,20 270:3, 20 279:23 281:16 285:15 286:15,16 287:11,22 288:15 291:6 292:7 293:13 294:9 295:10 296:9 297:16 298:12 299:8 300:2 304:21 305:15 308:5,16 309:10 310:2 320:13,14 330:1 333:23 336:2,9

paragraphs 80:16 122:20 126:4 197:22

parallel 25:23 48:7

parenthetical 228:9

parentheticals 260:13

part 17:6 27:25 35:8 41:21 42:17 46:23 75:17 88:13 94:9 102:18 113:25 114:9,11 117:5 128:19 130:5 152:15,18 188:25 209:12 210:11 212:19 215:10 226:2,23 246:14 252:2,6,7 260:4,16 291:18 302:13 304:20 309:12 320:7,17

partes 9:14 11:24 64:4 114:12

parties 7:7 148:5

parts 27:15 36:22 42:4,7 61:19 94:10 133:3,5,10,13 252:2,3 277:11 304:19

pass 192:25 301:19

passed 196:13

past 72:8 108:5 188:4 222:12 224:8 235:14 303:15

patent 7:15 9:4 11:25 12:6,17 13:5,14,15 14:9 15:4,10,11,13 16:15,17, 19,21,24 18:10 24:20, 23 25:7,24 27:20,21 28:10,21 32:14 33:4,5, 22 34:16,25 36:3,4,5,9, 19 37:18 38:13,25 39:1, 3,9,11,25 41:2 42:2,15, 17,25 44:19 45:3 47:2, 10 55:8,9 57:11,13

59:8,11,24 60:14 61:18 66:5 69:17 80:5,24 82:20,25 83:25 86:6 89:20 108:24 118:8,20, 22,23 119:4,8,16 120:11 123:1 127:12, 22,24 134:10,18 140:11,12 142:4,5,16, 18,20,25 143:7 145:16 146:3 148:8,12,18 149:25 150:14 151:7 152:1 153:4,7,16 155:18 156:6 158:10 159:18 169:5 170:15 171:7,10,15,19,21,22 173:1,5 174:10 182:11 188:7,20 189:15 194:3 204:13,16 215:23 216:6 218:24 219:1,9,11,16, 23 220:2,3,25 229:8 230:20,23,25 244:14 248:3 252:18 265:8,22 274:21 281:21 312:1,2, 11 313:9,10,19 320:19 326:25 327:8 329:6 330:7

patent-at-issue 43:25 150:1,13

patentable 53:22

patentee's 229:6

patents 10:1,4,5 13:17,19,21 14:5,7 19:23 31:4 41:7,20 42:21 43:15,18 45:6 59:16 115:16 119:19 123:24 125:16 127:18 128:1 134:1,5 137:18 144:4 145:5,13 146:21 148:9,15 150:16,19 152:4,12 153:5,15 154:1 157:17 168:5 185:20 188:15,25 189:1,2 190:23 192:8, 11 197:9 250:5 256:23 257:7 336:20

patents-at-issue 10:2 19:11 43:17 45:5 46:15 123:23 124:15 157:12 252:13

patents-in-suit 170:18

Paul 8:8 11:4

pay 21:25 23:9,19 24:5 144:7 145:3

pedantic 211:2 212:3

pencil 14:23

pencils 175:22

pending 11:12 200:6

people 120:7 128:9 144:19,25 145:16 176:24 187:25 220:17, 20 221:5 225:7,13 232:5 253:12 254:18

percent 94:14 150:14 164:24

percentage 22:17 43:20

Perfect 30:20 161:17

perform 109:10 197:1 227:4 233:16 270:6

performed 44:23 171:14 189:20 236:20 246:2 248:4,6,7 337:6

performing 262:13, 15

period 212:15,17

permitted 72:3

person 18:23 19:7 65:3,21 66:19 70:14,21 78:4,13 102:10 115:9 116:18 122:13 123:9 124:12 125:2,4,12 126:5 130:12,24 136:10,20 138:15 204:2,3 206:4 207:23 208:9,25 210:13 211:7, 18 213:11,17 215:1,20, 25 217:4 218:2 219:4 220:15 222:22,24,25 223:1 231:3,8,15 237:19 239:3,15 245:17 246:7 249:7 256:16 257:1 264:2 266:17 267:14 270:3 279:14 282:17 283:8,12 285:21,24 291:11 292:6,24 295:18 297:25 299:9 305:3 331:5

personal 22:18 281:3

persons 120:5 127:15 284:19

petition 11:24 63:9, 14 64:5

petitioner 8:9

petitioner's 80:9

Ph.d. 8:20 69:10 113:5 135:20 136:9 157:8 223:23 303:22

phenomenon 328:12

phone 39:18 40:5,8, 19 48:16 49:7

phonetically 223:4

phrase 66:23

physics 110:8 208:13,21 209:4 211:14

Pi 288:12 289:7 292:10

pick 287:4

picked 49:1 287:6 288:22

piece 301:6

pitch 55:24 99:14 103:24 104:3 286:20,25 291:10

PKF 89:1

place 109:20 233:24 266:18

places 85:13 272:10 277:22 281:13 282:23 284:24 323:16 325:24

plain 18:22 19:6,11,20 31:8 37:12 41:6 45:13, 22 65:2,20 66:18 75:24 76:24 79:8,11 86:6 89:24,25 90:20 125:24 130:5,8,11,23

plainly 324:4

plan 30:17

plate 48:7

play 107:12 176:6

player 237:1

playing 238:5 253:15,17

pleading 74:7

plenty 280:2

plug 313:3 321:16

plugged 290:3

plugging 268:13 293:22 323:23

point 11:8 37:9 39:23 49:22 61:8 70:9 78:3 106:13 109:6 136:4 146:2,23 153:1 163:15 171:9 221:1 268:23 274:15 334:7

pointer 31:10,13 32:4 33:10,17 34:1,4,11,19 36:12,16 37:23 39:6 59:7,10 101:13 108:19, 20,22 109:1 177:25 195:25 199:4 223:2,5,7 296:18

pointers 39:8,12 221:16

pointing 24:13,15 26:9,19 27:19 28:3,4, 12,17 29:2 31:1,7,22 32:7,24 35:21 36:17,23 37:8 38:17,22 39:10,15, 21 40:3,9,14,21,23 58:20,22,25 59:3,14,15, 19,21 60:4,12,17,21,22 61:1,2,9,16 62:4,9,11 67:1,2 99:24 100:3,4 102:19 105:12 106:1,3, 9,16 107:2,10 111:8 139:14 149:14 169:15 170:15,17 173:7 186:4, 7,13 187:1 220:12 221:1,6 250:7 296:7 319:5

points 237:9

popular 103:18

port 235:19

portable 38:15

portion 51:4 93:3 148:3

portions 43:16 135:22
POSA 71:10 126:18
POSITA 75:25 78:12, 22,25 114:24 121:14 206:12 225:1
position 74:11,24 75:8,22 76:19 107:9 108:19
positions 45:1 129:25
positive 201:12
possibility 121:25 185:14 248:19 257:4 336:15
possibly 144:22 167:20
potential 256:20
potentially 38:20 170:9 171:24 174:25
power 166:8
preamble 35:1 37:20
preambles 70:10
precise 100:4 229:1
precisely 49:14 84:7 105:5 326:16
predecessors 10:2
predict 84:13 160:8 197:2
predicted 45:14,20 52:17,20 53:8,16 54:9, 20 55:7,10,15 57:1,6 58:8 74:13 80:7 81:9 83:1,13,25 84:5,9,14, 15,17 85:5,7,8,9 86:5, 15 88:12,15,19,23 90:7, 15,25 91:13 92:2,21 95:12 99:22 104:6,11, 13 122:10,15 123:11 124:1,14,17 125:6,18, 19,23 126:19 154:3,7, 18 155:1,12,16,20 156:4 157:13,18,22 158:5,10,13,17,24 159:1,14,18 160:4,12 167:10,24 172:16 181:16 193:11 196:23 199:7 202:7,25 269:3,5 281:18,19 304:25 305:5 309:12 310:14 311:1 313:4 319:6,11,14 320:18,21 321:7,19 323:10,13,15,19 325:4, 12,20 326:12,14 327:2, 10,22 328:16 329:9,14, 22 330:8,18 331:1,14
predicting 160:9
prediction 80:6 85:25 86:11 90:16,23 91:11 99:24 123:12 124:2,18 125:20 154:4, 8,9 161:3 327:25
predictive 100:5 197:12
predicts 45:21
prefer 255:21
Preferably 63:9
preparation 17:25 18:5 41:22,25 43:13
present 26:4 158:1,4 159:24 244:23 245:5 247:14 248:8 275:15
presented 281:20
presents 244:18 249:3 332:2,18 333:15, 25 335:5,16 336:5
pretty 11:20 182:19, 20 245:17 267:6
preventing 10:18
previous 26:22 53:7 55:14,25 56:1 75:21 114:3 157:21 260:16,19 273:23 274:1
previously 9:21 93:10,12 179:11 189:7 195:21 208:5 326:7
primary 161:23
principals 140:18
prior 41:4 134:4,8 147:23 178:4 182:12 189:16 231:8 307:14
priori 54:19,21 55:2 57:8,17 84:19 85:14 90:10 92:20 104:7,8 325:6,17 326:1 328:5
privilege 96:25 97:2
privileged 68:1 128:7,10,11 131:17,22, 25 132:5,18 143:25 278:14
problem 13:1 124:21 126:15 313:6,16,20
problems 126:13 219:2 231:1
proceed 8:12 26:14 64:8 70:7 98:25 99:2,3 148:14 318:24
proceeding 13:4 29:19 145:22,25
proceedings 9:14 189:11 229:7
process 114:12 133:20 203:7
processing 191:7, 25
produce 222:11
produced 307:5
Professor 132:20 161:9 205:8 283:25
professors 277:15
project 105:11 225:4, 7
projects 222:2
pronunciation 9:7
proper 83:9 126:22
properties 251:2
propose 19:15 20:3
proposed 24:12 80:9
prosecution 134:9
protected 131:17
prove 195:9 242:22
provide 17:12 28:8 30:7 46:22 71:5 81:3 95:10 117:11 129:24 140:19 150:17 152:2 153:18 172:18 181:5,25 188:16 189:16 190:5 202:19 203:6,13,14,16 232:16 244:13 278:16 284:13 297:12 306:20 329:1
provided 17:17 33:6 36:9 39:22 41:18 44:9 45:10,19 81:5 85:24 90:8 93:7 94:24 95:16 100:6 112:23,24 124:11 129:5,13,17 131:2 142:8 145:5 146:4 161:20 162:24 182:7 189:11 201:7 206:19 207:13 216:12 233:11, 14 234:21 239:21 242:23 248:25 263:25 266:3,4,24 285:14,19 290:23 297:7 311:19 319:24 320:12 335:11 337:23
providing 91:11 118:19 127:4 128:22 199:23,24 244:7 287:3 290:2 292:4
provisional 244:6, 12,17,22 247:8 330:21 331:9,16,25 332:17 333:10,13,20,23 334:12 335:3,15,19,22,25 336:4,7,24
provisional's 335:10
Psi 58:14,18 101:1 105:20,22,23 106:8,12, 14 107:2 108:4,11 109:3,9 111:6 139:13 154:21 260:20,22 262:5 266:21 273:9 321:4 325:9
PTAB 77:19
public 7:3
publication 15:15, 18,24,25 16:8 315:4 336:21
publications 135:24
pull 11:17 24:22 30:23 63:8 73:22,24 79:18 99:4,7 113:1,20 147:7 161:6 204:13 205:11

259:7 315:7

pulling 307:3

punishable 68:19

purely 20:23 134:25

purpose 66:17 105:9 116:16 143:11

purposes 18:21 19:5 65:1,18 130:21

put 37:12 49:15 147:5 204:12 207:18 216:18 252:8 277:25 284:15 293:14

Q

Q-HAT 167:11 173:12,24 174:9,16 175:4

Q0 271:4 289:7 316:25 317:7 323:6

Q1 313:2 316:25 317:7 323:6

Q2 313:2 316:25 317:7 323:6

Q3 313:2 316:25 317:8 323:6

Q4 313:2

QK 298:2,3

qualify 37:25 211:18 217:3

quantity 86:12

quaternion 53:7,8 54:23 55:14,15,22 56:1, 7 157:21,22 162:8,13, 23 163:10 168:23 177:20 178:8 180:3,9, 20 181:1,14 199:13 207:10 209:24 210:11, 16,24 211:25 213:21 214:2,11,22,25 215:3,8, 11,16,19,22,25 216:4, 15,24 217:3,7,10 222:13 224:14,25 225:2,9,18,22 226:3,14, 18,21 227:1,3,19 228:18 230:1 232:1,4,6, 8,25 233:3,4,14,20 234:11,15,19,24 235:10,13,16 236:1,13, 14 237:2,4,23 239:7,14, 19 240:11,21 241:6,9, 22,24 242:6,17 245:8 246:8,12 247:1,20,22 249:18,22 250:19,21,24 251:8,12,15,20,23,24 254:1,4,17 255:4 256:10 257:23 260:10, 14,17,19,23 261:19 262:2,5,10,14,21 263:9 264:6 265:14,15,17 266:2,22 267:4,6,12,13, 21,22 268:1,4,8,14 269:22,25 270:5,16,19, 24 271:13,19,21,25 272:18 273:1,13 274:5, 11,15,18 277:16 279:13 282:10,13,19 283:1,6, 10,14,18 284:18 285:4, 5,8,18 286:2,4,10,11 287:23 288:1,24 291:1, 9 292:8,11 295:2,5,9, 14,20,23 297:20 298:5, 6,16 299:5,12,15,23 301:4,8,12,25 302:2,4, 9,13,15,18,20 303:5,8, 12,17,18,24 304:17 305:6,7,17 306:9 307:9 309:6 311:15 314:9 315:18 316:3,5,16,18, 23 317:8,14 318:6 319:3,18 320:5,7,16 321:17 322:1,16 323:4, 7,9,18,20 327:2,10,22 328:15,21,24 329:9,13, 16,21 330:10,14,22,25 331:15,19 332:2,6,19 333:1,15 334:5,16 335:16,20,23 336:5,17, 18,23 337:9,16,18,19, 21 338:23 339:4

quaternion-based 16:1 236:2 248:25 319:10

quaternions 162:5, 10 163:6,12,13 224:15 228:12 229:9,12 230:5 231:11,15,21 233:22 235:22 240:25 242:10 244:9,15,19,21,24 245:5,18 246:1,19 247:10,15,18 248:9 249:4,19 250:12 251:3, 9 255:13,18 256:18 257:3,16 261:10,14 263:17 264:14 266:18 273:21 274:3,10 276:16 284:25 291:13,20 296:23,25 301:6 314:7 315:2 318:3,11,15 322:9 333:19,25 334:13 335:5,9 336:11 337:3, 13

question 11:12 21:19 23:17 24:17 26:13,15,23 28:22 29:5, 6,23 30:11,15,21 31:19 32:12,23 33:14,15,20 35:22 40:12 42:3 50:5, 12,15 51:1,17,18 60:1 67:6 68:23 69:5 76:4 84:25 86:4 90:18 97:3,8 98:15,16 105:14 126:17 129:9 135:10 143:12 163:1 164:16 177:2 196:8 198:13 200:6,19 202:22,23 203:11 226:19 228:11,19 229:12 230:15 234:6 240:17 248:12 254:21 267:8 272:22 273:17 280:4,5,13 284:7 291:23 300:8 312:21 314:10

questions 10:11 29:9,10,14,22 30:14 56:18 71:19,21 72:8 97:23 143:21 176:24 200:13 201:11 204:3 271:9 275:6,22 278:2, 10,18 284:1,11 288:17, 21 339:24

quick 17:13 258:5

quicker 70:9

quote 141:15 326:25

quoted 229:24 326:24

quoter 136:11

quoting 26:8

R

rage-baiting 277:1, 3

rate 22:9,10 295:13

raw 51:2 52:14

Ray 113:4

read 11:21 13:16 42:17 53:13 77:23 80:12,17,20 81:2,8 86:5 89:23 92:13,16 93:1,20 94:5 95:20,24 98:12 102:14 116:4 118:15 119:19 137:3,7,8 140:8 141:16 143:6 149:24 151:13 155:14 156:1,5 165:6,7,13 167:8,15 171:18,20 172:2 175:15 178:10 180:14 181:5 184:3,19 186:10 187:12 189:5 193:20 194:4 195:4 200:11 203:17 212:7 220:3 229:3 284:8 300:7 324:5,7 332:8 336:6

readable 257:10

reading 27:22 50:8 56:2 63:25 64:15 74:17 78:18 80:11 82:22 120:11 139:20 151:18 152:7 166:6 178:11 181:18 190:17 197:20 212:13 317:1 327:7

readings 50:14 136:24 141:3 297:22

reads 74:10 329:6

ready 8:11 25:20 151:1,8

real 108:9 220:15 252:2,6 253:3 304:20 326:18,20,21

reality 138:13

realize 39:4

realized 138:19

reason 111:24 179:20 181:8 198:7 201:22 205:17 207:14 233:25 245:6 248:14 262:12,18 264:8

reasonable 63:24 64:14 77:25 179:3,4

reasons 122:17 264:4 333:17
rebuttal 161:9,13 208:4
recall 9:24 18:2 21:2, 17 22:15 23:1,18 41:14 93:19 114:4 147:20 161:25 162:6 193:5 200:24 224:17 280:19 281:3 320:11
receive 21:22 23:21
received 221:25
receives 47:13
recent 220:24
recently 42:10 147:25 220:18
recess 63:4 113:16 156:25 205:3 258:15 324:18 339:19
recite 182:21
recognize 78:14
record 7:2 21:9 22:22 63:2,6 95:22,25 96:1 98:10,11,14 113:14,18 132:10,12 151:10 156:23 157:4 205:1,5 243:4 244:2 258:13 259:5 324:15,17,20 339:10,14,18,22 341:4
recorded 7:17 12:23
records 21:4,6
redirect 339:12
reduces 307:18
refer 14:8 15:12,17 16:7,18,24 25:23 61:10 73:4 89:3 102:9 148:19
reference 19:16,21 24:14 26:4 28:2,11,12 35:20 36:13,15,19,24 37:2,6,7 38:8,9,18,19 40:16 57:23 58:11,15, 17 59:3,4,8,10,13,21,22 60:7,18 61:11 63:20 64:11 65:8,16,24 66:2, 12,23,25 67:9 99:25 100:9,14,17,19,25 101:5,7,9,12,13,17,20, 23 102:1,2,16,17,22 103:11 105:12,18 111:10 112:12,14 138:9 148:21 149:19 161:23 167:12,13,21,22,25 168:2,3,19,20,22 169:1, 3,6,14,17,19 170:3,13, 16 171:16 172:22 173:4,7 175:7,14 177:6, 22,25 178:1,8 179:15 180:3,9 181:1 183:10 184:17 185:2,11,13,20 186:1,8,13 187:1,5 193:22 200:10 201:5 216:6 219:16 250:22 251:14,17 270:12 279:18,22 280:2 306:5
references 111:24 138:17 163:19 179:8 280:21 281:4,11,14 306:11
referencing 102:10 220:9
referred 26:18 125:17 252:4 283:3
referring 20:16 46:17 47:17 61:20 70:2 99:18 159:19 167:16 168:4 176:1 194:23 238:9 263:14
refers 28:11
refigure 195:14
refresh 169:11 170:25 187:7
refused 183:14
registering 48:18 49:9
regularly 88:11 135:18
reinterpret 195:13
relate 43:22
related 15:9 58:19 65:12 75:1 94:12 100:15,19 104:3 105:25 122:2 127:17 134:11 152:3 174:25 188:24 206:8 208:19,22,24 209:7,13 210:9 211:16 212:5,9,14,23 213:3 219:11 220:12 225:24 226:1 229:7 242:4 248:9 250:19 266:4 274:2 280:18 281:4 292:12 295:6 309:21
relates 95:5
relating 219:1,8,23 230:25
relation 18:10 86:1 107:3 122:25 142:16 171:21 273:24 280:22 331:24
relationship 10:5 43:24
relative 7:5 103:9 159:9,20 250:23
relevant 42:7 103:10
relied 69:22 73:8,15 114:15,17 127:10,13 129:5,13,21 163:5 228:10 279:21 306:23 307:13
rely 69:23 70:2 72:23 114:20 129:19 153:10 228:21 279:18 305:18 306:3,11,25
relying 27:4 40:22 190:4 218:1 228:11 306:24
remain 275:24
remains 298:6
remember 23:2 24:5 53:19 93:17 109:3 128:17 133:7 134:22 135:4 161:22 162:4 169:25 182:22,24 193:24 195:2 224:22 281:10
remind 168:15
reminded 193:5,9 198:4 199:16
remote 31:11 220:19, 25 221:14,16 253:11
remotely 7:11
remove 190:16 191:2,15 192:4 193:2
renders 53:15
repeat 76:4 98:1
repeatedly 336:10
replace 262:9
replacing 261:25 262:4
report 65:7 66:10 73:5 84:8 117:20 124:7 130:10 132:21 133:1,10 138:6 140:22 142:9,13 242:25 305:15 328:4 330:2,5 331:9
reporter 8:13,15 24:16 99:3 113:10,11 120:25 166:22 289:21 340:11,18
reports 115:23 117:16
represent 7:24 8:1 57:5 87:3 91:4,19 105:23 106:2,12 108:1 109:8,13 167:2,5 224:10 251:8,21,25 266:22 299:12
representation 117:25 118:2 234:12 237:22,23 239:7,8,14, 19,20 240:11,21,22 241:8 242:16 254:13 283:5,19
represented 9:22 149:18
representing 9:3 106:16 164:18 291:9
represents 57:6 106:10 108:2 172:9,15 175:20 177:23 180:20 183:23 184:7 190:11 194:6
request 17:19
requested 30:9 203:25
require 82:21 83:2 89:21 96:22 97:22 226:14,20 227:13
required 58:8,9 65:15 66:3 67:8 69:22 155:2,13 226:8,12,25

257:13
requirement 57:10 82:18 84:6 89:18 92:7 219:5 227:19,21 330:14
requirements 209:15 217:19 222:24
requires 80:10 85:4 138:3 266:13 275:17 329:7 330:7,24
requiring 273:22
requisite 224:25
research 69:7 218:6, 9 280:18
resolve 331:20,22
resources 247:7
respect 28:5 36:16 37:11 67:3 75:17 92:17 101:1,3 102:25 107:9 108:3 111:7,10,23 125:20 159:21 167:12 168:19 170:17 171:15 188:6 198:11 245:2
respond 35:23,25 126:23 202:11
responded 97:3
responding 30:3 83:3
response 32:21 35:24
responsible 32:21
Responsive 113:4
rest 30:19 48:10,17 75:20 95:6 107:8 145:9 150:11 280:11 284:7 302:1
restating 85:1
result 103:25 307:17 311:6 332:11,15
resulting 219:14,21
resumed 157:9
return 30:9
returning 57:15
reveal 20:6 67:22 68:10 127:7 130:19 143:15,24
revenue 22:18
review 9:14 11:25 12:18 17:10,23 24:18 25:1,5 27:12 36:2 39:8 47:7 54:11 64:4 79:14, 22 80:19 86:21 87:19, 23 100:10,13 114:12 116:25 127:3 134:1,5, 13 140:3 150:18 151:5, 7,11 157:15 158:8 164:21 167:19 175:6 177:16 178:21,23 187:6 188:19,23 195:6 198:2 201:6 202:10,14,18 204:1 209:17 210:8 219:10 228:6 259:22 314:15,18,23 315:13 329:25
reviewed 42:14 43:3, 12 114:11 123:23 127:22 134:8 147:23 152:13 177:3,7 189:1 198:3 200:25 203:5
reviewing 126:11 153:4 198:16
rewrite 242:8
rewriting 274:4
rid 191:1,8 192:1,14
rigor 135:6 188:3
rigorous 135:8,15
ring 324:2
ring-based 223:5,6
rings 48:23
RJ 250:10 252:4
Robert 8:7
role 143:10 144:5,12, 14,23 145:2,14 146:11
roll 55:24 99:14 103:24 104:3 286:20,25 287:24 291:10
room 10:22,24 97:6
rotate 166:13 178:5 180:6,23 181:14 251:4, 6,7 292:13,18,19 294:14,15
rotated 103:8 193:12 194:21 197:11
rotates 180:1
rotating 57:22 311:9, 10,12,13
rotation 35:17 57:20 58:4 99:13 103:16,17, 23 104:2 105:10,15,19, 21 107:16,23 108:3 154:20,21 177:24 180:21 185:15 227:4 236:16 251:18,21 267:5 270:5,17,24 271:13,18, 20,23 272:5,13,19,25 273:4,6,20 274:5,9,11, 17 276:15 279:13,22 283:10,14,15 284:18 285:6,7,17 287:25 291:10 292:9 293:4,8 294:12 296:1 307:18 308:1,7,13,18 309:5,15, 22,24 310:18 311:3,8 314:1 319:25 320:10 325:9,15 328:2
rotational 46:3
rotations 100:25
rough 340:19,21
roughly 21:1 22:25 224:17
round-off 264:6
rules 96:21 97:21
ruling 152:18
run 190:24
rush 340:23

S

Sachs 16:17
salary 23:10,20,25 24:3
Samsung 7:12 22:13 74:7 75:22 76:13,19 77:18 78:12 79:25 82:15,25 83:3 93:9,11 94:23 113:24 127:25 128:2,5,15 147:15
Samsung's 20:4 67:20 74:11,23 75:7 81:11 94:24 147:21
Sarrafzadeh 7:18 9:8 11:23 161:10 205:9 341:2
satisfies 106:5,24
satisfy 84:6
savings 246:18 256:21
scale 144:8 145:3
scan 17:13
schematic 25:25
school 144:16
science 32:19 99:21 126:14 151:21 174:13, 17 176:7 199:19 201:5 206:6 207:6 208:17 211:13 213:9,15 221:22 255:6
scientific 32:21 126:23 135:7,16,18,21 175:17 177:15 183:6 187:21,22 188:2 202:4 203:7 211:3 229:2 278:8
scientist 117:10 152:7 203:16
scope 41:9 49:19 64:20,24 74:22 75:6,14 76:16 77:22 78:24 80:15 81:1,21 83:7 95:2 119:23 126:7 144:21
scratch 246:6
screen 18:11 25:8 27:25 32:4 33:10 34:1, 20 35:6 36:12,22 37:24 39:7 65:10 89:13 92:7 101:7,9 108:23 140:25 165:3 198:18 221:2,7 236:21 237:1,9 238:12, 14 253:3,15,17 259:12 261:13 317:4
scroll 78:8 80:1 122:6 167:2 173:9 187:18 197:23 205:22 227:16 228:8

search 280:21
searches 281:5,12
sec 178:20
seconds 338:14,15, 18
secret 324:1
Section 68:20
sections 233:23
secure 309:14
seeking 33:15
select 111:20
selected 17:20
send 22:1
sense 16:9,25 36:17 50:6 51:1 52:5 81:16 108:15 174:22 243:5 257:19 263:9,13 312:22 328:12
sensor 26:2 44:3 49:22 58:17 59:2,13,20 60:6 108:7 141:21 162:4,7 167:22 168:25 169:3,5,9 170:2 172:22 173:3 177:24 178:7 179:15 180:3,8,21,25 181:16 183:24 184:17, 23 185:3,24 186:2,6,12, 25 193:23 194:8,21 195:1,24 196:10 197:11 206:9 207:9 209:19 210:10,15,22 211:24 212:20 213:16,19,25 214:10,20 215:15 216:23 219:13 222:14 223:15,20,21 315:25
sensor's 167:25 168:1,20,21 193:12
sensors 47:11 58:23, 24 59:19 60:4,9,20 61:6,21 91:23 167:13 169:8,18 170:7 172:21 209:16 210:15,22 211:23 213:6,10,24 214:11,20 215:14,18 216:23 235:18
sentence 18:20 19:4 74:10 75:3,9 77:1,2 80:13 82:12 89:16 92:6 93:24 94:12 102:15 116:20 117:12,22 118:5 127:1 149:13 155:25 166:1 171:3 172:4,6,7 178:15 183:21 184:5 186:10,11 198:10,15 211:6 212:8,12 229:6 240:16,18 241:11 249:5 267:18 309:11
set 15:8 184:14 190:12 281:19 297:19
setting 89:10
setup 112:25
shape 31:10
share 43:16 74:25 95:8
shared 127:18 148:16
shawn 259:2
shell 131:2
shoes 254:12,14
Shore 8:5
short 56:19 62:20 95:20 98:23 204:19 275:5 324:11,13
show 12:14 27:3 34:14 41:14 44:6 94:9 116:21 159:3 165:22 239:22 246:25 260:1 265:3 288:23 297:13 312:16
showed 28:9 54:8 322:4 339:6
showing 26:1 38:15 55:20 65:9 75:8 77:24 90:5 93:3 94:13 100:2 137:21 138:6 153:19 164:7 201:15 270:19 271:23,24 272:5 302:10 308:21 309:7 312:10 315:1 320:14 322:18
shown 26:5 27:13 29:1 31:9 41:25 54:3,4 55:20 56:6 76:20 87:25 91:12,24 92:18 95:13 101:10,14 130:3 134:14 217:21 233:13 234:1,17 240:14 242:25 247:2 256:2,7,12,13 261:10 266:9 268:15,18 270:12,22 274:12 285:13,16 287:11 308:19 328:3 330:2
shows 31:15 32:2 33:8,25 34:18 37:22 39:20 55:5,22 57:9 86:14 89:9 155:8 197:25 234:20 241:3 242:12 250:24 256:1 264:11 266:7,20 267:4 269:24 271:18 276:19 283:22 285:4,5 286:4 295:1,8 297:1 305:16 314:2,4 316:17 322:2 326:17 328:22 332:25 333:1 336:18
sic 12:6 235:19
side 207:19 260:8
sign 246:15 263:8 268:23 271:3 321:13
signal 47:12 184:14 190:23 191:3,6,16,25
signals 190:12 191:16
signed 68:22
significant 43:16
silence 314:23
similar 43:22 248:18, 23 282:8
similarities 43:19
similarly 103:9 256:25
simple 234:22 243:1 257:22 259:17,24 268:12,18 270:16 285:17 291:23 320:2 339:7
simpler 31:19 86:4 156:3 287:7 297:7
simply 74:11 234:2 266:24 271:12 289:9 297:6 334:5
simultaneous 96:14 98:2 332:21
singularities 256:21,22
sir 16:14 27:1 56:22 72:18,20 79:15 96:18 240:15
sit 150:22 253:12
sitting 48:16 115:8 117:7,9 137:24 170:19 177:10 202:21 222:10 224:20,21 314:22
situation 112:1 141:12,16 191:7 246:20
size 277:13
SK 55:23
skill 18:24 19:8 27:17 45:18 65:4,21 66:7,20 69:17 70:15,21,25 73:5 74:14 78:5,13 115:9 116:19 120:6 122:14 123:10 124:13 125:3,4, 12 126:6 127:16 130:12,24 136:20 145:12 205:25 206:4, 17,21 207:5,23 208:1, 10 209:1 210:14 211:8, 19 213:12,18 215:1,20 216:1 217:5,16,24 218:3 219:4 230:2,19 231:3,9,16 237:19 239:4,16 242:20 245:17 246:8 249:7,16 256:16 257:2 264:3 266:17 267:14 270:4,9 274:6, 13 276:18 279:15 280:3 282:11,17,24 283:9,13 284:19 285:1,22,24 286:7,8 291:12 292:3,6, 25 293:2 294:3,6,20 295:19 297:25 299:9,21 305:4,13 311:17 312:9, 18 313:14 314:3 324:6, 8 331:6
slew 252:15
small 93:3 165:4 207:21 277:13
smart 220:13,19 254:12
smartphone 37:25 38:4,8 39:14 40:2,14 61:7

smartphones 49:16
smoother 29:11
soccer 235:20 237:1 238:6
software 191:6 227:7,11 228:18,21,23
softwares 227:12
soldier 62:16
soliloquy 176:10 280:12
solution 219:2 231:1
solve 312:19,25
sort 190:25 238:19,20 246:15 253:18
sounded 144:1 254:9
sounds 44:5
space 142:21 236:17 238:8 252:1 296:18 309:23
spatial 19:16,21 26:4 28:11 35:20 37:6 38:8, 18 63:20 64:10 65:8,16, 24 66:2,11,23 67:9 169:16 177:25
speaking 46:21 123:22 191:21 250:1 251:7
speaks 65:17 145:10 181:11 189:3
spec 39:4 44:21
special 89:8
species 30:22
specific 39:17 40:18 46:24 90:9 120:7 222:9, 18,22,25 239:21 242:3, 23 266:7 285:19 293:5 303:21 319:25 337:22
specifically 59:12 79:21 80:5 91:6 102:15 123:9 171:2 177:23 234:5 265:7,15 282:14 318:12 325:17 328:5,23 336:17
specification 43:17 127:18 148:16
spend 20:24 29:17 134:19 136:9 253:14
spent 21:3,10 217:2
spot 182:6
stand 181:24
standard 267:13
staring 150:22
Stark 7:2
start 25:18 106:22 107:7 108:18 111:19 131:3 165:5 214:7 287:8,9 291:22 315:15
started 59:24 134:7
starting 24:21 47:8, 18 55:21 171:8 239:23 242:24 266:25 267:19 268:16 285:14 289:16 320:13
starts 63:17 64:10 183:21
starving 258:10
state 7:23 54:22 57:8 88:9 106:25 109:9 158:11,18,19 159:2,15 160:5,7,13,15 197:1 242:14 260:21,24 261:16 262:1,9 265:16 281:17 283:4 285:11 295:2 299:2 306:8 307:8 315:20 316:20,24 317:5,9,10,13,14 321:3 322:18,25 323:1,14 326:1,5 330:2 339:2
stated 32:2 33:23 34:17 54:17 68:12 129:8 130:2 180:20 186:3 213:7 260:6,16 286:13
statement 64:18,22 65:12 74:20 76:12 77:11,19 78:21 82:7 118:17 121:17 122:23 137:9,16 138:14 143:3, 9 155:15 229:12 241:21 256:24 266:4 273:15 276:13 284:6 336:1,8 337:1
statements 68:13, 15,17,18 280:10
states 7:14 57:16,18 58:19 68:21 106:7 160:16 262:20 263:19 325:5
stating 34:13 272:1 280:10 332:16
statute 71:25
steering 110:10
Steno 7:3 8:14 12:13
step 87:1 238:7 257:12 298:2 302:2 304:1
stick 83:11 284:10
straight 233:8
straightforward 233:11,15 247:3 251:13 256:11 261:18 263:25 266:12 272:2 274:20 276:17 288:23 290:25 322:5 323:24
student 136:9 223:23 232:12,18 303:12
students 69:10 135:20 221:12 222:11 225:16 226:17,25 227:14 228:22 232:21 233:2 303:22
studied 70:24 108:7 222:13
studies 222:4
study 304:15
stuff 59:25 182:18 331:5
subject 35:16 210:9
submit 205:18,20
submitted 9:17 12:5 13:8,10 14:6 15:3 41:21 42:11 170:21 200:14 205:13
substance 284:10
substantively 133:8
substitute 261:19
substituted 259:21
substitution 259:17,25 260:23
subtract 326:4,18,19 328:12
subtracted 326:3 330:17
subtracting 328:10
subtraction 263:12
subzero 99:20
succinct 275:5
succinctly 275:22 277:20
suffering 312:15
sufficient 23:16,22 117:14 189:10 232:20 330:22
suggests 45:16 55:22
sum 121:11
summary 244:10
supervised 225:16
supervising 69:10
support 11:24 23:11, 22 64:6 129:19 218:2 229:11,22,23 230:13 244:7 330:22 331:18 336:25
supports 244:13
supposed 91:18 96:18
surface 31:8 238:16
swapping 13:3
swear 8:15
sweaty 253:21
switch 333:18
sworn 8:22
syllabus 302:8 303:10
symbol 201:24 323:7

symbols 109:4 173:24 201:16

synced 340:1,8

system 31:15 32:3 33:9,25 34:18 37:22 86:17 224:5,7,11,22 256:9 302:12 310:3

systems 206:9 224:8 235:12,15,25 252:16

T

tab 15:14,24 16:10,21 17:15

table 14:21,24 48:16, 17 49:7 311:19,23,24 312:3 313:9

tabs 15:1 17:4,5

tailored 224:7

takes 142:20 184:21 195:22 234:4 295:4

taking 7:10,20 8:2 37:21 42:11 105:16 194:20

talk 36:12 46:16 59:12, 16 60:25 61:3,5,6,21 98:10 162:7 169:16 170:12 194:25 261:24 269:21 336:21

talked 90:9 99:19 128:9 279:2

talking 30:22 38:13 46:21 47:10,12 53:4 57:13 59:24 60:19 61:12 91:7 104:23 106:18 108:5,10 125:17 137:14 143:1,8 157:14, 19 165:16 166:20 169:9,10 170:4,6 171:11 172:22 179:13 188:9 220:22 240:4,8 259:8 277:13 285:9,10 310:14,21 313:6 316:19 322:24

talks 38:14,23 39:18 55:9 59:14 62:3 83:25 85:13 86:25 89:7 91:23 100:16 102:16 119:4,16 156:9 157:17 162:6 241:3 273:23 282:5 293:3 296:1 299:22 310:7 336:17

tangents 277:21

taught 225:14,22,23 303:17

teach 12:9 144:18 176:23 177:8 225:21 232:13,24 233:2,19,21 234:8 247:17 268:6,7 274:20 297:14 301:11 314:6,11,13

teacher's 144:12,14

teaches 161:2 162:13,22 163:9,11 234:5 264:17 265:1,5 266:1 273:12 289:11 302:9 312:7 314:21 321:8 322:10 326:17

teaching 59:17 69:7 108:25 226:3 232:12 245:10,13 248:22 271:2 273:5 274:16 294:18,19 301:23

teachings 301:21

tease 51:3,6,10

technical 30:6 51:7, 10,19,21 54:6,7 108:18 138:15 146:2,23 153:13 163:15 168:16 174:13 182:11,12 189:16,19 199:24 206:8 208:19,22 209:7

technically 60:11

technologies 207:11 210:2,12,17,25 212:1 213:22 214:4,23 215:17

technology 187:24 209:11 218:24 230:23

television 31:11

telling 98:4 200:2 216:16

tells 86:16 109:19 282:14 296:21 317:18 318:7,13 319:17

temperature 48:23 49:1 279:5

temperature-controlled 49:6

ten 62:23,24 113:11 204:6 292:18 294:14

term 19:10,16 27:20 38:22 39:10 40:23 45:14,16,17 51:7 61:25 62:1 63:21 64:11 65:8, 15,23 66:3,24 67:8,15 74:12,15 75:10 76:1,5 77:5 79:9 104:9 114:24 115:15 117:4 119:20 122:15 124:9,13 125:6, 23 126:7,18 152:20,22 155:15 157:13 159:17 171:22 173:5,14 174:12 176:3 276:25

terms 14:25 17:3 41:7 44:13,16,22 45:9 51:20, 22 60:24 63:22 64:13 68:5 95:12 120:8 125:13 142:4,6 148:5 149:12 151:23 153:5, 13,14,20 168:16 171:23 260:20 261:20 262:25 279:4 283:18 301:24 321:12 330:13

testified 8:22 69:21 157:9 193:10 336:11

testify 14:2 96:19 151:2,4,8

testifying 10:8,19

testimony 118:1 170:23 229:20,23 306:6 334:18 335:12 338:20

Texas 147:16

textbook 70:24 72:16 302:16,19,20

textbooks 69:9,12, 22,25 70:1,19,22 71:4, 11 72:13,19,23 135:24 136:2 302:24 303:14 306:13

theory 71:10 232:24

Theta 58:13,18 101:1 105:20,22,23 106:8,12, 14 107:2 108:4,11 109:2,9 111:6 139:12 154:21 260:20,22 262:5 266:22 273:9 321:3 325:9

thing 59:4,22 69:6 77:5 85:2 96:16 110:25 132:5 151:6 170:10 209:4 218:12 220:3 231:7 235:24 245:23 252:5 257:17 296:3,16 302:3 304:2,14,16 319:18 326:22

things 14:22,24 48:22 50:18 60:1 69:8 77:12, 14 87:11,15 88:11 95:5 106:9 134:3 142:2 144:19 145:7,8,11,12 175:21,22 180:6 182:4 183:5 186:19 200:24 208:11 213:7,17 217:9 223:17 232:14,21 233:20 242:1 255:24 256:17 266:2 275:13 279:5 280:1 284:15,22 302:17 303:19,25 306:22 313:18 321:19 332:5

thinking 10:19 68:4 126:11 222:22 339:13

This's 60:1

thought 20:2 141:20 142:10,14 145:17 183:7 287:7

Ti 266:21

time 7:9 18:24 19:8 20:24 21:10 29:16 38:13 53:6,10 55:13,17 56:5,15 60:2 63:2,3,6,7 65:4,22 66:20 70:15 82:8 86:1 87:1 96:1 110:15 113:8,14,15,18, 19 121:4 126:13 130:13,25 134:25 138:10 142:13 151:8,9, 16 153:1 156:1,18,23, 24 157:2,5,6,20,24 158:1,2,3,4,6,7 159:25 160:3 166:5,7 176:11 177:5 203:24 204:4 205:1,2,5,6 217:1,5,8 220:21 221:9 243:2,4 254:19 255:4 258:5,13, 14 259:4 260:10,14,17 270:12 275:3,24 297:21

298:2 303:4 324:16,19 327:3,11 329:10 337:25 338:5,6,8 339:17,21 341:3,5

times 27:21 55:3 161:16 175:4 191:16 203:25 253:25 254:5 268:2 283:3 302:5 304:3 316:7

tired 99:3

title 68:21 220:2

titled 74:2

today 7:8 8:3,4,13 10:20,23 13:9,13 29:12, 23 41:16,17 43:13 44:1 45:6,11 118:19 161:16 170:19,23 173:6 177:10 179:21,23 180:18 189:21 201:8 202:19 203:25 222:10 224:20, 21 225:10,12 263:6 276:7 278:11,18 279:3 306:6 334:19

toiled 145:16

told 97:25 130:15 144:2 177:5

top 55:23 91:25 163:20 164:17 165:5 199:7 214:4 267:19 269:24 270:22 293:11 307:16 317:20 318:22

topic 136:10 277:17

topics 29:17 144:18

torsion 106:8 107:1 242:15 262:5,6

total 24:8

track 236:15

Trademark 7:15

trained 303:22

transcript 54:13 106:21 340:2

transform 241:9,24 319:16 336:22

transformation 178:3 240:13,19 248:15 291:4

transformations 256:11

transformed 193:22

transforming 183:22 184:6 194:6,25

transforms 195:23

translate 144:25 168:18 329:15

translated 167:11

translating 167:23

translation 15:19,21 185:14 242:5 271:3

transpose 166:10, 15 173:18

traveled 84:10

treats 40:7

trick 158:20 228:19

trig 246:12,15 264:5

trigonometry 246:9

trivial 242:8

true 68:14,16 69:2 77:18,20 82:16 89:16 116:20 137:25 138:12 141:7 186:19,22 229:17 242:19 250:10

truth 189:13 275:17

truthful 30:6

truthfully 10:20

turn 77:4

TV 220:13,19

two-dimensional 236:20

type 28:17 34:11 39:17 40:19 44:13 46:25 47:16,24 88:24 90:13,22 125:16 133:1 177:1 206:11 221:23 223:1,3 246:2 268:3 316:2

typed 133:4

types 46:8 74:16 75:11 76:7 77:10,13 80:8 81:13 82:17,19 83:2,4 89:17,20 91:3 92:9 93:9 115:24 116:8 117:16 120:23 121:6,7 212:10

typically 24:8 88:14 246:11

typo 268:20,22

U

U.s 11:25

U.S. 15:11 16:15,21 42:14 204:15

ultimate 108:21 145:21 189:13 324:3

Um-hmm 269:17 332:14

unable 165:6 170:22 198:21 203:13

uncertain 119:24

unclear 27:7 61:24 121:13 140:6

undefined 37:3

undergoing 149:15

undergrad 208:17 211:11 225:15 227:10 300:5

undergraduate 70:16 71:1,8 206:5 208:12 211:9 222:1,3 226:8,10,15,20,22 228:20 232:10,25 233:17 235:4

underneath 261:14 297:18

understand 10:6,9, 11 16:12 21:19 27:23 29:7 50:11,15 51:16,18 60:7,18 61:12 62:19 67:5,17 69:1,20 75:25 79:2 80:13,24 81:17,25 82:3 83:5,21,24 84:23, 25 86:3 94:20 95:4 105:13 124:9,13 125:5 126:7,18 127:15 144:20 145:1,4,24 146:7 148:7 159:6 163:24 169:20,23 170:20 172:25 187:24 189:6 190:6 193:18 195:10 198:17 200:7 201:9 203:10,20 211:5, 21 215:2,6,11,22 216:5, 14 217:7 227:11 228:22,25 236:8,10,12, 23 239:24 240:16 247:24 253:5 273:14 280:6,9 282:12,25 294:3,20 295:19 296:2, 6 299:10,23 300:18

understandably 329:7

understanding 143:19 175:17 189:6 216:4 217:10

understands 27:18 241:6 276:19 282:3

understood 18:23 19:7 45:18 64:7 65:3,20 66:19 114:24 122:15 130:12,24 136:21 198:25 248:11 249:6 285:1

unfair 275:14

unit 16:3 298:6

United 7:14 68:21

university 23:11,13, 15,21,25 144:15

unknown 157:14

unlike 162:9

unpatentable 53:15,19 63:23 64:13

unquote 141:16

unwilling 203:13

updated 160:14 260:9

updating 317:12

useless 72:2 192:13, 15

user 31:7 101:19 319:4

user's 31:13

utilized 162:5
utilizes 219:12 276:16
utilizing 26:2
UV 101:17

V

vacuum 126:25 141:19
vague 37:3 273:17
vagueness 61:17
valid 297:11
valuable 232:17
valued 166:4 167:10 172:8
values 87:2 91:22,24 120:22 121:5,14 197:15 268:13 328:14
variable 269:13
variables 327:1,9 329:8 330:9,25
variant 318:8
variations 103:21
varies 22:19 135:25 136:7
vector 54:22 57:8,22 58:12 88:5,10,13 90:9 91:8,10 92:18 99:14,17, 19 100:3,8 102:23 103:24 104:19,21,22,24 105:1,2,5,10,17 106:7, 25 107:15 110:19 112:3 154:22 166:4,10,13,15 167:10,24 172:8 173:20,21 180:7 181:17 183:23,25 184:4,6,12, 15,24 185:1,23 186:24 190:12,14 193:24 194:6,9 195:1,22 196:9, 16 197:10,12 242:15 250:2,3,4 251:6,8,10, 13,21,24 285:11 299:11 309:13 311:12,13 315:24 316:4,6,15,20, 24 325:15
vectors 148:20 149:18 178:6,16,17 180:2,24 181:15 185:13,18 251:4 262:1
velocities 53:6 55:13 56:5 109:11 295:6,15 317:12 318:17
velocity 109:12 157:20 297:21 299:6 315:1 319:3
venture 131:20
verified 309:8
verify 44:7,8 138:16
verse 182:21
version 15:20 18:18 35:9 58:9 103:19,21 184:13 231:8
versus 7:13 142:22 163:12
vertical 88:1 166:14
video 7:10,17 13:1 340:1,6,14,16 341:1
videotape 97:11
view 19:21 39:14 44:9 146:2,24 163:16 274:15
views 171:25
vision 226:24 232:11, 24 235:7
vocabulary 60:5,15
volume 7:19 341:1

W

W02009/15649981 15:15
waived 131:25 132:3
wanted 62:22 144:2 149:10 185:8
wasted 338:14
watch 215:14
watches 214:9
water 14:23
ways 46:13 77:7 144:25 237:15 266:7
wearable 214:8
week 253:14
well-known 191:5 267:20,23 311:14
well-understood 74:14 120:5
Wen 223:4
wheel 110:10
whispering 97:8
widely 228:13 229:13 232:1
Wii 253:10,11,21
willful 68:18
Wind 49:1,3
withdrawing 26:13
withdrawn 26:23
witnessing 235:11
WO 315:4
Wonderful 253:23
word 14:3 42:11 44:20,21 51:10 52:16, 20 53:19,24 86:5,7 90:15 119:25 120:4,10 126:15 131:7,19 159:5 165:24 169:18 182:21 185:6 198:12 253:1,5,7 263:1 296:5 331:23,24 334:23 337:16,18,19
words 26:7,9,19 51:23 62:15 85:2,4 93:19 115:6 149:8 150:9 152:6 164:14 168:10 172:9 181:6,23 187:12 188:3,6,21 194:1,4,12,16 195:15 198:11 200:2 203:20 240:1 295:23 334:25
work 20:14 21:7,21 22:18,21,24 23:7 42:18 95:23 196:24 203:14 209:16 210:5,21 211:19,23 212:6,11,24 213:5,24,25 214:2,16, 19 215:3 216:22 217:11 220:17,20 221:13 222:6,11 223:18 224:6 227:11 252:11 273:24 274:1 297:13 300:3 302:25 305:22,24 306:1 327:15 332:23,25
work-product 131:21
worked 22:5 127:13 128:21 145:16 182:23 213:9,15 215:4,13 221:13 253:11,20
workers 218:25 220:5,8 230:24
working 20:25 41:5 69:11 130:16 134:4 136:10 214:8 220:13,25 223:2 225:7 228:23
works 14:11 60:16 156:21 174:14 203:7 220:12 239:23
world 108:10 183:6 195:7,12
worries 164:13
worry 12:22
write 131:7,19 133:9, 13 135:18,21,22 163:9 203:23 205:16 313:12
writes 176:18,19
writing 76:19 114:15 131:3 133:20 134:7,20 135:7,9 142:11 180:23 293:5
written 162:16 163:5 182:18 194:16 198:12 207:17 217:21 219:6 235:21 239:12,13 240:5,9,10 244:13 253:25 254:3,6 261:4 265:10,23 273:10 291:25 303:3,15 312:15 313:5,15,19 329:18,24 331:18
wrong 44:20 181:9 183:12,17 202:13 212:13
wrote 65:10 131:13 133:11 134:2 142:12 168:10 170:20 171:1

179:18 180:11 182:16 183:8 184:10 188:18, 21,24 194:12 195:16 200:3,20 201:18 203:19,21 206:10 217:25 218:9 222:21 223:21 264:21 281:15 289:6,22 291:2

Wv 318:17

Ww 318:18

Wx 317:12

Wy 317:8,12

Wz 317:9,12

X

X-HAT 260:8 305:6

XK-HAT 321:3 326:6, 7

Xp 36:14

Xu 223:4 224:24

XYZ 167:6

Y

Y-BAR 167:11 173:12

Y-HAT 56:25 57:4 269:2 326:11

Y0 166:4

Ya 223:4

year 20:9 21:1 22:19, 20,24 23:7 24:8 41:11 67:11,25 133:6,12 134:21 135:3 170:23 200:16 281:2

years 41:13 42:12 44:11,19 45:6 69:6 108:7 114:4,5 136:10 147:19 148:11 161:21 162:1 163:23 167:17 168:11,17 169:10 170:1,3 171:1,17 172:2 175:7,15,25 177:3,7 179:18,24 180:1,16 181:12 182:3,17,19,22, 23 184:10 186:22 187:9 188:15,18,21 198:3 200:11,23,25 201:21 202:15,20 203:5,17,19 210:4,21 211:22 212:6, 10,18,23 213:5,9,23,24 214:2,3,15,19 215:7,8, 11 216:22 217:2 218:4, 7 222:12 224:9,13,17, 23 235:14 254:10 255:7,16 277:16 292:14 303:2,16

yellow 79:13

yes/no 32:20

YK 92:5,18

YK-HAT 90:25 269:5 319:13 321:7 326:4 327:25 330:18

Yp 36:14

Z

zoom 7:11 12:21 35:1 148:2 165:7 187:18

Zp 36:14