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Transcript of John C. Hart, Ph.D.

Date: December 22, 2017
Case: Samsung Electronics Co., LTD, et al. -v- Image Processing Technologies LLC(PTAB)

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Exhibit 2011
IPR2017-01218
Petitioner - Samsung Electronics Co., Ltd., et al.
Patent Owner - Image Processing Technologies LLC

1

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD. AND SAMSUNG ELECTRONICS AMERICA, INC.,

PETITIONER,

VS.

IMAGE PROCESSING TECHNOLOGIES LLC,

PATENT OWNER.

CASE NO. IPR2017-01190
PATENT NO. 6,717,518

CASE NO. IPR2017-01218
PATENT NO. 8,983,134

EXPERT DEPOSITION OF JOHN C. HART, PH.D.

FRIDAY, DECEMBER 22, 2017

JOB NO. 117834

REPORTED BY KIMBERLY EDELEN, C.S.R. NO. 9042, CRR, RPR.

2

EXPERT DEPOSITION OF JOHN C. HART, Ph.D., TAKEN ON BEHALF OF THE PATENT OWNER IMAGE PROCESSING TECHNOLOGIES LLC, AT 9:24 A.M., FRIDAY, DECEMBER 22, 2017, AT 400 SOUTH HOPE STREET, 18TH FLOOR, LOS ANGELES, CALIFORNIA, BEFORE KIMBERLY A. EDELEN, C.S.R. NO. 9042, CRR, RPR.

APPEARANCES OF COUNSEL

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3

I N D E X

E X H I B I T S

REFERENCED EXHIBITS PREVIOUSLY MARKED

(EXHIBITS CONTINUED ON FOLLOWING PAGE)

4

REFERENCED EXHIBITS PREVIOUSLY MARKED

5

LOS ANGELES, CALIFORNIA; FRIDAY, DECEMBER 22, 2017;
9:24 A.M.

THE REPORTER: Pursuant to Federal Rules of Civil Procedure, I am required to state the following: My name is Kim Edelen. My business address is 14520 Sylvan Street, Van Nuys, California 91411. This is the deposition of Dr. John Hart in the matter of Samsung Electronics and Image Processing Technologies, beginning at 9:24 a.m., on December 22, 2017. This deposition is taking place at the law offices of O'Melveny & Myers at 400 South Hope Street, Los Angeles, California.

Counsel, will you please state your appearances for the record, and then I will swear in the witness.

MR. COULSON: For patent owner Image Processing Technologies, my name is Chris Coulson, Andrews Kurth Kenyon.

MR. COOK: And I'm Brian Cook. I'm representing -- from O'Melveny and Myers. I'm representing Samsung in this case. And I just want to put on the record that the witness, Dr. Hart, is appearing in -- for a deposition in IPR 2017-1218 which deals with Patent 8983134. And IPR 2017-1190 which

6

deals with Patent 6717518, and that's the scope of his deposition today.

Sorry. With me also is my colleague Nick Whilt.

JOHN C. HART, Ph.D.,
having been first duly sworn by the reporter, was examined and testified as follows:

EXAMINATION

BY MR. COULSON:

Q Good morning, Dr. Hart.

A Good morning.

Q Would you state your name for the record, please.

A John C. Hart.

Q And what university are you based at?

A The University of Illinois.

Q And you've testified -- it appears you've testified before in an ITC trial; is that right?

A Yes.

Q And given depositions before?

A Yes.

Q So you're generally familiar with the process?

A Yes.

Q So just as a reminder, if you don't understand

7

one of my questions, will you ask me so I can rephrase it?

A Sure.

Q And you're doing a good job of answering orally but you'll -- you'll answer orally, not nod your head in response to questions. Okay?

A Okay.

Q So, Dr. Hart, what's your hourly rate for the services you're providing to Samsung?

A I charge an hourly rate but it goes through a company that then bills Samsung. And I'm not sure what the rules are for that disclosure with respect to my contract with that company, so I don't know that I'm at liberty to say.

Q Well, it's true this transcript will be publicly available, but I guess we will have the opportunity to mark material as confidential if necessary. So given -- with Samsung's counsel we can work on that after the deposition.

So given that we'll have that option, can you tell me the hourly rate that's being charged for your services?

A I don't know. I'm not sure what the group that I send my invoices to charges Samsung for my hourly rate.

8

Q Well, what's the rate that you are receiving?

A I don't know that I can disclose that based on my contract with that company that charges for my services.

Q Okay. So you won't tell me?

A It's something over $500 an hour. I'm not sure of the exact amount.

Q Okay. We'll work with that. Try to work with that.

Can you give me an idea roughly when you were retained by Samsung?

A I don't remember the exact date. It's been over a year.

Q And rather than drilling in on the rate, can you give me a sense of the total amount that you've received for your services to Samsung?

A I really don't know. I haven't added it up.

Q Can you -- apologies. About when were you retained?

A It's been over a year. It hasn't been a year's worth of work front to back. It's been as needed.

Q And what -- approximately how many IPRs have you worked on for the Samsung v. Image Processing IPRs?

A I don't have the exact account. It's at least these two and there's been others, but I don't remember

9

the exact number.
Q More than five?
A I don't think it was more than five.
Q Around five?
A I don't know.
Q Okay. And have you submitted invoices to the company that submits invoices to Samsung?
A Yes, I did.
Q Approximately how many have you sent?
A I don't know. There's been months where there was no invoice sent. So something less than, you know, 12, but...
Q Can you give me -- what's an amount -- can you recall the amount of any of the invoices roughly?
A No. I add it up and send it off, and I don't remember the specific amounts.
Q And how much time have you spent -- what did you do to prepare for this deposition today?
A I read through the patents, the declarations and the other materials for the IPR.
Q Did you meet with Samsung counsel?
A Yes, I did.
Q For about how long?
A I don't know. At least a day.
Q Is that here in L.A.?

10

A Yes.
Q And who did you meet with?
A I met with Brian and Nick.
Q About how much time roughly does it -- have you spent on preparing the declaration for the two IPRs at issue today?
A I don't have an exact number. I didn't really look at how much time. If you add it up on the declarations and then reviewing all the materials needed for the deposition today, so I'm really not sure exactly how much time that would have been.
Q So sitting here today, you can't give me -- can you give me a rough estimate?
A No. I wouldn't feel comfortable giving you a rough estimate. I'm not exactly sure even, you know, order of magnitude how long that was.
Q And do you know in the approximate -- approximate one year that you worked with Samsung for the Image Processing v. Samsung matters, how many months did you have no activity?
A So first I think it's been more than a year.
Q Thank you.
A And I don't know how many months it's been without activity. I know there's been months where there's not been activity. I don't remember how many.

11

Q Did Samsung counsel assist you in preparing your declaration?
A Yes, they did.
Q Were you provided with the prior references that you -- that are the subject of your declaration by Samsung counsel?
A I believe they pointed me to a lot of references. I found -- I looked at references as well and I don't recall exactly, you know, how each one of the references was selected.
Q Can you identify any of the references for the '134 patent, Gilbert, Bassman, Gerhardt and Hashima that were not provided to you by Samsung counsel?
A No. I really don't recall going through all the references that we went through, how each and every one of them was found.
Q And for the '518, the references are Stringa, Ando and Suenaga. Do you recall any of those that were not provided to you by Samsung counsel?
A No. I don't recall any specifics, how we got to any of those references.
Q Can you recall any of the references that are at issue in the '134 or '518 IPR declarations that you located?
A No. I don't remember specifically which ones

12

and how they were found.
Q Did you locate any of the references that are the subject matter of your two declarations, the '134 and '518 declarations?
A I don't recall. I know I found some references. I don't remember which and how they came about for each one. I just didn't document the -- you know, how these were located as part of my declaration.
Q It would be pretty memorable if you found a reference that was used in an IPR petition, wouldn't it?
MR. COOK: Objection. Form.
THE WITNESS: I find references all the time. You know, I pride myself on knowing the literature, and often I point to things that I'm aware of and those get incorporated. It's not unusual.
BY MR. COULSON:
Q But nothing is coming to mind for the '134 and '518 petition references?
A No. I don't have that specific of a recollection of what we did to find those references.
Q Well, let me hand you, and I will mark a couple, I think, University of Illinois web pages we located. We'll mark these as 2012 and 2013, please.
Exhibit 2012 is a printout of a web page from Parallel.Illinois.edu. The top is labeled Parallel

13

Computing Institute.
(Deposition Exhibit No. 2012 was marked for identification.)
BY MR. COULSON:
Q Do you recognize Exhibit 2012?
A Yes, I do.
Q What is it?
A It's a printout of the -- of a page describing my membership in the Parallel Computing Institute.
Q What is the Parallel Computing Institute?
A It's kind of an umbrella organization at the University of Illinois that collects faculty and others that have interest in parallel computing that have worked on projects for parallel computing.
My main work with the Parallel Computing Institute was as one of the members of the Universal Parallel Computing Research Center, the UPCRC that was sponsored by Intel and Microsoft at the University of Illinois, I think, from around 2007 to 2012 and a little bit beyond that.
Q Can you turn to the next exhibit, 2013, please.
(Deposition Exhibit No. 2013 was marked for identification.)
BY MR. COULSON:
Q That has at the top John C. Hart, Computer

14

Graphics Illinois.
Do you see that?
A Yes, I do.
Q Do you recognize Exhibit 2013?
A Yes, I do.
Q And what is it?
A This is the -- from the website Graphics.cs.Illinois.EDU. There are entries for faculty and students and others, and this is the entry for pointing to me describing some of my work in computer graphics.
Q Can you look under "Title & Interests" next to your photograph on Exhibit 2013, please. It says "CS - high performance graphics, shape modeling."
Do you see that?
A Yes.
Q What's high performance graphics?
A High performance graphics is -- it's working with algorithms, methods, approaches for doing computer graphics and related techniques on high performance platforms, often parallel platforms, special purpose hardware platforms, or even general purpose computer platforms focusing on speed and getting things accomplished at a higher rate of speed than was possible before.

15

Q What is shape and modeling?
A Shape modeling is a general field. It would include things like Computer Aided Design and the ability to describe a shape, for example, like this bottle of water, numerically, so that it could be represented computationally.
Q You can put aside those two exhibits, Dr. Hart.
I'm going to hand you a copy of the '134 patent that has been previously marked as Exhibit 1001 in IPR 2017-1218.
You're prepared to talk about the '134 patent?
A Yes, I am.
Q Can you turn -- all set?
A Yeah.
Q Can you turn to the end of the '134 patent, the claims section.
A Okay.
Q And I wanted to give you an opportunity to look at Claim 3, and it's independent Claim 1 for the next series of questions.
Do you have those? Bottom right column.
A Yeah.
Q You understand that Claim 3 depends from Claim 1 and includes all the limitations of Claim 1, right?

16

A Yes.
Q For Claim 1 I understand that you have used lettering, I think both parties have used lettering for certain claim elements, so I wanted to make sure we're on the same page with the lettering before we get into the claim. Okay.
If you can refer to -- I see you're looking at your declaration. You can refer to wherever you want, of course, but let me point you to Page 53, 55.
MR. COOK: Of course the declaration you're referring to is marked as Exhibit 1002; is that right?
MR. COULSON: That's a good point. I'll hand it out. I see the witness has brought declarations with him, but I should hand out copies, so I'll do that now.
MR. COOK: I have a copy of it, actually.
BY MR. COULSON:
Q So, Dr. Hart, I'll hand you a copy of Samsung Exhibit 1002 for the '134 patent, IPR. This is a stapled double-sided version. Maybe that will help you. That's been previously marked. And you can refer to the one you brought or Exhibit 1002 that I've handed you, whichever you prefer.
A Okay. Thanks.
Q You see for Claim 1, the claim paragraph beginning with "forming at least one histogram" that you

17

referred to on Page 55, Section B of your declaration, Exhibit 1002?
A Yes. "Forming at least one histogram of the pixels."
Q Yes. So if we refer to Exhibit -- excuse me. Strike that.
If we refer to Claim Element 1A you'll understand we're referring to the claim element "forming at least one histogram of the pixels in the one or more of a plurality of classes in the one or more of a plurality of domains, said at least one histogram referring to classes defining said target."
A Yes.
Q And for Element 1B, I'll refer you to Page 57 of your declaration.
Do you have that?
A Uh-huh.
Q If we refer to Element 1B today, you'll understand that to refer to "identifying the target in said at least one histogram itself"?
A Yes.
Q Element 1C is on Page 59, among other places in your declaration.
If we refer to Element 1C we can agree that we're referring to "wherein forming the at least one

18

histogram further comprises determining X minima and maxima and Y minima and maxima of boundaries of the target"; is that right?
A Yes. I believe in -- here on Page 59, I've got it as "wherein identifying the target in said at least one histogram," and I believe it's wherein forming this copy of the patent, so given that, yes.
Q Okay. So I'll just do this quickly. Looking at the patent, we'll agree that Element 1C refers to "wherein forming the at least one histogram further comprises determining X minima and maxima and Y minima and maxima of boundaries of the target," right?
A Right.
Q Let me point you back to Page 57 of your declaration, Exhibit 1002 of the '134. And I'll just note we'll be going through the '134 declaration, which is the IPR 2017-1218. So that's Exhibit 1002 I'm referring to.
Are you with me on that page?
A Yes. Page 57.
Q Yes.
What's your interpretation of Element 1B, "identifying the target in said at least one histogram itself"?
A It's as the declaration states, it's -- my

19

interpretation is as I've demonstrated it in comparison with in this case Gerhardt and Bassman.
Q I'd like to ask you about the claim limitation and you applied, I understand, essentially plain meaning to your interpretation of the claim elements, right? You didn't apply any special meaning to the elements of Claim 1 or Claim 3?
A I applied plain and ordinary meaning of what a person of ordinary skill in the art would have utilized at the time of the patent based on what was disclosed in the patent itself. And that was sufficient for -- to understand how each of the claims was applied with respect to both the embodiments in the patent and in the prior art that I examined.
Q For Element 1B, does identifying the target require locating the target in space?
A I didn't come up with a formal definition of "identifying." I used the term "identifying" to look at how the histogram was being used, and with respect to the target in each of the cases that I applied this claim limitation to, and in each case it was clear what was meant by "identifying." So in some cases, yes, "identifying" meant locating, but in other cases it didn't necessarily mean "locating."
Q So if I understand you correctly, your

20

interpretation of Element 1B is that identifying, it doesn't require locating the target?
MR. COOK: Objection. Misstates testimony.
THE WITNESS: As I said before, it depends on the example. So there were examples where -- there were examples where that met this claim limitation where identifying was referring to locating and other examples where identifying was not referring to locating.
BY MR. COULSON:
Q So if they're examples and your interpretation of Claim Element 1B where identifying doesn't require locating, then I understand correctly your interpretation of Element 1B is that it doesn't require locating the target?
MR. COOK: Objection. Misstates testimony.
THE WITNESS: I think all I'm saying is that in some cases when I applied Claim Limitation 1B to prior art, there were examples where I felt the prior art met the claim limitation. But the identification of the target was not necessarily a location.
BY MR. COULSON:
Q So you would read Element 1B to encompass identifying that does not identify a location of the target?
A I don't believe I made any statement about

21

encompassing or defining the word "identifying." I think all I'm saying is that when I applied Claim Element 1B to the prior art, there were cases where it was clear that Claim Element 1B applied to the prior art but the result was not a location of the target.

Q Claim Element 1B would include cases that -- where identification does not locate the target then?

A I was able to find examples where that was the case.

Q So that's in the scope of 1B under your interpretation?

A I don't know about scope. I know that I was able to apply it to cases that did not result in a location.

Q So you don't limit -- Strike that.

You did not limit in your analysis Element 1B to cases where location of the target was found?

A That's a rather broad statement. I applied each of these claim elements relative to the other claim elements referring to targets, referring to histograms, in the specific examples of each of the prior art cases that I looked at.

And 1B could be applied in some of those cases where the process of identifying the target in said at least one histogram itself did not end up – did not in

22

that particular portion give a location.

Q Under your interpretation of Element 1B, would identifying a characteristic of a target -- Strike that.

Under your interpretation of Element 1B, would finding a characteristic of the target through forming a histogram satisfy Element 1B?

MR. COOK: Objection. Vague, incomplete hypothetical.

THE WITNESS: So I believe characteristic is one of the claim elements from the '518, and so I don't want to -- you know, I don't want to refer to those claim elements, for example, when looking at the '134.

I basically applied the claim elements from '134 to the prior art using the terms from the '134 based on the context of the prior art and how those terms were used in the specification of the '134

MR. COULSON: Can we go off the record for a second.

(Brief discussion held off the record.)

MR. COULSON: Can we go back on, please.

Okay. So, Counsel, you're making objections that are -- the Trial Practice Guide specifically prohibits, and I've let it go on a little bit. I've tried to solve the issue off the record, but was unsuccessful.

23

I'll ask you to confine yourself to the objections set forth in the Trial Practice Guide such as "objection, form." Specifically "objection, vague" is one of them that the board has stated specifically must not be made in these proceedings.

BY MR. COULSON:

Q So let's try --

MR. COOK: Okay. I'll let -- I'll do my best to conform my objections to that. I believe I'm entitled to state a brief word to explain the basis for my objection. I didn't realize "vague" is one that's prohibited. I can check that, if you'd like. But my objections, I don't believe they're leading. I believe they're just a very brief statement of the basis for my objection.

MR. COULSON: I just wanted to point the issue out, and I'd ask you to not do that in the future.

MR. COOK: Okay.

BY MR. COULSON:

Q Dr. Hart, let me get back to our questions. So how do you understand the word "characteristic"?

A The word "characteristic," I don't know that that's a term used in the '134.

Q I think that's true.

A But it is used in the '518.

24

Q Well, so I'm asking you about -- if this helps, I'm asking you about the '134 patent.

A Yes.

Q So I'm trying to understand your interpretation of Element 1B that you applied.

A Uh-huh.

Q So I would like to -- we talked about location a minute ago. You recall that. I'd like to understand if you understand Element 1B such that finding any characteristic about a target, say, for example, its color, would satisfy Element 1 -- satisfy the identifying of Element 1B?

MR. COOK: Objection. Form.

THE WITNESS: So I didn't make any statement in the declaration regarding the definition of "identifying" or the scope or what it encompasses. What I did do is I applied 1B to the prior art in some very specific cases and the context of the prior art and the context of the specification and made a judgment, expressed an opinion that -- whether or not that prior art met the limitation of identifying the target in one histogram.

And in some cases it did that without finding a location of the target.

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25

BY MR. COULSON:
Q Maybe this will be easier for you. Can you give me some examples of what would satisfy identifying in Element 1B?
A Sure. So on Page 116 of my declaration, Paragraph 158, "Gerhardt selects an intensity threshold to identify pixels within the intensity histogram that correspond to the expected area of the user's pupil."
Q I'm sorry. What paragraph, please?
A 158.
Q Would finding colors that characterize a target satisfy identifying of Element 1B?
A In this example of Gerhardt I'm finding the identification is of the area -- the expected area of the user's pupil. And so that's an identification. There's a bunch of other examples in the charts starting at Page 143.
Q Well, if it would help -- I don't know if this will help or not. We'll get to the prior art. Right now, before I get to this particular prior art applications, I'm asking you a question about Element 1B. And let me try to restate the -- restate the question one more time.
Would color, would finding the color of a target satisfy identifying of Element 1B?

26

A I don't -- I didn't make a statement that broad in the declaration. But there are examples of utilizing a histogram of brightness, of luminance that identified a target.
Q So would finding a color range characteristic of a target satisfy -- through forming a histogram satisfy Element 1B?
MR. COOK: Objection. Form.
THE WITNESS: I didn't make that statement. I do have some examples where looking at a luminance histogram was a form of identification of a target in the histogram that satisfies Claim Element 1B.
BY MR. COULSON:
Q So you don't know whether finding a color range characteristic of a target through forming a histogram satisfies Element 1B under your interpretation of the element?
MR. COOK: Objection. Form.
THE WITNESS: I would need to see a specific example so I could look at the context of what was occurring, if it was meeting all of the requirements as made in the specification for the claim element, than the claim as a whole.
BY MR. COULSON:
Q So you're not sure?

27

A Given a specific example, I would be quite sure.
Q Based on your analysis that you completed so far, you don't -- you can't say one way or another?
A I could say one way or another given a specific example. I did not provide an opinion generalizing Claim Element 1B in a vacuum.
Q Well, let me back up. So in rendering your opinion you looked at the patent, the '134 patent. And what we're talking about is your opinion in the '134 declaration. Okay?
A I'm sorry. Was there a question there?
Q Yes. I wanted to make sure we're on the same page. We're talking about -- you understand we're talking about your opinion in the '134 declaration. Okay?
A Correct. We're talking about '134.
Q So in doing your analysis, you looked at the disclosures of the '134 patent, right?
A Yes, I did.
Q You looked at the prosecution history for the '134, right?
A Yes, I did.
Q And you also looked at the several prior art references?

28

A Yes, I did.
Q And based on those things, you haven't reached a conclusion as to whether Element 1B -- for Element 1B as to whether finding a characteristic color range of a target would satisfy identifying for Element 1B; is that right?
MR. COOK: Objection. Form.
THE WITNESS: What I did do is showed some examples where using a luminance or an intensity histogram could be used in a specific example to identify a target that meets the limitation of Claim 1B.
BY MR. COULSON:
Q I just want to be clear on the record as to the -- based on your analysis, you can't say right now whether finding a characteristic color of a target would satisfy identifying of element -- Claim Element 1B?
MR. COOK: Objection. Form.
THE WITNESS: I didn't do any general analysis of individual claim elements in absence of the other claim elements, and I did not do any general analysis of the claim elements without applying them to any prior art. So the limits of my opinion are based on the application of these elements to the prior art and the elements as a whole.
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29

BY MR. COULSON:
Q So you don't have an opinion one way or another on that?
MR. COOK: Objection. Form.
THE WITNESS: I did not enter an opinion stating the general interpretation of 1B as it could be applied to anything.
BY MR. COULSON:
Q Well, I'm asking you specifically about identifying a color range that is characteristic of a target. Do you understand that's what I'm asking you about?
MR. COOK: Objection. Form.
THE WITNESS: Do you have a copy of Gilbert?
BY MR. COULSON:
Q I do have copies of prior art. But I'm not asking about Gilbert or the other references right now.
Why do you need Gilbert to answer that?
A I could show you an example in Gilbert of a -- where a range of color values would satisfy Element 1B.
Q So your opinion is that finding a range of color values that is characteristic of a target does satisfy Element 1B identifying; is that right?
MR. COOK: Objection. Misstates testimony.
THE WITNESS: No. I can give you an example

30

where Gilbert identifies based on a -- based on an intensity histogram in that particular instance satisfies Claim Element 1B.
BY MR. COULSON:
Q I want to make sure I'm not technically misunderstanding. Is intensity the same thing as color?
A Intensity is a single value. Color is often represented three dimensionally, multi dimensionally. Depending on the representation of the color you could have a single axis of intensity, another axis of, for example, saturation, and another axis of hue. And so intensity is part of color, but you wouldn't talk about the two synonymously.
Q Okay. I wanted to make sure we weren't miscommunicating.
A In the declaration, Paragraph 31 of the declaration describes the relationship between intensity and color referring to it as luminance or brightness. There are subtle differences between luminance, brightness and intensity, but they talk about the same basic concept of that component of a color.
Q Okay. Let me try to use the language from this Page 11 of your declaration to maybe be more precise. Maybe that will help. We'll see.
Would identifying a range of hue and saturation

31

that is characteristic of a target using a histogram, would that satisfy Element 1B under your interpretation of the claim?
MR. COOK: Objection. Form.
THE WITNESS: I don't know. I would have to see the specific example. And I don't recall looking at any examples that used hue and saturation that I analyzed to determine if they met the requirements of Element 1B.
BY MR. COULSON:
Q Did you look at any examples in your analysis that used hue?
A I don't recall any that used hue.
Q Did you look at any examples that used saturation?
A I don't recall any that used saturation.
Q Well, let me go back to Element 1B. Do you need a second to review the patent or whatever you're looking at?
A I'm just looking at the abstract of '134. The bottom sentence mentions the domains include luminance, hues, saturation, speed, oriented direction, time concept, first axis and second axis.
Q Would identifying -- I'm going back to Element 1B. Do you have the patent claims?

32

No need to do it from memory.
A Okay.
Q Would identifying a group of possible targets satisfy -- through a histogram satisfy Element 1B?
MR. COOK: Objection. Form.
THE WITNESS: The claim language said identifying the target, so I didn't really consider cases where you had multiple targets.
BY MR. COULSON:
Q Would identifying a group of -- Strike that.
Would identifying several possible targets through using a histogram satisfy Element 1B?
MR. COOK: Objection. Form.
THE WITNESS: So Figure 20 in '134 shows the screen described in -- starting in Column 23, Paragraph -- or Line 35. It says "Another application of the invention relates to automatic tracking of a target, by, for example, a spotlight or a camera."
And it continues in the next paragraph, Column 23, Line 59, "In the example shown in Figure 20 Monitor 212 is shown with five simulated objects, which may be, for example, vehicles or performers on a stage, including four background targets and one target to be tracked."
So based on that disclosure from '134, there is

33

a target to be tracked, but there could be other targets in the input.
BY MR. COULSON:
Q Are you saying that Element 1B is satisfied by identifying several possible targets?
MR. COOK: Objection. Form.
THE WITNESS: In the examples I applied Claim Element 1B to, those examples focused on a single target. So I did not have to look at an example where multiple targets were used for satisfying Claim 1B.
BY MR. COULSON:
Q Okay. So the portion you read from Column 23 of the '134 in Figure 20, tell me again what was that disclosure telling you about Element 1B?
MR. COOK: Objection. Form.
THE WITNESS: I read Claim Element 1B in the context of Claim 1, and I read Claim 1 in the context of the specification, and the specification includes an example which refers to additional targets, background targets, and then a main target. Four background targets and one target to be tracked.
BY MR. COULSON:
Q And the example you just read from in the patent at the bottom of Column 23, the user selects by clicking on one of the objects; is that right?

34

A In this example, yes. The paragraph goes on around Line 63, the user of the system selects the target for tracking by moving Icon 220 over Target 218 and depressing a predetermined button on a mouse, on Mouse 210.
Q So the system doesn't identify five possible targets shown in Figure 20, right? Is that right?
A I wasn't asked to form an opinion on that particular topic, but going by what is specified here at the bottom of Column 20, the specification is referring to these five objects as four background targets and one target to be tracked. It's using the term "targets" to describe the four background objects.
Q Are you saying that the two -- excuse me. Strike that.
Are you saying that the '134 patent discloses a way for the system to identify five potential targets in Figure 20?
MR. COOK: Objection. Form.
THE WITNESS: In applying the elements from the claims to the prior art, I never needed to look at multiple targets in order to apply those elements.
In this particular example from '134, the fact that the user selects the target using an icon means that the user could select any of the other targets.

35

For example, the fact that the user needs to make that selection means that the others could have been viable targets.
BY MR. COULSON:
Q That the user could have chosen from to select?
A Yes.
Q I just want to make sure I understand what you're saying. You're not saying that the -- that the '134 patent discloses the system doing some analysis that then results in five potential targets shown in Figure 20?
MR. COOK: Objection. Form.
THE WITNESS: I didn't say that the system could not do that. What I am saying is I'm giving an example from the specification where there are multiple targets, and one solution that the specification provides towards figuring out which target should be tracked.
BY MR. COULSON:
Q I think I may have asked the question in the negative. Let me try it in the positive. That may be easier for you to answer.
Does the '134 patent disclose a method or procedure whereby five potential targets are identified as shown in Figure 20?

36

MR. COOK: Objection. Form.
THE WITNESS: I would have to look in more detail at '134 to look at how it handles multiple targets. But multiple targets did not really factor into understanding Claim 1. Claim 1 does not appear to specify anything about multiple targets. It refers to the process of tracking a target and then discusses the target.
And that was the scope of what I analyzed regarding Claim 1, and specifically Element 1B, to the prior art. And in each case I was able to identify one target that was being operated on, so I did not do an analysis of '134 where it focuses on multiple targets, so I don't really have an opinion in this declaration based on how '134 handles multiple targets because it wasn't necessary to apply Element 1 to the prior art.
BY MR. COULSON:
Q Do you have an opinion --
A Or Claim 1 to the prior art. Sorry.
Q Do you have an opinion as to whether '134 handles multiple potential targets?
MR. COOK: Objection. Form.
THE WITNESS: I didn't make an opinion in the declaration. Sitting here on the spot I've pointed to this Figure 20 as an example where '134 looks at

37

multiple targets.
BY MR. COULSON:
Q You're not sitting here today saying that '134 patent discloses doing an analysis that results in identifying multiple potential targets?
MR. COOK: Objection. Form.
THE WITNESS: That's not part of my opinion. I would have to give that -- to make a statement like that, I would have to give that analysis as much analysis as I gave the other parts that did form my opinion. So I'm not prepared today to make a statement to that extent since it didn't really apply to my application of Claim 1 to the examples of prior art.
BY MR. COULSON:
Q Does Claim Element 1B require separating the target from the rest of the image as a result of -- Strike that.
Does Element 1B require separating the target from the rest of the image?
MR. COOK: Objection. Form.
THE WITNESS: Claim Element 1B just talks about identifying the target in a histogram, in at least one histogram itself. The process of forming that histogram is described in Claim Element 1A, so I'm not sure what you're asking for in terms of -- I'm not sure what that

38

question is asking with respect to 1B.
BY MR. COULSON:
Q Let me try to rephrase it. Would identifying pixels that are not in the ultimate target satisfy identifying of Element 1B?
A It would depend how the histogram was formed and comes out of Element 1A, forming at least one histogram of the pixels and one or more of the plurality of classes, in the one or more plurality of domains.
And identifying the target based on the histogram, it would depend on what the histogram was composed of in order to determine how that target was identified. And in each of the prior art cases, I was able to determine that identification. And my opinions are limited to how those prior art cases did that identification.
Q You are willing to explain how you're interpreting the claims so that we can understand your analysis, right?
A Absolutely.
Q Would identifying only some pixels within a target satisfy the identifying of Element 1B?
MR. COOK: Objection. Form.
THE WITNESS: Can you repeat that question?
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39

BY MR. COULSON:
Q Certainly.
Would identifying only some pixels from within a target satisfy the identifying of Claim Element 1B?
MR. COOK: Same objection.
THE WITNESS: So Gerhardt is an example where -- before I continue, can you repeat the question one more time, that way I can answer specifically with Gerhardt.
BY MR. COULSON:
Q Maybe that will be easier for me to get the information. Why don't we look at Gerhardt.
A Well, I'd like to answer the question if you can restate it.
Q Certainly. I can restate it.
Would identifying -- you understand I'm asking you your opinion of the scope of Claim 1B under your interpretation. I'm not asking you about particular prior art at this point.
A Yes. And I wanted to answer that question with an example from Gerhardt.
Q Okay. So can you answer the question without referring to specific prior art?
A My opinions are based on the application of these claim elements to the prior art. So I think -- I

40

can give you an answer using Gerhardt as an example. That may give you the answer you're looking for.
Q Okay. Well, let's look at Gerhardt. Are you on --
A I'm on Page 77. It's in the charts for -- 77 is in the charts for Claim 1A, but the same passage is referred to in Claim 1B.
MR. WHILT: Do you have another copy of Gerhardt, Counsel?
BY MR. COULSON:
Q Yeah. Let me give out Gerhardt. Maybe that will help.
Okay. I'm handing the witness Exhibit 1013 from the '134 IPR.
A So Column 9, Line 39 talks about Figure 5 describing "Figure 5 illustrates a histogram with several bins of pixel intensity data corresponding to the image of Figure 4."
And Gerhardt satisfies Claim 1, but Claim 1A and 1B, in particular, and it's looking at an intensity histogram of Figure 4, and that's shown in Figure 5 designed to identify the pupil which is the target in Figure 6.
And you'll notice that Figure 5, the values are in that lower I think it's five percent, marked at 80 --

41

marked as 80. Its values are different than 80.
And those are the -- those are the values that identify the target, the pupil here in Figure 6. So I think that demonstrates -- that's one of the -- this Gerhardt satisfies Claim 1B and the rest of the elements of Claim 1, and also gives you an example where a portion of the histogram that corresponds to the target is used to identify the target in the histogram, even though the histogram is of all the values, all the grayscale values, all the intensity values besides the one in the target.

Q Why don't we look at -- can you look at Paragraph 113 of your declaration on Page 57 on this point. It's Page 57, Paragraph 113.

A Yes. I'm there.

Q And you say here in Paragraph 113 that the data to the left of the arrow 80 in Figure 5 of Gerhardt possibly corresponds to the pupil; is that right?

A Yes. Left of the arrow as possibly corresponding to the pupil.

Q So the data to the left of arrow 80 in Figure 5 of Gerhardt may or may not, for any particular data, correspond to the pupil, right?

A Correct. That data corresponds to intensities that are dark.

42

Q So solely based on forming the histogram of Figure 5 in Gerhardt, we can't tell where the pupil target is? We have to do additional processing, right?

MR. COOK: Objection. Form.

THE WITNESS: So this example in Gerhardt of finding dark values using an intensity histogram --

BY MR. COULSON:

Q And you're referring to Figure 5.

A Yeah. Figure 5. And Figure 5 identifies that there are pixels that are likely of the pupil in the image. And so the target has been identified as being in the image on the basis that the expected values from the target in the image appear in the histogram.

Q Do we know where the pupil is solely based on the histogram of Figure 5?

A No. Only that it exists and likely exists in the image. That there are pixels of intensity that one would expect from the pupil in the image.

Q In Figure 5 the dark bars at Item 80 and to the left, those are intensity values, not specific pixel locations, right?

MR. COOK: Objection. Form.

THE WITNESS: Figure 5 shows pixel intensity values on the horizontal axis and then counts the number of pixels that have that value vertically. So those are pixel intensity values horizontally.

43

BY MR. COULSON:

Q That don't correspond to a particular location, each bar is a count of the intensity values for that particular intensity?

MR. COOK: Objection. Form.

THE WITNESS: That's correct. The histogram of pixel intensities does not include the location of the pixels, other than that they are in the image.

MR. COOK: Counsel, are you getting to a point where we can take a break? We've been going over an hour.

MR. COULSON: Certainly.

BY MR. COULSON:

Q And let me just, for IPR proceedings, you understand that you're not to talk to Samsung counsel during the break about your testimony?

A Yes. I understand that.

Q And these -- because this is a inter partes review proceeding, so we're on the same page about that?

A Yes. We're on the same page about that.

MR. COULSON: Let's take a break. Thank you.

(Recess taken from 10:42 - 10:52 a.m.)

MR. COULSON: Let's go back on the record.

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44

BY MR. COULSON:

Q So I understand, Dr. Hart, you -- can you tell me your hourly rate at this point?

A Yeah. It is $500 an hour.

Q Okay. Let's go back to discussing Gerhardt. Can you turn to Column 11 of Gerhardt, Exhibit 1013 to the '134 patent IPR.

A Column 11?

Q Yes, sir. And I'll start at the top of Column 11. So the process of the histogram of Figure 5 has -- identifies as a result of the histogram a threshold number for intensity, right?

A Effectively, yes. I'm looking to see if they use the word "threshold" or not, but what they're pointing at in 80 of looking at intensity values less than or equal to that value would be a threshold.

Q And using the threshold value, the system of -- or the description in Gerhardt, the next step is segmenting the image into dark and light pixels, right?

A Yes.

Q And there are typical several dark regions that are -- Strike that.

There are typical several dark regions in the segmented binary image, right?

A Yes. There can be.

45

Q Are you looking at the figures? Figures 7C and 8C, for example, show multiple dark regions in the image?
A Correct.
Q The next step is the dark regions need to be converted into blobs, right?
That's b-l-o-b-s.
Right?
A Well, they're not converted into blobs as much as they are blobs. A blob is just what we use to refer to a -- in general, though a contiguous region of pixels.
Q Well, I'm looking at Column -- we're in Column 11, the paragraph that begins at Line 25 through approximately 37. I'll give you a second to look at that.
A Okay.
Q So in Gerhardt, the dark regions need to be explicitly defined as blobs through a -- through assigning them to groups of contiguous sets of dark pixels; is that right?
MR. COOK: Objection. Form.
THE WITNESS: Gerhardt refers to them as blobs. The line here is each of these contiguous sets is called a blob. What Gerhardt is describing here is determining

46

of those pixels which are in the same contiguous set.
BY MR. COULSON:
Q And there's one way to determine the pixels in the dark region that are in contiguous sets as described in this article mentioned in Column 11 by Robert Cunningham, right?
MR. COOK: Objection. Form.
THE WITNESS: Yes. That's cited as one method for -- one segmentation approach that may be adapted for use with the present invention.
BY MR. COULSON:
Q In looking at the next paragraph, there are other approaches that could be used to segment images into contiguous sets, such as gradient magnitude and direction or intensity or RGB based methods, right?
MR. COOK: Objection. Form.
THE WITNESS: There are a number of segmentation approaches. The -- what's being described here is what different approaches might use. For example, pixel intensity, RGB color or gradient magnitude and gradient direction.
BY MR. COULSON:
Q And the next -- I'm looking at the next paragraph of Gerhardt, Column 11, Line 52 and on, the preferred approach of Gerhardt for converting dark areas

47

to pixel blobs is using a single-pass method; is that right?
A Yes.
Q How does that method work?
A It identifies pixels in a raster scan approach, top to bottom, left to right. When each new pixel is examined it determines if that pixel is connected to another pixel of the same color. In this case to another similarly dark pixel. And then grows regions in that method.
Q And once the pixel blobs are defined by a method such as raster scan, they're then analyzed for properties such as size, dimensions to attempt to determine which of the blobs is the pupil, right?
MR. COOK: Objection. Form.
THE WITNESS: So Gerhardt describes several steps in further determination of the pupil segmentation and so on of the pupil in the image. This step is describing taking the thresholded dark pixels wherever they appear on the screen and then finding the individual connected components of that segmentation. There are subsequent steps that are further employed to determine where the pupil is in the image.
BY MR. COULSON:
Q By this step, you're referring to the

48

single-pass method at Column 11, Line 52 as the preferred approach?
A Yes. That single-pass method is taking the dark pixels that were identified in the threshold on the histogram and then determining which of those dark pixels are in the same connective component.
Q Let me ask you about a part of the -- following that step, the other steps include analyzing properties of the blob such as dimensions or size or, et cetera, right?
A Yes. I mean, there's pages and pages of subsequent processes that happen to, you know, achieve the goals of this particular patent.
Q Let me ask you about one on Column 13, Line 25.
A Okay.
Q This is -- it's the second moment of inertia for the blob. Do you see that? I'll give you a chance to read it. I just want to ask how is that determined for a blob, if you're familiar with that.
A Yeah. The second moment of inertia is a statistic about a shape. The first moment might be the center of the mass and the second moment would be some additional statistics about the shape.
That, and other statistics about the blob can be computed in the process of determining the pupil.

49

Q Can we look -- if you wouldn't mind keeping the reference Gerhardt available, I'd like to point you to -- in your declaration as well, to Page 60, Paragraph 116.
A I'm sorry. Page 60?
Q You're on the right page. We're on Page 60, Paragraph 116. It begins on the prior page. And I'm asking you about Figure 10 which appears on Page 60 of your declaration, Exhibit 1002.
Are you with me?
A I understand.
Q Can you refer to -- do you have Gerhardt with you as well?
Can you refer to Column 12, Line 52.
A Okay.
Q Figure 10 of Gerhardt is a simplified case, right?
A What do you mean by "simplified"?
Q Paragraph -- are you on Column 12, Line 51? I did that a little fast. Do you have the reference before you?
A Yes. I'm at Column 12, Line 51. I got you.
"Figure 10 illustrates some preferred blob properties. Specifically, a first blob and a second blob are shown for a simplified case." Okay.

50

Q So Figure 10 of Gerhardt is a simplified case, right?
A According to the specification, yes.
Q And you don't disagree?
A I didn't look at the simplicity of the examples, but I understand that Figure 10 is what they're referring to here.
Q As a simplified case?
A Yes.
Q And if you can look at the figures, can you direct -- I direct you to Figure 13, Figure 14 of Gerhardt. With me?
A Yes.
Q These Figure 13 and Figure 14 of Gerhardt are also examples showing several defined blobs, right?
A Yes.
Q And the figures show some bounding boxes, but, in fact, there would be more bounding boxes. They're just simplified diagrams for illustrative purposes, right?
MR. COOK: Objection. Form.
THE WITNESS: Yes. The specification states that bounding rectangles are only shown for a few blobs for illustrative purposes.
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51

BY MR. COULSON:
Q Let's look at Column 21 of Gerhardt. And I'd like to refer you in your specification -- Strike that.
I'd like to give you a reference in your declaration to Paragraph 65 on Page 28, if I have that right. Do you see a reference in Column 21 there?
A Yes. I'm there.
Q Column 21, the section starting at Line 1 through approximately 18, that's referring to doing the blob definition operation on a smaller part of the image than the full image, right?
A Yes.
Q So looking at -- if you need it, I can refer you to Column 20 at Line 50. The image size is 640 by 480 pixels, the full image, right?
A Of one specific prototype system, yes.
Q And that's discussed at the bottom of Column 20, that prototype?
A Yeah. The Sun SPARCstation2.
Q So the -- what I want to ask you is at Column 21 at the top, there's the smaller image examples they give, one of them at Line 5 is 320 by 240.
Do you see that? That's Line 5.
A Yes. I see it.
Q And that's half of the full window?

52

A Actually it's a quarter.
Q Well, the horizontal dimensions are half and the vertical is half, and that results in it being a quarter image?
A That's correct. I could fit four 320 by 240 pixel rectangles not overlapping into a 640 by 480 screen.
Q And the other example, 220 by 160, that's about -- the horizontal dimensions are about a third of the horizontal dimension of the full image?
A It's a bit larger than the third horizontally and I believe it's exactly a third vertically. Three times 160 is 480.
Q I meant to do the easy one. I guess that would have been the vertical one.
And the pupil size typically is -- it says in Gerhardt about ten percent of the image; is that right?
A Yes. That's what Gerhardt says.
Q So do I understand the smaller windows in the examples in Figure -- at Column 21 are bigger than the expected pupil area?
A So you said 220 was about a third of 640 and 160 was a third of 480. So that would be one-third horizontally, one-third vertically, that would be about one-ninth of the size of the screen. That would be

53

about 11 percent.
And the pupil occupies about ten percent of the total video image, so it very well could be that the pupil occupied a decent amount of that 220 by 160 pixel subset.
Q And do I understand that the example given here in Figure 21 of Gerhardt, the smaller window can be incrementally increased in size; is that right, until the -- if it needs to attempt to locate the pupil in larger windows?
A Yes. That's the -- the size of the active window could be incrementally increased.
Q There's no provision for decreasing the size of the active window?
A Actually that paragraph concludes once the pupil blob is again successfully detected, then the active window size can be reduced to its baseline size.
Q During the detection process there's no provision for decreasing the window, active window size. It happens after the pupil has been detected; is that right?
A It's not stated in this paragraph.
Q What do you mean?
A The paragraph -- this paragraph doesn't state that the window size is reduced during the detection.

54

Q And --
A Until it's successful, and then it's reduced.
Q I'd like to ask you about the center -- centering. Have you had a chance to read through these paragraphs? I'll just ask you. You can read if you need to.
The center of the smaller window described in Gerhardt at the top of Column 21 is based on the running average centroid location, right?
A It does state "By keeping a running average of the centroid location for previously-selected pupil blobs, an active imagery region can be examined that is centered about the running average centroid location."
Q So there's no provision for changing the center of the active window in the process described here in the top of the Column 21. Do I have that right?
MR. COOK: Objection. Form.
THE WITNESS: I believe the running average of the centroid location is updating the centroid location. That's what the running average means.
BY MR. COULSON:
Q Yeah. That's a good point. Let me rephrase the question. So within a particular frame -- Let me back up a little bit.
Do I understand that running average centroid

55

updates over time? As frames come over time it updates the centroid location expected for the pupil; is that right?
A The running average is accumulated for previously selected pupil blobs.
Q So for a single current frame that's being analyzed by the process of 21, the center doesn't change? It's based on the running average centroid which is determined from previous frames?
MR. COOK: Objection. Form.
THE WITNESS: I'd really have to analyze that to know -- it doesn't say it's not being updated. It does say it's a running average for previously selected pupil blobs that could include the current pupil blob, and as you're increasing the window size you could be adding additional pixels to that currently-selected pupil blob that would adjust its centroid location when averaged with the others from previous frames.
BY MR. COULSON:
Q Do I understand -- let me try to understand that answer. Do I understand that the window -- the active window is increased when there is a failure to select a pupil blob?
MR. COOK: Objection. Form.
THE WITNESS: The specification states "In some

56

cases the use of a smaller active image region will result in a failure to select the pupil blob. In these cases, the size of the active window can be incrementally increased until the pupil blob is again successfully selected."
BY MR. COULSON:
Q So under what circumstances is the active window size incrementally increased in the process described in the top of Column 21 of this Exhibit 1013?
A This paragraph states that it's increased when the active image region results in failure to select the pupil blob.
Q Are there any other circumstances in which the active window is incrementally increased that are disclosed here in Column 21?
A It just refers to that -- the case where the -- a failure to select the pupil blob.
Q And if there's a failure to select a pupil blob, do I understand correctly there would be no centroid of the -- of a pupil identified --
MR. COOK: Objection. Form.
BY MR. COULSON:
Q -- as a result of the failure?
MR. COOK: Objection. Form.
THE WITNESS: Not necessarily. There could be

57

all sorts of reasons why you could expect the failure to select the pupil blob. You could, for example, have some of the pupil blob but not all of that.

You may want to ensure that you've got all the pixels in the blob within your smaller window, and only have a portion of them.

BY MR. COULSON:

Q Is there any disclosure in Exhibit 1013 of a failed process for selecting a pupil resulting in a centroid value?

A I don't recall any specific failure cases, but we are looking at an optimized implementation of one of the embodiments, so I would really have to re-analyze the patent to -- on those grounds to see if there were other failure cases like that, but I don't recall any.

Q How is the running average centroid calculated in Exhibit 1013?

A I don't recall seeing a specific formula for computing the centroid of a potential pupil or a blob. Column 12, Line 49 describes "Figure 10 illustrating some preferred blob properties. A blob has a bounding rectangle that corresponds to the X and Y coordinate maxima and minima for the pixels within that blob."

They show a centroid there, after describing those maxima and minima, and they also describe what you

58

could refer to as the aspect ratio, the ratio of the horizontal dimensions to the vertical dimensions.

All of those could be computed based on the bounding box parameters of the minima and maxima of the X and Y coordinates of the blob pixels.

Q And how is the running average over time calculated generally?

A I don't recall seeing a specific formula for the running average over time, and there is a variety of methods for doing that. The windowing over time could be uniformly weighted for previous and current centroids, or it could weight the more recent centroids more heavily than prior centroids. I don't think it really specifies how that average is computed. If it does, I don't recall a specific formula.

Q Let's look at Page 13 of your declaration. And we'll still be with Gerhardt.

Sorry. That's the wrong -- Page 23. My apologies.

Do you see Figure 1 and 2 of Gerhardt?

A Yes.

Q Do I understand -- and what does Figure 1 and 2 show generally?

A The physical construction design of the hardware of a video camera mounted on a helmet pointed

59

at the eye.

Q And do I understand -- is it correct that the camera is in a fixed position with respect to the eye?

A Based on this design, the eye rotates in its socket, so a fixed position with respect to the eye would be a bit misleading. Certainly not a fixed orientation with respect to the eye and there may even be motions of the eye as it's rotating.

Q Well, let me -- maybe I'm not using the right terms. Let me refer you to the bottom of Column 5 of Gerhardt.

Sorry. Bottom of Column 6. The very bottom. Either one.

Is the camera in Gerhardt in a fixed position with respect to the eye socket?

A It states that it's in a fixed position relative to the eyes. And that's advantageous because it eliminates costly computation overhead associated with either head sensing or additional image processing.

Q I'd like to refer you to -- I'd like to ask about the calibration process. Could you please refer to Paragraph 65 of your declaration.

A My declaration.

Q And I'm looking on Page 29. That's a multipage paragraph. I'll give you a second to look at that.

60

It's referring, I believe, to the calibration process of Gerhardt.

A Okay.

Q And you may wish to refer to Columns 18 and 19 of Gerhardt. I think you're citing Column 18 here. It's the section labeled System Calibration of Gerhardt.

Let me know when you've got that before you.

A Okay.

Q This calibration process is to determine a relationship between the user's pupil and the location and the screen location where the pupil is looking; is that right?

MR. COOK: Objection. Form.

THE WITNESS: The first paragraph of System Calibration states that it's used to determine a mapping relationship between the relative position of the pupil's center and the point of regard on a display screen. I think "point of regard" is intended to mean the point that the pupil would be looking at.

BY MR. COULSON:

Q And that process requires the user to repeatedly look at different spots on the screen; is that right?

A Yes. And that's documented in the subsequent paragraph.

61

Q Okay. You can put that aside for now and I'll go ahead and I'll ask you something else.

If you could go to your declaration, please, at Page 5, Paragraph 24.

A Okay.

Q You're citing to this Exhibit 1009, character recognition article by Glauberman. Do you see that?

Oh, excuse me. I misstated that. Exhibit 1009 I believe is the Trier article.

A Yes. Exhibit 1009 is Trier, Jain and Taxt. It's a survey article from Pattern Recognition.

Q What's a survey article?

A So in journals -- and this is true in computer vision and many other fields -- you can have a research article that introduces a new idea, a new concept. And then you can have a survey article. And a survey article takes recent results, recent research articles and collects them together to kind of get a higher level picture of what's been developed as a whole instead of each individual piece.

Q And what's the relevance of feature extraction for character recognition to the issue of the '134 patent?

A So we cited Trier, Jain and Taxt for the use of histograms to identify and track image features. And so

62

there are examples of histograms, in particular the Glauberman reference, character recognition on business machines that dates back to 1956 on the use of histograms for feature extraction.

Q Why don't we just put that aside.

We went off to the particular prior art, but I'd like to get back to the patent we were discussing, the '134 patent. So we'll be at the claims for a moment here. It's at the end, obviously.

I'd like to ask you about Element 1C, which we explained what that referred to earlier. Do you recall that?

A Yes. "Wherein forming the at least one histogram further comprises determining X minima and maxima and Y minima and maxima of boundaries of the target."

Q Is it your opinion that the -- this Element 1C does or does not require the determining of the minima and maxima boundaries of the target to be part of the forming of the histogram?

MR. COOK: Objection. Form.

THE WITNESS: So in applying 1C, "wherein forming the at least one histogram that determines" -- "that comprises determining X minima and maxima and Y minima and maxima," does not appear, at least according

63

to the specification, to need to happen at the time the histogram is formed.

And there are a couple of examples in the specification where it would not be formed at the time the histogram was being formed, that the minima and maxima of the target would not be decided.

One example is Figure 17. So Figure 17 shows -- is designed to find the target of a user's head in a video conference system. And what's being shown here is velocities. The data is the velocity of the pixels.

And the idea is that if pixels have a lot of pixel velocity in the way they're measuring -- the way '134 measures pixel velocity is the change in the gray value over time, so from one frame to another frame the difference in the pixel value indicates the velocity of the change of the pixel value.

So it's going to detect the outline of the head based on head motion, and the likely event that the gray values will have changed from skin tone to some background color or from hair to some background color.

And you can see in these -- in these projection histograms of those pixel velocity values, those pixel change values, it's bi-mobile, there are two humps. And the goal here is not to find the smallest and highest X

64

value of that projection histogram. The boundary of the target and -- that's in the claim language for that Element 1C, the boundary of the target is actually at the peaks. And there's no provision in the construction of any of the embodiments that would keep track of the values at those peaks during the construction of this histogram.

This is something that gets extracted after the histogram is built. Let me just double-check to see if there's any other examples there.

Yeah. There's another example in Figure 12. And Figure 12, these are also velocity points, pixel velocity points where the X coordinate is the velocity of the pixels -- the X coordinate of the velocity of the pixels, the Y coordinate is the -- the Y coordinate of the velocity of the pixels, but you'll see here that the bounds that they're after, the la, lb -- little l, and lc -- it's labeled with la, lb, lc and ld. The lower case ls indicate the values and the upper case Ls indicate the bounding box.

Those do not occur at the absolute minima and maxima of the -- of the histogram. They occur after the fact at these values based on the shape of the histogram, based on a variety of analyses that you can make of the data, and so these bounds that bound the

65

target, the X and Y extents of the target, are not computed on the fly but after the fact.

So based on -- just to conclude, so based on those examples from the specification, I -- and in the application of that Element 1C, I did not see a need to require that the prior art computed the X minima and maxima and Y minima and maxima of the boundaries of the target on the fly.

There are some cases where they were computed on the fly, both in the specification there is -- you know, it keeps -- the specification has registers that will keep track of the minima and maxima -- minimum and maximum extent of a projection histogram. It will keep track of that as the histogram is being constructed. But we saw two examples where they were using different values for the minima and maxima of the target that would be computed afterwards. So it's got examples of both.

Similarly, there are examples in the prior art where it was computed after the fact and there are examples in the prior art, specifically Gilbert, where it was computed on the fly.

BY MR. COULSON:

Q A projection history, an X or Y projection histogram, minimum and maximum need not be the same as

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the minimum and maximum boundaries of a target?

A So Claim 1C states "wherein forming the at least one histogram further comprises determining X minima and maxima and Y minima and maxima of boundaries of the target."

I think in several cases we've seen examples where that X minima and maxima and Y minima and maxima are the smallest and highest values of a projection histogram, but there are two examples in the specification of '134 where the boundaries of the target were not those smallest and largest values in the histogram.

Q Yes. So I have a general question not about 1C. Is it true that the minima and maxima of an X and Y projection histogram need not be the same as the minima and maxima of a target?

MR. COOK: Objection. Form.

THE WITNESS: I can show you an example where in both Figure 12 and Figure 17. In Figure 17 -- and I want to be very careful when we say minima and maxima of the target, the boundaries of the target. Here these are -- these are determined by the '134 specification to be the boundaries of the target. And those are not what the specification determines X MIN, X MAX as the greatest coordinate and least coordinate of the

67

projection histogram.

BY MR. COULSON:

Q So X MIN and X MAX as shown in Figure 17, for example of a projection histogram, need not be the same as the X boundaries of the target that the histogram is analyzing; is that right? That's what you're saying, right?

MR. COOK: Objection. Form.

THE WITNESS: To be very specific about what I'm saying, the X -- to be very specific let me refer to the definition of X MIN and X MAX.

So these are described in Column 20. We have MIN, MAX, NBPTS, RMAX and POSRMAX, P-O-S-R-M-A-X. And these are various statistics on the histogram that are collected on the fly by one of the embodiments of '134.

And MIN and MAX are specified in Column 19 in the -- from Lines 51 to 57. And so the MIN value is the value of the smallest pixel accumulated in a histogram, and the MAX value is the value of the pixel -- is the highest value used that was received in the construction of the histogram.

So using those definitions of MIN and MAX, we have a case where the MIN value is here and the MAX value is here on the projection histogram of Figure 16. Basically to the smallest then highest values of that --

68

of the X coordinate at the bottom of Figure 16.

Those do not correspond to the boundaries of the target in Figure 16 which are actually the peaks that are used, Lines 126A and 126B.

BY MR. COULSON:

Q You mean Figure 17, right?

A Yeah. I'm sorry. Figure 17. Figure 16 is very close to it, but yeah it's Figure 17. Thank you.

Q So the X MIN and MAX of the projection histogram need to not be the same as the X MIN and MAX of the target?

MR. COOK: Objection. Form.

THE WITNESS: So Element 1C says "the X minima and maxima and Y minima and maxima of boundaries of the target," that in some cases will be the MIN and MAX histogram statistics that we saw but in some cases it won't be.

BY MR. COULSON:

Q Right. So the MIN and MAX of a projection histogram and the MIN and MAX of a target boundary are different things?

MR. COOK: Objection. Form.

THE WITNESS: That's what's shown in Figure 17. The MIN and MAX values accumulated in the construction of the histogram along the X axis. That projection

69

histogram in Figure 17 on the X axis, those MIN and MAX values do not correspond to the MIN and MAX extent of the target or specifically in 1C's language. They are different than the X minima and X maxima of the boundaries of the target.
BY MR. COULSON:
Q Well, let me go back through some of what you said.
Let me go to Figure 12 of '134. And can I refer you in the text of '134 to Column 8, Lines 54 to 55. This is the description of the -- brief description of the drawings.
A Uh-huh. I'm there.
Q Do you agree that Figure 12 shows a two-dimensional histogram of a moving area?
A The full description of Figure 12 in the spec here is that it shows the formation of a two-dimensional histogram of a moving area from two one-dimensional histograms.
What it's showing in the central area here labeled 40 is referred to in the spec in the longer description of Figure 12.
Q Is that Column 21, Line 40?
A Yes. That's where I'm at.
Q Okay. So what is the dotted area, the dotted

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collection of dots of Figure 40 of -- excuse me.
In Figure 12 what is Item 40, the collection of black dots?
A The black dots correspond to the X and Y coordinates of pixel velocity data.
Q And the pixel velocity data is for pixels that have speeds that are significant speeds; is that right?
A The significant speeds mean that the speeds are greater than -- in the X coordinate greater than value La and greater than value Lc in the Y direction. So if the pixels had zero velocity they would be at the origin -- so they're off the origin, so they have what was characterized as a significant velocity.
Q Maybe we should back up. So what is speed, speed V? We should back up even more. Speed V is one of the parameters. I think you mentioned it earlier in the abstract discussed in the '134 patent, right?
A Yeah. In the abstract I did mention it, but it's a domain. The domains include, among other things, speed V.
Q And how is -- another domain -- sorry -- is oriented direction DI, right?
A The abstract says oriented direction. I think that's D1.
Q D1 or DI. Oriented direction is one of the

71

domains, right?
A Yes. Referred to in the abstract.
Q And how is speed V domain calculated for a pixel?
Let me break it down and go step by step. It might be easier for you.
Can I refer you to Page 14 of your declaration which should have Figure 13 from the patent on it.
A Okay.
Q So this is the -- Figure 13 is the -- shows the histogram formation -- or excuse me. It shows the histogram block 25 for the domain V; is that right?
A What was the number you were referring to? Oh, 25a, the histogram formation?
Q I actually think I changed the question in the middle, so I apologize.
A Okay.
Q Figure 25 -- Strike that.
Figure 13 of the Patent '134 which on Page 14 of your declaration shows the histogram block 25 for the parameter for the domain speed designated V, letter V, right?
I'll refer you to the bottom of Column 17, for your reference, and top of 18 of the patent, specifically starting at Line 65 of Column 17. That

72

should be your reference to describing Figure 13? I'll let you read that and I'll just ask you again. Okay?
A Okay.
Q Is Figure 13 showing the histogram block for the domain V called speed?
A Yes. In the description of Figure 13 it says, for example, with respect to speed, which is preferably in the value of the range from zero to seven, classifier 25b.
Q And 25a is the histogram formation portion in Figure 13 for that domain, right?
A Right. Yeah. 25b talks about the classifier. 25a is the histogram formation.
Q And that includes a memory 100, right?
A Yes. There's a memory labeled 100.
Q And you can see memory 100 referenced say Line 66 of Column 17 throughout to the top of the middle of Column 18.
A Okay.
Q So I'll actually move to Column 19 of the patent for your reference starting at Line 20, Column 19. So to form the histogram for the V domain speed, that's done on a pixel-by-pixel basis, right?
A So this section of '134 talks about the validation signal is updated on a pixel-by-pixel basis,

73

but the data coming in, for example, would be pixels.
Q That's a fair point. Maybe we should have stayed at Column 18 at the top.
You can look at whatever you want. I'm just trying to help point you to the parts --
A Sure.
Q -- that may be helpful.
So my question is for forming the histogram for speed, each pixel speed value is used to increment the histogram if it meets certain speed criteria, and not used to increment the histogram if it doesn't meet the speed criteria, right?
MR. COOK: Objection. Form.
THE WITNESS: So the classifier, 25B, can be used to consider only data within a particular speed category or categories, for example, speed one, speed three or five, speeds three to six. So you could set the classifier to only increment the histogram from a pixel if it represented a speed of one, or you could set it to increment the histogram -- the appropriate histogram entry if its speed was three or five, or you could have it increment the histogram if it was -- if the input was a speed of anything from three to six, in those examples.
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74

BY MR. COULSON:
Q Certainly. So let's take a speed of three to six as an example for the classifier 25B. Okay. Are you with me on that example?
A Yes.
Q For particular pixel values, if a pixel has a speed value of, say, two, it will not be used -- the data for that pixel will not be used to increment the histogram in memory 100; is that right?
A If the classifier was set to consider only data with speeds from three to six, then a pixel with a speed of two would not increment the histogram stored in memory 100.
Q For a pixel that has a speed of four in this example, the memory location four in the histogram 100 would be incremented by one based on that pixel data; is that right?
A In that particular example the pixel with speed four would pass the classifier, and that pixel's value would be used to contribute to the histogram.
Q And specifically what happens is memory location four of histogram 100 would be incremented?
A Yes. And the example described in Column 18, that paragraph from 11 to about 28, that would be plotting a speed histogram, so that speed of four would

75

increment memory location four by one.
Q And as pixel data is evaluated it will be used to continue to form the histogram, depending on whether it passes the classification criteria of three to six in this example?
A I'm sorry. Can you repeat that question.
Q Yeah. Sorry.
For the example of a certain window of image data that's being -- for which a histogram is being formed, as each -- each pixel will be used if it meets the speed criteria to increment the histogram memory 100 for that window of pixels, right?
A So the design of the classifier is to limit based on the value used for the histogram which pixels are used to increment the histogram.
Q So for a certain window, XY window of pixels, the pixels that meet the classification criteria will increment the memory 100 for the speed value for each pixel, right?
MR. COOK: Objection. Form.
THE WITNESS: In a particular example where you are just plotting a histogram of velocities and using a classifier to limit those velocities for a histogram of velocity, then that is the proper use of the classifier.
There are other examples in '134 where these

76

units shown in Figure 13 are used in concert with each other as shown in Figure 11, where you've got multiple inputs and those multiple inputs can influence each other through that shared bus. The shared bus shown in -- as Item 23 in Figure 13.
BY MR. COULSON:
Q I'd like to ask about the incrementing of the memory 100. Is the incrementing of memory 100, for example, memory 100 in Figure 13, is that forming the histogram for speed?
A Forming the histogram is one of the terms in the claims, and I think it's illustrated by disembodiment, including memory 100. So a portion of forming the histogram as demonstrated by this embodiment is that they -- the memory keeps at its memory locations the current count of the valid and classified data that it receives on the input.
Q What do you mean by a portion of forming? Did you say "a portion of forming"?
A You tell me.
Q Let me ask it again. Is the incrementing of the histogram 100 -- Strike that.
Is the incrementing of the histogram memory 100 the forming of the histogram for speed for the histogram block 25 in Figure 13, for example?

77

A Is the word "forming" used in Column 12? We're referring to Figure 13. I forget which column we were in.
Q Yeah. I can help. I can point you to Column -- we started at Column 17, Line 55 where it begins "Referring to Figure 13."
A Is the term "forming" used in this section?
Q Yeah.
A I don't recall.
Q It's in the column and line I just pointed you to.
A Oh, 17, Line --
Q 55.
A Thanks. Oh, the histogram forming portion. 25a, for histogram formation.
So in referring, for example, to Claim 1, Element 1A, "forming at least one histogram of pixels in the one or more of a plurality of classes in the one or more of a plurality of domains," that this embodiment addresses, you know, the forming of at least one histogram, and -- but the forming of that histogram, you know, is performed by the whole -- you know, by the whole machinery, the whole embodiment.
Certainly the current version of the histogram is held in memory 100 and, you know, these

78

embodiments -- yeah. This embodiment that's described meets those requirements of the forming of at least one histogram.
Q I'm looking for a box here. Let me -- to ask you a question, let's look at Figure 12, please, of the patent.
A Okay.
Q It's either that or I draw a box.
Let's consider a box in the image, in other words, a subset of the image, an XY subset such as the box in the middle of Figure 12 as an example. I wonder if that's easier or harder than just drawing a separate box.
Do you have a preference?
A Are you referring to the box bounded by La, Lb, Lc and Ld?
Q Yes. So for the box -- as an example, for the box bounded by La, Lb, Lc and Ld in an image, let's say we form a histogram of speed for the pixels in that box. Those pixels -- the pixel data will be used to increment the memory 100, right?
A So Figure 12 shows two histograms.
Q Maybe I'll draw it. I thought it might be confusing to try to use that figure. Let me try it this way: Would it be easier if you draw an image with a box

79

in it? Or would you prefer I do it?
A Why don't you go ahead and then I can try to figure out what you're drawing.
Q I guess we'll have to mark it.
THE REPORTER: 2014.
(Deposition Exhibit No. 2014 was marked for identification.)
BY MR. COULSON:
Q Please let counsel have a look at it before you look at it, sir.
MR. COOK: Okay. Thanks.
MR. COULSON: It's publicly available now.
BY MR. COULSON:
Q What I'm trying to get at is I want to set up an example. So what I've tried to draw at Exhibit 2014 is a portion of a frame of pixels, in other words, a portion of an image. Okay.
Does that make sense?
A Yes.
Q And I've labeled the portion box?
A Yes.
Q When we form a histogram such as by using the histogram formation, Unit 25, it will use the pixel data only within -- only for the pixel within that box if that's what we set it to do, right?

80

A It depends how it's been configured. There's multiple histogram formation units that share the same bus. And that bus sends a validation signal back into the histogram formation. They can select which pixels you're using and what you're creating a histogram of.
So you have to be very specific when configuring all of these different domains with these different histogram formation units to create a histogram of something.
Q All right. Well, I think I can do that. If you can look at Column 21, please, of the patent.
A I'm at Column 21.
Q Line 12, referring to a user defined area.
A Okay.
Q So if we -- referring to Exhibit 2014, the drawing, if we set the user defined area for X and Y to the size of the box I've drawn, only pixel data for pixels within the box will be used to form a histogram, right?
A For how many histogram formation units?
Q I'll take the example of just the speed histogram we've been working with. Just one. But I don't think it matters for the example.
A Well, how are you setting the X coordinate limitations of the box and the Y coordinate limitations

81

of the box?
Q I'll have a user selected X and Y limitation in accordance with the box of Figure 2014, and I'd like to form a speed histogram without any restriction in the classifier.
A Okay. The speed data coming in data V will be for all pixels. How are you going to limit that?
Q I will be limiting it strictly by the X and the Y limits of the box.
A And how are you configuring the embodiment to do that?
Q I'll set the -- do you see Item 108 on Figure 13? It's also on your -- I want to use the term coincidence unit or validation unit, but I want to use a term that you understand.
The box in the lower right of Figure 13.
A Yes. So it's -- the reproduction there -- okay. 108. Got you. Okay.
Q What shall we call 108?
A Let's just call it 108.
Q Okay. So we set 108 so that only speed X and Y are admitted into the histogram formation units. Okay?
A So the speed data V comes in to the mux on data V. So what are you setting 108 to do?
Q To check for an X, whether the X limitations

82

are satisfied, the Y limitations are satisfied.
A Okay. And so how is 108 set to do that?
Q Well, the X histogram unit 28 will be set for that range. And the Y histogram formation unit will be set to the Y range to get my box.
A Okay.
Q So for this example, a histogram will be formed in memory 100 for speed for only the pixels in the box, right?
A So if you configure the X coordinate histogram unit and the Y coordinate histogram unit to create a validation signal through Box 108 to only allow velocity data, speed data from the pixels for Xs lying between those two -- the left and right bounds and Y coordinates between those two bounds, then that box -- then the only velocities that would go into the memory would be the ones corresponding the pixels in that box.
Q How do we -- when do we know that we're finished forming that histogram? Maybe that was a bad question.
Once we form the histogram for the pixels within the XY box drawn on Exhibit 2014, we're finished forming the histogram, correct?
A What was the beginning of that question?
Q Once we formed the speed histogram for the

83

pixels -- for all the pixels in the XY box in the middle of Figure 2014, we have finished forming the histogram; is that right?
A If that's when you want to finish the histograming and query the histogram, then that's your decision.
Q And if I made that decision, then once I formed a histogram -- once I've used the velocity datas for all pixels in the XY box in the middle of Exhibit 2014, I've completed forming the histogram, right?
A Sure, by declaration. You want to consider the pixels in that box, so once all of those pixels that you have with those X and Y coordinates have been sent to the machine, then you can query the histogram formation unit for the resulting histogram.
Q And at that point histogram memory 100 will have formed a histogram -- Strike that.
If we then -- could we then add an additional set of pixels, say to the right of the box I've shown in Figure 2014, and add those -- that pixel data in through to the histogram formation unit and continue forming the histogram in memory 100?
A The embodiment described -- this embodiment described in '134 would allow that.
MR. COULSON: Okay. Let's take a lunch break.

84

MR. COOK: Okay.

(Lunch recess taken at 12:31 p.m.)
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LOS ANGELES, CALIFORNIA; FRIDAY, DECEMBER 22, 2017; 1:17 P.M.

JOHN C. HART, Ph.D., having been previously duly sworn by the reporter, was examined and testified further as follows:

MR. COULSON: Let's go back on the record.

EXAMINATION (resumed.)

BY MR. COULSON:

Q Dr. Hart, welcome back from lunch. I'd like to go through some of the disclosures you mentioned from the '134 patent. Can you get that before you?

We talked about speed, right? Do you recall that?

A Yes.

Q Speed is a disclosure we looked at, speed at the value of the zero to seven.

A All right.

Q In your mind, is speed different -- a different domain than velocity in the disclosure of the '134 patent?

A I think speed is a scalar value. Velocity is a

86

vector value. And I think they're using V to say speed, so it may be referring to it as velocity. But speed is defined in the patent separately, so I believe when they used the term V they're actually talking about speed and they have a separate direction.

Q Yes. Direction being -- it's in various places. You can look where you want, but let's look at -- for example, at the top of Column 4. I'd just like to talk about speed oriented direction velocity.

So are you at a disclosure of oriented direction?

A I see it at the top of Column 4, that speed and oriented direction are the -- are two of the domains that are preferably selected from.

Q I think I can do a little better. Maybe Column 14 of the patent, '134 patent, around Lines 10 to 20, to try to help orient you.

A So I'm there. Was there a question?

Q What is oriented direction?

A So in the description here in Column 14, it corresponds to what's called a Freeman code which is basically a number from one -- from zero to seven that tells you a direction in increments of 45 degrees, so basically zero, 45 degrees, 90 degrees, 180 degrees, so on, all the way back around to 360 degrees.

87

Q So oriented direction is perhaps obviously different than speed as domains, right?

A Right. Those are two separate domains.

Q Is it your position, your understanding that velocity is a different domain than speed or oriented direction?

A I think I was using velocity to refer to that V value which is actually speed. So I'm not sure that velocity is defined in those terms in '134.

Q Okay. So let's look at Figure 12. You'll recall perhaps Column 21 -- Columns 20 and 21 have some disclosures about that for your reference.

A Okay. I'm there.

Q Okay. I'd like to ask you about Figure 12. Is the data that's used to form histograms shown in Figure 12 for a limited set of speed values, or does it include all speed values for the pixels under consideration?

A So I will note they do use the term velocity histogram based on POSRMAX and that's in Column 20 at Line 30. So given the discussion in Column 20 it looks like we are actually looking at velocities with an X coordinate and Y coordinate in Figure 12.

Q Do you consider velocity to be a separate domain from speed or oriented direction?

88

A Velocity is a combination of the domain of speed and oriented direction.

Q And what is the -- Strike that.

How is velocity calculated for a particular pixel?

A I don't recall a specific definition from '134. It wasn't the specific definition of velocity that was used in that -- in Figure 12. It wasn't part of what I needed to apply the claims. So I don't recall a specific definition of what they were using for velocity.

There's a bit of a description of it in Column 20, but it was -- it wasn't necessary for me to apply the elements of Claim 1 to the prior art, so I didn't do a full analysis of that.

Q Are the pixel -- Strike that.

Is the pixel data that's used to form the histograms of Figure 12 for pixels that have a subset of velocity values indicating motion, or is it including pixels with all velocity values?

A So can you repeat the question.

Q Yes.

What I'm trying to get at -- I'll go back to that question but I'm trying to make it as easy as possible. Are the -- is the set of pixels used to form

89

the histograms in Figure 12 limited in some way, and if so by what, is what I'm trying to get at?

A Sure. I understand what you're asking.

In Column 21 halfway down starting at Line 25 discusses Figure 12 and mentions La, Lb, Lc and Ld that represent the limits of the range of significant or interesting speeds.

And I'll mention that speed is being mentioned here and velocity is being mentioned in Column 20, so they're being used somewhat interchangeably in the specification.

These limits may be set up by a user or an application program using the system. Or they may be set up as a ratio of the maximum of the histogram, the maximum value, the highest peak of the histogram or maybe set depending on the application.

So what's being shown here are all of the values, the interesting ones are the ones that lie between La, Lb, Lc and Ld.

Q You're referring to Figure 12 when you're saying "shown here"?

A Yes.

Q And Figure 12 is showing all of what values?

A It depends on where you look, but in Column 21 they're referred to as speeds and velocity data.

90

So they're referred to as velocity data at Line 27, and they're referred to as speeds at Line 31. And perhaps they're referred to as speeds in terms of the X coordinate of velocity with a Y coordinate of velocity, that projection would remove the directionality of the velocity and turn it back into a speed, because it would be a single value along the coordinate direction.

Q Let me -- so Figure 12, let's try to break this down so I can understand what you're saying about Figure 12.

You mentioned before I believe that you saw two histograms in Figure 12, two one-dimensional histograms; is that right?

A There is a histogram on the X axis and a histogram on the Y axis of Figure 12.

Q What is, in your understanding, the histogram shown on the X axis of Figure 12?

A So Column 21, Line 27 refers to Figure 12 as velocity data. And velocities have a speed and a direction. And I believe that's being derived from some analysis that happens in Column 20.

So for these pixels to be velocity data, the magnitude, which would be the distance from the origin, would be their speed and their direction would be the direction from an origin.

91

Q Let me focus just on the X axis -- let me back up a little bit. Figure 12, there's an X axis and a Y axis. Is that the same as the X axis and Y axis of a frame of image data going from zero to, for example, 255, if that was the full size of the frame?

A Without knowing the exact formulation of the velocity, it's difficult to tell. But typically a velocity is a vector value, and so you can represent it as an X component and a Y component where the X is the X component of the velocity vector and the Y is the Y component of the velocity vector.

Q Are you saying Figure 12, Item 40 is a plot of velocity vectors for all pixels in an image frame?

MR. COOK: Objection. Form.

THE WITNESS: So Column 21, starting at Line 25 states that "Figure 12 diagrammatically represents the envelopes of histograms in X and Y coordinates for velocity data."

BY MR. COULSON:

Q Well, I'm not sure I heard an answer to my question. Maybe -- can you try describing what Figure 12 represents? Maybe that's easier for you. I'm having trouble understanding what you're saying Figure 12 represents.

92

A Sure. Based on my understanding from Columns 20 and 21, it is a plot of velocity data for pixels and it's showing the histograms -- the X coordinate -- the X coordinate projection histogram and the Y coordinate projection histogram of that velocity data.

Q Can you look at the bottom of Column 21 -- excuse me, bottom of Column 20.

A Okay.

Q Do you agree or disagree that Figure 12 is something that is to be used to find the moving area of an image?

MR. COOK: Objection. Form.

THE WITNESS: Well, this section states that the various histograms and composite signal that are output are used to determine if there is a moving area in the image to localize this area and/or to determine its speed and oriented direction. So it would be used to determine if there was motion, where the motion occurred and the speed and direction of that motion.

BY MR. COULSON:

Q How under your interpretation of Figure 12 could we determine the location of the moving area?

A If motion is detected then you would have to look at the other data associated with the pixels for

93

which that motion was detected to determine their locations.

Q How would you know which pixels to look at?

A The configuration shown in Figure 11 has a shared bus, 23, and this shared bus can use the output of one classification unit in order to set a validation signal for other classification units, so you could then refer to one domain that satisfies a condition from another domain.

Q So what criteria would we use to find the moving area as a result of Figure 12?

A So there are significant motions defined by these bounds, La, Lb, Lc and Ld. If those were set up as classification units, the pixel satisfying those classifiers could trigger a validation signal to one of the other units to validate the data reflecting the coordinates of the pixel's position.

Q So we would need to make histograms using La, Lb, Lc and Ld as the criteria, and then look at the area that -- of the image that results?

A You would use La, Lb, Lc and Ld in the classifier units. I don't think you would do anything with those histograms that were generated other than trigger the validation signal.

Q Are you saying that we need to make a new

94

histogram using La, Lb, Lc -- Strike that.

Are you saying that we'd need to make new histogram or histograms using La, Lb, Lc and Ld as limitations to find the moving area?

MR. COOK: Objection to form.

THE WITNESS: I'm not sure what it is you're trying to do. If you're trying to find where those pixels are, one of the ways you could find out the location of those pixels is through a projection histogram of the X coordinate and the Y coordinate of the pixel locations based on the validation signal of pixels passing these particular tests.

BY MR. COULSON:

Q To define "location" we would make different projection histograms than the projection histograms shown in Figure 12 on the X and Y axis?

A If you want to define the location of those pixels, then, yes, that's one way you could do it.

Q What have we determined as a result of the histograms formed in Figure 12?

MR. COOK: Objection to the form.

THE WITNESS: I believe that Column 21 is describing the process of setting the bounds of significant motion that set up minimum and maximum bounds of the target. And those can be obtained through

95

analysis of the histograms, but not as the MIN value and MAX values of those histograms.

BY MR. COULSON:

Q So we have found as a result of Figure 12 the limits of either speed or velocity that represent -- Strike that.

So as a result of forming the histograms shown in Figure 12, we have found limits for either speed or velocity?

A No. I think Figure 12 shows a process where you're using projection histograms of velocity on the two coordinate axes in order to inform your decision what the actual bounds of the target should be, and those bounds are set by La, Lb, Lc, Ld. And those bounds form X minima and maxima and Y minima and maxima that serve as boundaries for the target.

Q Does the fact that Figure 12 is disclosed in the '134 patent mean to you that Claim 1 should read on the disclosures of Figure 12?

MR. COOK: Objection. Form.

THE WITNESS: I used the disclosure of Figure 12 and Figure 17 and the other figures to understand Claim 1, specifically that final limitation regarding the X minima, maxima, Y minima, maxima of the boundaries of the target in applying it to other

96

examples of the prior art.

These two examples both show situations where the boundaries of the target don't necessarily coincide with what was labeled as MIN and MAX in the histogram formation unit in this Box 112. And so that claim limitation should not be limited to only the calculation on the fly of MIN and MAX during the formation of a histogram, but can also include the analysis of a histogram after it's been formed as it was done in Figure 12 and in Figure 17.

BY MR. COULSON:

Q Let me just make sure I understand your position on Figure 12. Are you saying that there's no particular limitation on speed or velocity or anything else on which pixels are used to form histograms on Figure 12?

MR. COOK: Objection. Form.

THE WITNESS: I have to go by Figure 12 as it's displayed. And as it's displayed I see histograms of all of the data. I see data plotted outside of La, Lb, Lc and Ld. And I see a description of the process that's being used in Column 21 to set those limits.

So those limits could be used for further processing of that velocity data. But given the way that those La, Lb, Lc and Ld are chosen with respect

97

specifically to the shapes of these projection histograms, provides me with an understanding of what the boundaries of a target should look like and how they should be chosen.
BY MR. COULSON:
Q So you can't tell for sure whether there's a limitation on the types of pixel data input to the histograms in Figure 12?
MR. COOK: Objection to form.
THE WITNESS: So there's a paragraph in Column 21 starting at Line 11 that says "In order to process pixels only within a user-defined area, the x-direction histogram formation unit may be set to process pixels only in a class of pixels defined by boundaries, i.e., X MIN and X MAX.
And the next paragraph says Figure 12 represents the envelopes of histograms 38 and 39, and then using those envelopes of the histograms to choose La, Lb, Lc and Ld, and that these limits may be set.
These limits form a rectangle that surrounds the area of significant speeds. And that a few smaller areas noted as 41 are typically ignored.
And so that language leads me to understand that the embodiment could be configured to ignore these outliers, these 41 dots outside of the rectangle. But

98

in the process of setting those bounds to configure the device to ignore those outliers, they analyze the histograms, the projection histograms of the data, and it's that process that leads me to understand how the embodiment is used in order to set those bounds in order to define the boundaries of the target.
BY MR. COULSON:
Q You referred to the possibility of a user-bound area for X MIN and X MAX at the top of Column 21. That's a possible way to limit the data used in forming the histograms, right? You're saying that's a possible way to limit it?
A Yes. That paragraph in Column 21, Line 11 describes the use -- the ability to set an X MIN and X MAX to limit the input data. And then the following paragraph describes how you can use the information, the analysis, for example, provided by the projection histograms to set those bounds using, for example, La, Lb, Lc and Ld.
Q But the patent doesn't disclose specifically limiting the pixel data used to form the Figure 12 histograms?
MR. COOK: Objection. Form.
BY MR. COULSON:
Q One way or another.

99

A I mean, the language that the patent uses in Column 21, you know, may be set. Yeah. May be set. These are things that could happen. I don't think they are happening in this particular example, because we can see the data being plotted. We can see the histograms, including the tails that should have been excluded if the data was actually being limited by La, Lb, Lc and Ld.
So I think they are suggesting that the embodiment can indeed filter out the data outside of that box, but in this particular example of Figure 12 they -- they're focusing on how you figure out where La, Lb, Lc and Ld are, and you do that by looking at the projection histograms. And you do that to determine the boundaries of the target data.
Q And your basis for an opinion of whether or not the histograms -- or whether or not the data being used for the histograms at Figure 12 is limited or not is the shape of the Item 40 in Figure 12?
MR. COOK: Objection. Form.
THE WITNESS: I'm using Figure 12 to understand the specification and how -- and how the claims should be read in light of the specification.
So Figure 12 tells me a lot of things. It tells me how to set the boundary of the target. The

100

text in Column 21 tells me how those boundaries could be used to limit the consideration of data in the creation of a histogram. It tells me a lot of things.
I don't think Figure 12 itself is -- I think if I look at Figure 12 in and of itself I see all the additional data, so I'm not seeing the case where the data is being excluded if it's outside of La, Lb, Lc and Ld other than the indication with Label 41 of that outlier data lying outside of that, and that you could set up the embodiment to do that.
BY MR. COULSON:
Q But other than looking at the shape of Item 40 in Figure 12, you don't rely on any disclosure in the patent text itself as to whether or not the input data is limited by luminance or DP=1 or any other particular criteria?
MR. COOK: Objection to form.
THE WITNESS: There's a description of how this is set up in Column 20. But other than that -- I mean, other than that, I'm not aware of any other disclosure of how Figure 12 was set up.
BY MR. COULSON:
Q And which disclosure -- which lines are you referring to?
A So Line 55 of Column 20 starts the discussion

101

of Figure 12. And the paragraphs preceding that are discussion of computations that could be used for velocity values and motion. There's no statement that explicitly says one is being used for the other, but it wasn't really necessary for my understanding of what the specific definition is of the data shown in Figure 12.

Whatever data is being shown in Figure 12, it's clear from the specification and the figure that I have a projection histogram on the X axis and a projection histogram on the Y axis. Those are being used to determine the boundary of the target. And those determinations are not the minimum and maximum values of the histograms.

Q That's what you're taking away from Figure 12?

MR. COOK: Objection to form.

THE WITNESS: That's one of the things I took away from Figure 12, yes.

BY MR. COULSON:

Q Let's look at Figure 14A. I can refer you to Paragraph 38 of your declaration.

A Figure 14A you said?

Q Yes. I believe they may be a little out of order. Let me give you a sheet number. Do you have it?

A It's Page 9.

Q Okay. 14A below Figure 12, right?

102

A Yes.

Q And I could refer you to disclosure in Column 20, Line 49 to 54.

A Column 20, Line what to 54?

Q Look at Line 49.

A 49.

Q See Figure 14A?

A Yes.

Q What I wanted to ask is Figure 14A -- what is being shown in Figure 14A? Let's start with that.

A Figure 14A shows a hypothetical velocity histogram.

Q Is Figure 14A used in the example shown in Figure 12, or is it a separate disclosure?

A I don't recall the discussion of Figure 12 referring to Figure 14A. Figure 14A is discussed in the paragraph prior to Figure 12, prior to the paragraph discussing Figure 12, and it's discussing a hypothetical velocity histogram. And Figure 12 shows histograms of velocity, so they're related in that sense.

Q Does Figure 14A show a hypothetical histogram where all values of velocity are included?

A Figure 14A is hypothetical. The specification says it's referring to a velocity that's categorized for up to 16 velocities, and it's showing 15 of them as well as an envelope, which is a smooth version of that discretized bar graph.

103

Q Let's turn to Figure 17. Figure 17 is -- shows histograms formed for only pixels with DP value equals one, right?

A Yes.

Q Let's look at the embodiment of Figures 20 through 23. It's in Columns 23, 24 paragraphs.

A All right. Figures -- 21 through 23?

Q Yes.

A And you said Columns...?

Q 23 and 24.

A Okay.

Q Does this show formation of histograms for only pixels with DP=1?

MR. COOK: Objection to form.

THE WITNESS: So the discussion in Column 24 which is describing Figure 21, which is illustrating the growth of regions of those windows, is -- is giving an example where DP=1 is a criterion to consider only a subset of the pixels for use in the projection histograms. But the last sentence says "Alternatively, the system may be set to detect a velocity greater than zero, or any other criteria that define the edges of the object."

104

So that approach that's illustrated in Figures -- I think it's 21 through 23 could be used with other criteria other than DP=1.

BY MR. COULSON:

Q Okay. I'm going to refer you -- we're going to talk about something else. I'm going to refer you in your declaration -- if you can put the patent aside. It's available for your reference at any time. I'd like to refer you to Paragraph 115 of your declaration in the '134 case. It's on Page 58.

I will also hand you a copy of Bassman Exhibit 1014 in the '134 IPR for your reference.

You can see Bassman -- the discussion in Paragraph 115 is in the section for Element 1B of the '134 patent?

A Okay.

Q My question is do you -- is it your -- are you asserting that Bassman satisfies Element 1B -- Strike that.

Is it your opinion that the disclosure of Bassman satisfies Element 1B?

A Yes. I make the statement Gerhardt and Bassman each disclose the step of identifying the target in said at least one histogram, 1B.

Q And I've given you Bassman. Can you explain

105

how the Bassman reference discloses step 1B?
A Okay. Element 1B identifying the target in said at least one histogram itself. Bassman states at the bottom of Column 6 "One technique for object detection at each strip pixel position is to compute a histogram of the image intensity values within the integration window centered at that pixel position. Based on attributes of this histogram, for example, the number or percentage of pixels over some threshold value, you can classify that strip pixel as either detection or background."
Presumably vehicles would have a higher pixel value than the street, a darker street, which would be the background. By performing this operation on each strip pixel, one can construct a one-dimensional array that essentially serves to identify the target.
Q Can you look at Figure 5 of Bassman. Are the histograms you're referring to formed of pixels in the -- what's labeled as the image zone here in Figure 5 which is equivalent to a lane of a road?
A I believe so. I believe that's the strip that's being referred to, because of the strip of pixels in the bottom of Column 6.
Q Is one histogram formed for each row of pixels Y in the image zone of Figure 5?

106

A No. There is an integration window centered at that pixel position, a little neighborhood, and the histogram is computed for that neighborhood.
Q What do you mean by "neighborhood"?
A The bottom of Column 6, it says that at each strip pixel position, you compute a histogram of the image intensity values within the integration window centered at that pixel position. So an integration window is a neighborhood surrounding that pixel. It's pixels nearby that pixel.
Q So the pixels, are they -- the histogram is -- the histograms you're referring to described at the bottom of Column 6 for Bassman are not formed just at one -- in one line of pixels?
MR. COOK: Objection. Form.
THE WITNESS: Specification says there's an integration window centered at that pixel position, so an integration window means that there's some breach in some neighborhood of surrounding pixels for which you're computing the histogram.
BY MR. COULSON:
Q Can you look at Column 6, Line 28. Does that explain of -- of Bassman, does that explain what the integration window is?
A It does in especially the last sentence of that

107

paragraph that says "Other types of integration windows not described here may also be used."
Q Let's take the first example of an integration window being -- that's Item A in the paragraph at Column 6, Line 28 of Bassman. That's all image pixels on a row Y within the boundaries of a lane.
Do you see that?
A Yes.
Q In that case is a histogram formed for each Y value in the image and an average intensity calculated as a result of each histogram?
MR. COOK: Objection. Form.
THE WITNESS: So the process at the bottom of Column 6 for computing the histogram states that you have some threshold value, and pixels with values below that threshold value would be classified in one way and values above that threshold value would be classified the other way.
Let's say darker values would correspond to the background and lighter values would correspond to detection.
In your Example A where the window is all of the pixels in that row that are within the delineated lane bounds, you'd be looking at a horizontal subset of pixels and using that as your integration window.

108

So it would be horizontal set of pixels within that lane bound, and you would be using the histogram, the same histogram for all of those pixels to determine if each of those pixels was detection meaning a vehicle or background meaning a street.
BY MR. COULSON:
Q So within a lane, say the lane shown in Figure 5, you form numerous histograms for each Y value, and then you -- once each Y value of histogram is formed, you analyze the histogram and categorize that Y line as either a detection or a background; is that right?
A Yes, according to that definition A of the integration window. And you might want to do that, for example, if there was glare or different contrast up closer to you than farther away. Closer to you tends to be towards the bottom of the screen. Farther away tends to be towards the top of the screen.
And that would give you the ability to have different thresholds separating street from vehicle for closer portions of the street than farther away. There could also be varying illumination conditions of the street that would be valuable.
Q And the categorization of each lane Y within the lane is stored in the 1-D strip shown to the right

109

of Figure 5, right?
A I believe so. The text refers to cars 504-1 and 504-2 in that 1-D strip. So I think what you said would be consistent with what was indicated. It just says the 1-D strip is computed by a converter.
Q Is it the calculation of the 1-D strip that you assert discloses limitation 1B identifying the target in said at least one histogram itself?
A No. It's the process of computing a histogram of the image intensity values within an integration window that I used to identify a target in a histogram.
Q Are you referring to the process of computing a histogram of image intensity values within an integration window that's performed prior to forming the 1-D strip shown on the right of Figure 5?
A Yes.
Q I'm going to refer you to Paragraph 157. I'm going to hand you Gilbert. Gilbert has already been marked as Exhibit 1005, I believe.
I have the same series of questions. Do you assert Gilbert discloses Element 1B of Claim 1 of the '134 patent?
A Yes, I do.
Q And how does it disclose Element 1B? I believe we probably covered that this morning.

110

A Partially.
Q So it might be short.
A I'm just trying to find the charts. So Gilbert satisfies 1B in several ways. One way is in the identification of the target in the intensity histogram, and another way as the identification of the target in a projection histogram.
Q As to the intensity histogram, are you referring to the finding of the threshold Item 80 in Figure 5?
A Item 80 in Figure 5 of...?
Q Strike that.
Gilbert, is it the formation of intensity value histograms for the windows TR, BR and PR in and of itself that satisfies Element 1B?
MR. COOK: Objection to form.
THE WITNESS: That is one example of how Gilbert satisfies Element 1B.
BY MR. COULSON:
Q Simply forming those histograms of intensity for TR, BR and PR satisfies 1B?
MR. COOK: Objection to form.
THE WITNESS: The process of forming those histograms are used to derive information about the target, the existence of the target in the window, and

111

the existence of the target within the window identifies the target.
BY MR. COULSON:
Q Is it the result of forming the three histograms for the TR, BR and PR windows that's used to form a rule for classifying intensity values?
A Form a what?
Q A rule for classifying intensity values.
A So the video processor section of Gilbert describes a rather intricate amount of analysis to identify the target in those windows. One of the elements of that identification is an intensity histogram. And the intensity histogram provides the information needed to identify target in the window.
Q I'd like to focus in, if I may, on the -- I guess it's the Bayesian classifiers on the left of Page 50 of Gilbert.
A Okay.
Q I want to see if we're in agreement on a fact question about this reference in Gilbert.
Let me just ask it as a question: The way in which the histograms that are formed for the windows TR, BR and PR are used is as inputs to the process of making a Bayesian classifier; is that right?
MR. COOK: Objection to form.

112

THE WITNESS: Yes. I specify in Gilbert a Bayesian classifier can be used to decide whether a given feature acts as background plume or target point.
BY MR. COULSON:
Q And the formation -- without further processing, the formation of the intensity histograms for TR, BR and PR is not enough to identify the target?
MR. COOK: Objection to form.
THE WITNESS: Can you repeat the question.
BY MR. COULSON:
Q Yeah. Certainly.
I want to see if it's your opinion -- I'll set it up a little bit. I want to see if it's your opinion that the formation of the three histograms I'll ask about by itself is enough to satisfy 1B, or whether it's your opinion that additional processing using those histograms is required to satisfy 1B.
A Okay.
Q So do you need to get a reference before I ask?
A I'm going to look up the claim language again to be precise.
Q Ready?
A Yes.
Q Does the formation of the TR, BR and PR window histograms itself without further processing satisfy

113

Element 1B of the '134 patent?
A So in looking at Element 1B, I think there are several examples in the '134 spec where simply creating a histogram was not enough to identify the target. There's further processing in their examples.
We talked through some further processing in Figure 12, in Figure -- I think it was 17, and other examples.
The formation of the histogram and the identification of the target in the histogram is an important piece of that process, but there are other subsequent steps of those processes, both in Gilbert and in '134.
Q So the formation of the three intensity histograms of Gilbert is not enough by itself to satisfy Element 1B, right?
A I analyze Gilbert as a whole. I didn't pick apart individual pieces to analyze the subset of Gilbert.
The values of the target, the pixel values, the intensities that form the target are in the histogram of the target, the intensity histogram of that target window.
The subsequent analysis illuminates what those values are, but the subsequent analysis depends on the

114

creation of the histogram. And that subsequent analysis, along with the creation of the histogram, identify the target in those histograms as those intensity values.
Q So you're asserting the formation of three intensity histograms plus additional analysis is what satisfies Element 1B in Gilbert?
A I believe I have an opinion that Gilbert as a whole satisfies, in fact, each and every element of Claim 1. I didn't delineate which components of Gilbert satisfy any of the elements of Claim 1.
Q So you can't say?
A I didn't do the analysis.
Q Let's go on to Element 1C. I have a follow-up question on Element 1C -- do you have that before you? -- of the claim. We're done with the prior art reference.
A Okay.
Q It was kind of a general question.
A Okay. 1C, "wherein forming the at least one histogram further comprises the X minima and maxima and Y minima and maxima."
Q Right. So I understand -- do I understand correctly from your earlier testimony that you're of the opinion that forming a histogram, and then after the

115

histogram is formed, doing analysis to determine the boundaries of the target can satisfy Element 1C; is that right?
A I believe that's right. What I said before was that both examples in '134 and in some of the other references I saw examples where a histogram was formed and then the targets -- the boundaries of the target, the bounding box consisting of the minima and maxima and the X and Y coordinates were determined after the histogram was formed.
Q Is there any limitation on how much additional processing can be done after the histogram is formed in order to find boundaries?
A I don't see any limitation on the amount of computation or analysis. I think '134, Claim 1 and specifically Element 1C says that you form a histogram and determine the X and Y minima and maxima as boundaries of the target.
And I think that determination is based on the formation of that histogram, and in all the examples it has been based on the creation of that histogram, then you've satisfied -- certainly if -- then you satisfied the restrictions of Element 1C.
MR. COULSON: Okay. Why don't we take a break.
(Recess taken from 2:35 - 2:48 p.m.)

116

MR. COULSON: Back on the record.
BY MR. COULSON:
Q Dr. Hart, can you please get Gilbert in front of you, Exhibit 1005, and open it up to Figure 2. And I'd like you to -- for your convenience, I'd like to also refer you to Paragraph 79 of your declaration.
A Okay.
Q So Figure 2 shows a window TR, a window or subregion BR, and also window or subregion PR, right?
A Right.
Q And there's a description -- at Column 48 there's a description of -- do you see the paragraph beginning "The basic assumption" at the top of the right column of Page 48?
A "The basic assumption"?
Q Yes.
A Yes. I'm there.
Q So there's no disclosure in Gilbert as to how the tracking window is initially placed at the very start of the process, right?
A Yeah. I don't recall anything specific about initialization.
Q And there is no disclosure -- let me set it up again. Look one paragraph down, paragraph beginning with "The tracking window frame is partitioned."

117

A Uh-huh.
Q There's no disclosure in Gilbert of how the window or how the partitioning is done between the region BR and the region PR and the region TR, right?
A Yes. I don't recall seeing anything of how those are initialized to ensure they contain background or plume.
Q In fact, there's no disclosure later in the process of how to partition BR, PR and TR, right?
A Yeah. I don't recall seeing anything about how those are initialized, but at the same time I wasn't -- I didn't need to see the initialization of those elements to determine that Gilbert satisfied the elements of Claim 1 and the other claims.
Q Look at Page 52 of Gilbert, left column, the first full paragraph below the formulas starts with "The tracker processor"?
A Okay.
Q It says the tracker processor is what controls position and shape of the target tracking window, right?
A Among other things. In addition to the windows also the servo, s-e-r-v-o, motors that orient the camera and lensing.
Q So the tracker processor controls the target tracking window and it also controls other things. Is

118

that what you're saying?
A Yes.
Q The inputs -- we're going to say on the left-hand column of Page 52. Look at the first full paragraph, if you'd like. There's a series of five inputs for the tracker processor listed here, right?
A Yes.
Q And the third one is orientation?
A Yes.
Q And orientation is calculated by looking at the two different center points of the two halves of the target estimation shown in Figure 4?
A The formula for orientation is on Page 50. It's the arctangent of the -- of that ratio of Y coordinates over X coordinates.
Q For two different center points, right, are used as input to that?
A Yes.
Q Target shape is also an input to the target processor -- Strike that.
Target shape Item 5 is also an input to the tracker processor, right?
A Yes.
Q And to get to target shape, is that -- that's based on rectangles, equal length of rectangles, for

119

example, what's shown in Figure 5 on the previous page?
A Yes. As defined by that SI formula on the left column of Page 51.
Q And to identify target shape, we need to transform the projection functions into a parametric model for the structural analysis, right?
A So Page 51 describes the parametric model for structural analysis, and that forms, for example, the target shape used for the tracker processor.
Q In looking at the paragraph below all the formulas above the tracker processor paragraph we looked at a minute ago, you see where it says for I equals 1, 2 to 6 on -- I think I went a little fast there.
Can you go to Page 52 on the left-hand column?
A This one?
Q That's the page. It lists the five inputs to the tracker processor?
A Uh-huh.
Q If you can look below the formulas SXi and SYi, can you verify for me that the very first and the very last of the equal area rectangles are not used in calculating the target shape?
A There's a statement that says "Observe that the first and last equal area subintervals are not used in the shape description, since they are quite sensitive to

120

noise."
Q So they're not used? You have to answer orally.
A Yes. They are not used in the shape description in this example.
Q Can you -- I want to ask you about the tracker processor a little further. Can you open your declaration. I would stay with Gilbert. Open your declaration to Page 121. That should be Paragraph 166. I'll let you read it.
A Okay.
Q You have the opinion that the tracker processor of Gilbert is analogous to the temporal processing unit of the '134 patent; is that right?
A Yes. As stated in Paragraph 166, for example.
Q Why do you have -- can you explain that opinion? Why are they analogous?
A So the tracker processor I referred to in Paragraph 166 is one of many examples of a temporal processing in Gilbert that served to satisfy Claim 3. There's a full list in the charts.
Q Can you give me a reference, please.
A Sure. Page 155.
Q Where on the page? Which --
A Oh, Page 155 of my declaration. On the left --

121

it's a chart. On the left is Claim 3 and on the right side starts all of the references of Gilbert that have been identified as satisfying that claim, in particular the -- which includes the temporal processing.

So the role of the temporal process or in '134 is given in Column 10, Line 16 -- 15 and 16. It shows "The operation of a temporal processing unit 15, the function of which is to smooth the video signal and generate a number of outputs that are utilized by spatial processing unit 17."

There's a number of examples in Gilbert -- the tracker processor is one of them -- that are designed to smooth the video signal to provide inputs over time that can be used for further processing.

Q How does the tracking -- Strike that.

How does the tracker processor smooth the signal? Is that using the confidence weight?

A So the tracking processor uses a number of input -- one of them is confidence -- to control a number of camera parameters. One of which is lensing, so that you keep the image in focus.

Q Could you turn in Gilbert, please, to Figure 7. It's on Page 55.

A 55?

Q Yes. And you discuss -- I believe you discuss

122

this on Page 85 of your declaration for your reference. Anyway, there's a reproduction of Figure 7 on Page 43 of your declaration.

A Okay. So Page 43?

Q Yes. It's also Paragraph 85.

A Okay.

Q So Figure 7, to orient us, these are representative simulation outputs, right?

A Yes.

Q Can you tell, based on the disclosures of Gilbert, what the boxes are that roughly surround what you've labeled in red as target rocket, R? Like which windows they are?

A Which boxes are you referring to?

Q Yeah. I think I went a little fast there. I apologize.

If we look at the left of Figure 7, and we look at your -- Page 43 of your declaration, you have something circled in red there which you label "target rocket," right?

A Yes.

Q And there's I guess it appears to be two rhombuses that are around that red circled item.

Do you see those?

A Yes.

123

Q What are they? Can you tell what they are from the disclosure of Gilbert is my question?

A Gilbert says "In addition to the digitized images, the simulation displays the target and plume tracking windows and the projections accumulated for each video field."

Q Just for the record can you give me where you're getting that from in Gilbert?

A Sure. It's Gilbert, Page 55, left column, middle of the second paragraph.

Q Okay. Is there a disclosure of a -- Strike that.

Is there a disclosure of a background region, BR, in Figure 7?

A Not according to this description of Figure 7. It just says that they're showing the target and plume tracking windows.

Q And are you aware of any disclosure of how to determine the background window?

A Certainly in the specification earlier in the paper, Figure 2, for example.

Q Yes.

Is there any disclosure -- Strike that.

We discussed earlier Figure 2 and some description of Figure 2 in the right-hand column of

124

Page 48. And I believe we established there's no specific disclosure of how to determine the size or location of the background window, the BR, the background region; is that right?

MR. COOK: Objection to form.

THE WITNESS: So the first full paragraph on the right column of Page 48 characterizes the tracking window as surrounding the target.

And the next paragraph partitions that tracking window into a background region and a plume region, and then the region inside the frame is called the target region, and that's what's shown in Figure 2.

And so from this description in this paragraph illustrated by Figure 2, the background region of the tracking window doesn't contain the target. The target is in the target region and the plume region contains at least a portion of the plume.

BY MR. COULSON:

Q Other than that description in the two first full paragraphs on the right-hand column of Page 48, there's no disclosure in Gilbert of how to make those -- the selection of where BR, TR and PR will specifically be located, right?

MR. COOK: Objection. Form.

THE WITNESS: I don't believe that's part of my

125

opinion. My opinion is on Gilbert -- the analysis I performed on Gilbert was to address the claims of '134, which were based on specifically forming histograms and identifying a target using a histogram, and then using that histogram to bound the target.

In the cases of bootstrapping Gilbert, the assumption is that the target lies within these regions in order to use those histograms to determine the parameters that are subsequently used to determine if the -- to identify the target.

So based on the setup in Gilbert, the subsequent histograms that are generated are used to identify the target. And that's -- that was sufficient to meet the requirements of Claim 1, regardless of how the target initially gets into the target window.

BY MR. COULSON:

Q I just want to verify. Other than the first two paragraphs on the right-hand side of Page 48 of Gilbert, you're not aware of any disclosure of how the background -- the BR, background region, is set?

A In that first full paragraph, right column of Page 48, the background sample, the tracking window is placed about the target image to sample the background intensities immediately adjacent to the target image.

So that's where the background samples come

126

from. And then I've got the illustration of the background region in Figure 2 and as characterized in that second full paragraph on the right column of Page 48.

I didn't do an analysis of Gilbert to determine how they initialized the system. It wasn't necessary for me to determine the -- I already had enough information based on the description of the Gilbert system to meet with -- meet the requirements of the claims of '134 that were the focus of my analysis without trying to understand how the initial tracking window position was set or how those individual regions were initialized.

Q So you're not offering an opinion as to how the background region is specifically located?

A Initially, that's correct. I'm not offering an opinion how those regions are initialized.

Q Are you offering an opinion as to how the background region is determined later in the process?

A Sure. In that the process describes a way of maintaining the target in a target window, and maintaining a background region that doesn't contain the target, and maintaining a plume region that continues to track the plume.

Q So you're offering an opinion that the

127

background region is set, if I am reading from it correctly, according to the first two paragraphs on the right-hand column of Page 48; is that right? That's what you're relying on.

MR. COOK: Objection to form.

THE WITNESS: I mean, I'm not offering an opinion on the initialization of those regions. I'm pointing to those two paragraphs of Gilbert to characterize the definitions of those regions. It was the definition of those regions, the histograms that were generated from them, and the use of the -- the use of the data from those histograms to identify the target that I based my opinion on.

BY MR. COULSON:

Q You can put that aside. We're going to go to Hashima, Exhibit 1006, previously marked Exhibit 1006.

I'll hand counsel and the witness a copy of Exhibit 1006.

A Thank you.

Q Can you turn to Figure 7 and 8, please, of Hashima, Exhibit 1006.

A Okay.

Q Can you verify for me, so Figure 7 shows the binarized image that's formed based on the intensity threshold. That's done in Hashima, right?

128

A Yes.

Q And Figure 8 is the -- shows the same image but indicating that eight group of dark pixels have been identified, right?

A Yes.

Q And if you can turn to Column 8, please. The bottom of Column 8, Step S7. And you can refer to Figure 5, S7, if you'd like, if that's easier for you as well, of Hashima.

A Okay.

Q Can you verify for me that the eight groups shown in Figure 8, for example, are checked to see whether they satisfy a size or area criteria before they are checked for a number of peaks and projection histograms?

A Okay. Yeah. The description of Step 6 says "Figure 9 shows an example in which a target detecting process is effected on an image having the group number 3 which represents the target mark."

Q So you agree?

A With what?

Q I'll read it again. I wasn't clear on the answer. I'm going to reask the question. We all have the same issue.

Do you agree that for the eight groups shown in

129

Figure 8, for example, they're checked to see whether they satisfy a size or area criteria before they are checked for a number of peaks in projection histograms?

A No. Figure 9 is separated because of a -- oh, Step 6, which separates group number n from the other image data by the labeling process and it's separated by window process.

Step 7 is the area filter and it says "Figure 9 shows an example in which the target detecting process is effected on an image having the group number 3 which represents the target mark."

So the process that gets you from Figure 8 to Figure 9 is not based on area. It's just based on selecting number 3.

Q I am asking about what happens after Figure 9.

A Okay.

Q So let's get on the same page. So Figure 8 we have eight groups. Figure 9 shows that we're taking one of the groups that happens to be Group 3 and we're making a window around Group 3, right?

A Okay.

Q After that, S7, is performed, which is an area filter, to see if the group passes an area criteria or not.

A Okay.

130

Q And only after that area criteria step, then the number of peaks in projection histograms Steps 8 through 10 is performed?

A Okay. I agree with that.

Q That's the end of that question. We can put that aside. We're going to move to the '518.

A Okay.

Q I'll send you 1001 where we're discussing 2017-01190. This is the '518 patent. I'll hand you your declaration, Exhibit 1002, for IPR 2017-01190.

Do you need a copy, Counsel?

MR. COOK: If you have an extra one.

MR. COULSON: I do.

BY MR. COULSON:

Q And if you'll open the patent to Claim 39.

A Okay.

Q To make sure we're using the right letters, I'll just start on Columns 37 through 39. You can look wherever you'd like. I'll open your declaration to Page 54.

So we can agree that 39C element is the identifying a portion of the image of the face comprising the feature to be detected using an anthropomorphic model based on the location of the identified facial characteristic, right?

131

A Correct.

Q And 39D is selecting pixels of the portion of the image having characteristics corresponding to the feature to be detected, right?

A Okay.

Q Next one, 39E, is forming at least one histogram of the selected pixels, right?

A Yes.

Q F is analyzing the at least one histogram over time to identify characteristics of the feature to be detected?

A Yes.

Q And G is said feature being the iris, pupil or cornea, right?

A Yes.

Q Eye diagram for you.

Please mark this.

THE REPORTER: 2015.

(Deposition Exhibit No. 2015 was marked for identification.)

MR. COULSON: Thank you.

Counsel, I think I gave you my copy. Could you possibly share with the witness?

MR. COOK: Sure.

\\\

132

BY MR. COULSON:

Q I just want to get our terminology and basic eye anatomy straight before we dive in.

Exhibit 2015 is some eye anatomy diagrams. Do you have any disagreement, looking at the top image, with the fact that the cornea is separate from the sclera, s-c-l-e-r-a, which is the white part of the eye?

The cornea is shown in light blue. The sclera is shown in darker purple. You would agree those are separate parts of the eye?

A I'm not an expert in anatomy. The notation of iris, pupil and cornea were referred to in those terms in both the '518 and in the other elements that I utilized, the prior art and so on. So I'm not sure. Is there a situation where the sclera needs to be separate from the cornea?

Q Well, let me do this: We're going to talk about prior art, et cetera. The material does mention the sclera, which is the white part of the eye.

Do we agree that the sclera is the white part of the eye or should we -- you're not recalling at this point?

A I don't know that eye anatomy was part of my opinion. Certainly the feature being the iris, pupil or cornea was part of the opinion. The references all

133

describe the term iris, pupil and cornea. And I think when we go over those, if there's a question maybe we can refer back to this. But I don't have an opinion on the anatomy of the eye.

Q Okay. Well, let me just set the table here so that -- and then we'll move on as you suggest.

So the top of Exhibit 2015 shows the sclera and cornea, and the bottom of Exhibit 2015 shows the cornea, iris and pupil.

And just sitting here so far you don't have any -- you don't disagree with how these are laid out based -- in 2015?

A No. I don't have any disagreement of how they're laid out.

Q Well, we'll move on, and if at any time you would like to come back to Exhibit 2015 or refer to it, we can do it. Hopefully this will help with the process.

A Okay.

Q Now, let's go -- having that out of the way, let's go to the Claim Element 39D, please.

This is claim of the '518.

A Okay.

Q Do I understand -- we've obviously read your declaration. I'd like to see if I understand your

134

opinion correctly about how you're interpreting 39D.

Are you interpreting 39D selecting pixels of the portion of the image having characteristics corresponding to the feature to be detected to mean selecting pixels of the portion of the image including -- Actually, strike that. I need to do a little bit more set up.

Okay. We've read Element 39D and 39E. My question is this -- are you looking at something else? I'll give you a minute to look at it.

A I'm just looking at 39 as you read it.

Q 39E, are you interpreting forming at least one histogram of the selected pixels to mean forming at least one histogram including the selected pixels?

A I will have to check the references in order to determine if in every case it was what the histogram was to be able to make that determination. So let me take a look.

(Brief pause from 3:38 - 3:41 p.m.)

BY MR. COULSON:

Q Why don't I come back to that question. Let me ask you about a specific reference.

A Okay. That would be helpful. I was almost done, but...

Q Would you prefer to keep looking or shall we

135

come back to it?

A It's up to you.

Q If you're almost done, go ahead.

A Okay.

So in looking at Claim 39, you have to look at the claim elements relative to each other. And there's a process here identifying the characteristics of the face other than the feature to be detected, and then identifying a portion of the image of the face comprising the feature to be detected using an anthropomorphic model.

When you identify that -- the portion of the image comprising the feature to be detected, then you are selecting pixels of the portion of the image having characteristics corresponding to the feature to be detected. That selection -- I understood that selection not to necessarily be equal to the portion of the image of the face comprising the feature to be detected. And so that selection is just selecting pixels of a portion of the image having characteristics corresponding to the feature being detected, and then forming a histogram on the selected pixels.

So the only reason you would select those pixels is to perform that histogram, because you've already identified a portion of the image comprising the

136

feature to be detected.

So I believe -- I believe I was expecting that selection to be -- the selection of pixels to be the selection of the pixels that would be used for the histogram.

Q Let me break that down a little bit. So figure -- 39C we're selecting a portion of the image that includes, for example, an iris? Do you follow me?

A Are you talking about a specific reference?

Q No. I want to understand your opinion about 39D, so I want to ask some follow up -- I would like to ask some follow-up questions.

A Okay.

Q So 39C, we're identifying part of the image of the face that includes the feature to be detected which would be the iris, pupil or cornea, right?

A Uh-huh.

Q Does 39D require selecting part of the portion of the image identified in 39C, or can 39D be all of the portion of the image identified in 39C?

A No. No. I believe those are different portions. And I'm looking at my analysis of Eriksson. And I believe in identifying the individual steps for this, in fact, the histogram is -- when I did the analysis forming at least one histogram of the selected

137

pixels isn't necessarily the histogram – I mean, the pixels I used for the histogram aren't necessarily all of the pixels that were selected from the image having characteristics corresponding to the feature to be detected. And I believe this Eriksson example – this Eriksson example demonstrates that.

So in 39E – I'm on Page 45 of the report. Forming at least one histogram of the selected pixels, Eriksson forms a histogram of a line passing through the pupil.

And for 39D, selecting pixels of a portion of the image having characteristics corresponding to the feature to be detected, in order to get to that point where you can find a histogram of a line passing through the pupil, you have to find the eyes first. And so I outlined that.

So I believe I misspoke a moment ago. The selection of pixels that are used for the histogram is not necessarily the selection of the portion of the image having characteristics corresponding to the feature to be detected.

And I believe that's also the case for the '518 patent. When I was looking at their – at '518's disclosure, the specification, I believe the parts of their examples that I mapped to – let me take a quick look here.

So one example is Figure 27 of the '518. You can see histograms generated of the eye area there. And that eye area is significantly refined from the eye area located in Figure 26.

Q Let me hand you Eriksson exhibit previously marked as 1005. Can you refer to Paragraph 103 of your declaration, which I believe you may have been looking at.

So I'd like to ask you about the -- it looks like you've opened to Page 317, 318 of Eriksson, right?

A Uh-huh.

Q Let's talk about the detection of fatigue as disclosed in this reference. Okay. So I'm looking at the Detection of Fatigue header on Page 317, in that section.

A Yes.

Q So what Eriksson does is it determines a match value for each frame. For example, there's an average match value found for the first number of frames during initialization, right?

A So there's a match value that -- when the match is significantly lower than the average, then it's a closed frame, otherwise it's an open frame.

Q And that match value is how Eriksson determines whether the eye is open or closed. That's what you mean by open frame, closed frame, right?

A Yes. That's my understanding.

Q And the matching function -- Strike that.

The way the match value is determined is by the matching function, M (x,y) I guess in the middle of the left hand column of 318; is that right?

A Yes.

Q And the matching function is determined from three points, a computed center of the pupil, and then two other points, a radius away from the computed center of the pupil on Line Y; is that right?

A Yes. The match function is computed at three points.

Q So the figure -- or the graph shown in Figure 5 is not used in calculating the match value, right?

A No. Wrong. There's some unknown variables here. One is -- one set of variables is XY, the center of the eye, of the pupil, center of the pupil, and another variable is R, the radius about the eye, which is the radius of the iris. And I believe those parameters need to be set according to the histogram.

Q There's a template, an iris template disclosed on Pages 316 and 317, right?

A Yes.

Q And the center of the pupil is determined from the template, right?

A It doesn't say what they use for X and Y for that equation on Page 318. They do mention that when the eye is closed they have trouble keeping track of the center of the pupil, and so they use the minimum peak at distance R from the pupil, and that leads to a good match when the eye reopens.

So I think when the eye is closed, there's an example where X and Y are recomputed from the histogram.

Q And where is the disclosure of X and Y being computed from the histogram, what you called a histogram?

A Yeah. Right above results and future work on Page 318. When the eye is open the valley in this intensity curve corresponds -- corresponding to the pupil will be surrounded by two large peaks corresponding to the sclera. When the eye is closed this curve is usually very flat in the center. However, the latter case there is no pupil to center the curve on which can lead to very unpredictable shape.

In order to minimize the risk of having one big peak nearby due to noise, we always use the minimum peak at the distance R from the pupil. This will lead to a very good match when the eye is open and very likely a

141

bad match when the eye is closed.
Q And that's what you're relying on for your basis for saying Figure 5 is used?
A Yes.
Q Let's talk about Figure 5. What does it mean? And you have your declaration still open.
A Yes, I do.
Q It's Paragraph 103.
So what is the characteristic curve -- I'm reading from the section you quoted on Paragraph 103, okay, in Eriksson. What is the characteristic curve generated by plotting the image intensities along the line going through the pupil from left to right?
A This is described by Eriksson in the title of this section as a horizontal histogram across the pupil.
Q Do you -- are you asserting that the curve generated by plotting image intensities along a line going through the pupil from left to right is a histogram?
A Yes. I'm following Eriksson's disclosure that it is a histogram.
Q Other than Eriksson calling it a histogram, do you have any other basis for calling a plot, a horizontal plot of image intensities for, on one line, a histogram in accordance with the claim?

142

A Well, in addition to them referring to it as a histogram, they are using it as a histogram and not as an image. So the -- they're analyzing peaks and valleys in the same way that you would analyze peaks and valleys of a histogram.
Q And that qualifies it as a histogram in accordance with the use of histogram in Claim 39?
MR. COOK: Objection. Form.
THE WITNESS: I think we've seen several different forms of histograms, projection histogram and luminance histogram. These are all referred to in general as histograms. And this example here is also referred to as a histogram.
BY MR. COULSON:
Q Are you using the ordinary and customary meaning of histogram in your analysis or are you applying a special meaning based on the disclosure of '518 patent?
A I'm not using a special definition of histogram that '518 would have produced because '518 didn't give me a specialized definition of histogram. I'm using customary and ordinary usage of this.
Eriksson was published in the IEEE conference on Intelligent Transportation Systems. It says here "All papers received in response to their call for

143

papers have been peer reviewed. We believe you will agree their quality is excellent." These papers plus several sessions have been organized into a variety of tracks.
So this paper went through a peer-review process. So in addition to the authors, who are -- who work in the artificial intelligence, robotics and vision laboratory, you have the reviewers for an IEEE conference that would agree that this is a histogram.
Q Does the plot of image intensities along the line going through the pupil from left to right of Eriksson, does that count anything?
A Yes.
Q What does it count?
A Anytime that you're looking at luminance -- for example, when you're using a luminance histogram, an intensity histogram, you're looking at a region of the image. Intensity is basically a count of power, of radiometric power, numbers of photons, so in this case you've got a histogram of the number of photons coming off of the eye in a single line. And this is a -- this is a histogram of those photons.
Q Does the curve generated by plotting the image intensity across the line going through the pupil from left to right of Eriksson show the frequency of

144

occurrence of anything?
A Yes. It shows the frequency of occurrence of photons.
Q And how does it show the frequency of occurrence of photons?
A The intensity value is the number of photons that would be emitted or received or detected in a given amount of time.
Q If you look at the very -- let's look at Figure 5. The very left-hand bar on the left-hand side, are you with me on that?
A Yes. I see the left-hand bar.
Q What does that bar represent?
A I believe that bar represents the intensity of a left most pixel in that line.
Q Do the bars on the graph of Figure 5 show how many pixels on the line going through the pupil have a certain intensity value?
A Yes. I believe each of these bars indicates the intensity value of a pixel on that line going through the pupil. They also indicate the frequency of photons or other radiometric energy, radiometric power specifically, from that line going through the eye.
Q Let's look at the left-hand bar, again, on Figure 5. Let's say that's a value of 255 for

145

intensity, for assumption purposes. Are you with me?
A I can assume that. That would be 255 sure.
Q I say that because it's kind of at the top of the levels.
A Sure. It's an assumption because we don't have a vertical scale.
Q Does the curve generated by plotting the image intensities along the line going through the pupil from left to right shown in Figure 5 count how many pixels on that line have an intensity of 255?
A No. This is not a histogram of intensity.
Q Is there a requirement that the plot of image intensities along the line going through the pupil count how many pixels on the line have certain intensity value?
A No. A projection histogram, for example, doesn't count the number of pixels that have the same intensity.
Q Is the curve shown on Figure 5 a projection histogram?
A I didn't try to formulate it as a projection histogram. I treated it as a histogram as denoted by the title of this section, as denoted by the caption of Figure 5 stating these two are histograms corresponding to an open and closed eye respectively.

146

Q So you're not offering the opinion that the intensity curve of Figure 5 is a projection histogram; is that right?
A There could be a formulation where it becomes a projection histogram. I didn't need to make it a projection histogram in order to have it meet this claim element, so I didn't try to formulate it as a projection histogram. I'm treating it just as a histogram, as it's provided here.
Q So you're not offering an opinion that it's a projection histogram?
A That's right.
Q Could the curve of intensity shown in Figure 5 be represented as a one-dimensional array of intensity values at each position X in the line through the pupil?
MR. COOK: Objection to form.
THE WITNESS: That's an alternative interpretation of this plot in the same way that you could take a one dimensional -- you could take a line of binary pixel values. If I have a -- if I have just a single one dimensional row of pixels, they're either black or white. If I make a projection histogram of that, I get the exact same thing.
So in the first case I'm looking at a binarized image, a scan line from a binarized image. In the

147

second example I'm looking at a projection histogram. And they are -- they're identical. So you can have the same data. In one case it's an image scan line, in the second case it's a histogram. It's just how you define it, how you use it, what it's being used for. And in the second case it would be a projection histogram.
BY MR. COULSON:
Q So was that a yes?
A To which question?
Q I asked you if the curve -- intensity curve shown on Figure 5 can be represented as a one-dimensional array of intensity values at each value of X.
A And the answer is what you see there shown as a histogram is also a plot of the intensity values along that scan line. So it's yes, but it's yes because they happen to be coincident. They happen to be the same data. But just because they're the same data doesn't mean that they're the same thing.
A scan line isn't necessarily a histogram. In this case we have a histogram in the same way that I could make a projection histogram of a single row of binary image data, and that projection histogram would be identical to the scan line of binary image data.
Q Does the fact that you can represent the

148

intensity curve of Figure 5 as a one-dimensional array of intensity values at each value of X disqualify the curve of Figure 5 from being a histogram?
A No. The curve in Figure 5 is a histogram. It's labeled a histogram.
Q But it's your opinion then that there's no requirement to sort the data of the intensities at -- along a line in Figure 5 in order for it to be a histogram? It can just be the intensity values along a line Y for each X value?
MR. COOK: Objection. Form.
THE WITNESS: I think Figure 5, the order of these elements is useful for ensuring the distance R of the pupil, ensuring the -- that the statistics, the pupil center and other values remain consistent even when the eye is closed. So I think the ordering of the elements is the same.
Another way of looking at this histogram, when we have a projection histogram we're looking at a projection of all of the values onto a single axis. And this is in the IEEE in signal processing, common to computer vision researchers and electrical engineers, it's common to look at projections and slices. And what you're looking at here is a characterization of a two-dimensional image by a single slice.

149

And in signal processing Fourier, F-o-u-r-i-e-r, transforms you have the projection slice there, which shows an equivalence between projections and slices in fourier space. So it's fairly common for computer vision researchers, electrical engineers, anybody working in signal processing, especially with images, to think about projections and slices in the same terms.

And what you have here is a slice version of a slice counterpart to a projection histogram. And it's a characterization of your two-dimensional image by just looking at one slice.

BY MR. COULSON:

Q Well, let me be clear. The image intensity plot of Figure 5, it doesn't explicitly include any data from any other line Y other than the middle -- or other than the line going through the pupil, right?

A Yeah. The center of the pupil.

Q You're saying it just reflects the information from the image?

A Yes. To the point because we're going through the center of the pupil, the eye is -- the eyeball itself is fairly radially symmetric. It's hidden by eyelids, but it's fairly radially symmetric. There's no more information we care about above or below the eye,

150

so we've figured out an eye region and then we are passing one line through at precisely the right location that characterizes everything we need to know about the entire region for the purposes of the technology.

So that's part of the mind-set behind calling this a histogram. It's a statistical representation of the entire region, of everything you need to know about the entire region in a single one-dimensional graph in the same way that a projection histogram can often give you everything you need to know about a two-dimensional region in a one-dimensional graph.

MR. COULSON: Actually, why don't we take a break. Off the record.

(Recess taken from 4:20 - 4:29 p.m.)

MR. COULSON: Let's go back on the record, please.

BY MR. COULSON:

Q I'd like to continue to ask about Eriksson. We're going to turn to Page 41 and 42, 43, 44 of your declaration.

A Okay. Starting at 41?

Q That's correct. 39C and 39D are at issue.

I would -- I'd like your help to tell me what you're asserting for Eriksson is the portion that's identified in 39C, and then for each portion you say is

151

identified that meets 39C what pixels are selected of that portion for 39D.

It seems like you may be making multiple options here so I want to understand your opinion. Okay?

A Okay.

Okay. So for the example I'm talking about in Paragraph 95, so let's see, this is 39C, so -- and you wanted me to -- this is Page 41. This is where you wanted me to start?

Q You can start wherever you'd like. I want -- I see this has your section on 39C and 39D.

A Yeah. Okay. So you want 39C and 39D, the regions used for 39C and 39D?

Q That's right.

A Okay.

Q And we're on the same page if you identify -- if you identify a portion of the image in 39C, then that same portion of the image I'd like to know what you're saying is selected from that portion.

A Okay.

Q We'll try to be organized about it.

A Sure.

Q Okay.

A So 39C, there's an example given on Page 41. I

152

think there's other -- going to be others in the chart, but let's look at the example in Paragraphs 94 and 95 and so on.

There is a vertical center of the face, the centerline, and an area around that line, so I think the specific term is fairly close.

So there's a region of the face that is fairly close to that centerline, and that bounds the left and right sides of the search space.

And then the vertical bounds are from the histogram of the projected edges. It's a projection histogram of the edge image shown in Figure 2.

Q Is that the middle of Figure 2?

A Yes. That's the edge image. And then there's projection histogram of that on the right side and the two ends of that largest peak denote the top and bottom of a region.

And so that's the region used for identifying a portion of the image of the face comprising the future to be detected using anthropomorphic model based on the location of the identified facial characteristic, so that's the portion of the image identified in 39C.

Q So can you summarize for this first option 39C what are the bounds of the portion?

A So, for the example I have here starting at

153

Paragraph 94, the left and right bounds are a region fairly close to the centerline. And the top and bottom bounds are the top and bottom of the largest peak of that projection histogram of the edge image.

Q Let me stick with this example. Where do you assert that Eriksson bounds a region from the top and bottom -- actually, let me back up.

When you say the top and bottom of the peak, what do you mean? The top and bottom of the largest peak? Is that what you said?

A Yes. So here's the largest peak and there's the top and there's the bottom.

Q So if we have the white peak in the middle of the right of Figure 2, you're pointing to the top and bottom of the -- that peak as the top and bottom vertical, right?

A Right. That peak has a valley to the left of it and a valley to the right of it, so I'm pointing to those two valleys.

Q The valleys. And where in the reference do you see it -- are you relying on for bounding -- for creating a region with those boundaries of two valleys?

A On Page 316 of the lower left corner of the page, since both eyes are likely to be positioned at the same row, HY will have a strong peak on that row.

154

However, in order to reduce the risk of air we consider the three best peaks for further search.

And so the idea is that the eyes are likely to correspond to those peaks. And I'm going by the bounds of that peak, separating that peak from the other two peaks, or any of the other peaks in the image.

Q And where in the reference are you asserting it discloses that the peak is not a line, but a vertical region between the two valleys?

A Well, the alternative I think you're suggesting is that if I just define the region as the tip of that peak, then I've got a single line. That's not enough room for the eyes at all. There's no region there that the eyes could be in.

And in the next section we're finding the exact location of the eyes. We're searching over -- you need to have a search space. Someplace to search for the eyes.

And for this to work, I don't think -- I wouldn't expect it to work with a single line being the search region. I think you need a region. The anthropomorphic model used to identify this, the eyes is that -- the eyes have a lot of edges associated with them.

This peak indicates that there's more edges in

155

that whole region than in the surrounding regions. So I'm inferring that we use the region instead of your suggestion that we use a single scan line.

Q So I understand your 39C, the first option is a -- I guess a rectangular area with the minimum X and -- the minimum X and maximum X values being fairly close to the symmetric center of the face and the vertical minimum and maximum being the top and bottom valley next to the largest peak in the -- shown on the right of Figure 2?

A Uh-huh.

Q So what's -- tell me about the next element, 39D for this option. What's selected?

A Are you talking about the selecting pixels of the portion of the image having characteristics corresponding to the feature to be detected, specifically selecting pixels of the portion of the image. And so you want to know what portion of the image I'm using for 39D?

Q Well, not exactly. I believe you've identified 39C, the portion of the image.

A Okay.

Q Now I'd like you to tell me in 39D, where selecting pixels of the portion of the image that have characteristics, and can you tell me which pixels you're

156

selecting from that portion of the image?

A So there's a step in there that furthermore thresholds dark regions. That's in the finding "Exact location of the eyes" section. Following that there's the "Estimate the position of the iris."

And so if I can read the language again. So one of the characteristics are that the eyes are darker, and so the section "Finding the exact location of the eyes" is creating a threshold that looks for intensity valleys. It's a threshold of intensity. And then does a raster scan to find four or five regions that could be potential eye locations.

Q So for 39C, you told me about a rectangular box that was the portion of the image. For 39D can you tell me -- I'm not sure. Can you break it down for me which pixels are being selected?

A Yeah. In that example of looking at the intensity valleys, the selecting pixels of a portion of the image having characteristics corresponding to the feature to be detected, the characteristic is that the eye tends to be darker than -- the eye region tends to be darker than other areas of the face, and you're selecting those pixels that are darker than other pixels in that region that we've already outlined.

Q So we're selecting dark pixels?

157

A Yes. That's one of the examples. That's the one I describe in Paragraph 101. So the region in that example in 101 would be the darker -- the darker pixels. Those would be the pixels that were selected.

Q And for -- let's just stay on this Option 1 for a second. Let me ask you this: The next element, 39E, where do we form a histogram of the selected pixels?

A Right. We're forming a histogram of pixels from a line going through the center of the pupil. And that's -- and that line is in the pixels selected because they were darker.

Q You're referring to Figure 5 for satisfying 39E?

A Yes.

Q Okay. That's Option 1. How many other options do we have to go through?

A As many as you'd like.

Q Well, how many have you identified there in your report?

A Certainly 101 describes one of the options, along with Paragraph 100. That sets up the search region.

If you go to the charts --

Q Well, why don't we do 101 first and then we can go to the charts, just due to time.

158

A Okay.

Q So this -- we'll call this Option 2. Take me through Option 2. That's in the text of your report.

A I don't believe I have charts in here, actually. Yeah. I don't see any charts.

So another -- another option is for 39 -- another option for 39D is to use the iris template.

Q Oh, I'm sorry. Let's start on 39C, the selecting the portion, or you can tell me it's the same portion.

A Yeah. I think 39C is going to be the same portion.

Q For all your options?

A For at least these two options, yes.

Q Again, 39D?

A 39D, you could also look at the position of the iris using the template.

Q Is that the same as -- the same dark pixels you mentioned before?

A No. In Eriksson you do this after you found the dark pixels, but it's another element of Eriksson that satisfies 39D.

Q Are you referring to the template?

A Yes.

Q Which circle in the template is satisfying 39D?

159

A The template as a whole. You are -- you're finding a match for that template and the -- and so then you're selecting pixels in the box surrounding that iris that are then used to support 39E's histogram.

Q And can you point me to the box? You're referring to Figure 4?

A Yes. The box around the template. The iris template in the example shown in Figure 4.

Q Okay. So for Option 2, the box shown in Figure 4 is what you're saying satisfies 39D, right?

A Uh-huh.

Q And is 39E Figure 5?

A Yes.

Q Is that for all the options?

A Yes.

Q So we've covered two options. Is there a third option we have to respond to?

A I think those are the only two that I'm aware of.

Q All right. Let's go on to something else. Let's go to Stringa 1006. I'll give you that. This is pre marked as 1006, Page 41 in your declaration.

A Okay.

Q I'm not sure that's the right cite.

I guess my question for Stringa is similar to

160

what I just asked you. If you could tell me what your -- what portion of the image you're saying is identified for 39D, please. I may not have given you the right cite.

A So you want 39C or 39D?

Q Let's start with 39C.

A Okay. So the example pointed to in Paragraph 98 is the expectation zone of the two eyes.

Q Do we have multiple examples to go through?

A Yes. So for Stringa that's one location.

Q Oh, sorry. Can you point to a box in the reference for the expectation zone so we're clear on what you're saying?

A Sure.

Q Thanks.

A Okay. So that expectation zone is mounted vertically. There's this -- in Figure 6 there is the eye connecting line.

Q Is that Z?

A Yeah. Z.

Q Okay.

A It's the maximum of the filtered vertical histogram. And the zone extends above and below it by an amount L1 and L2.

Q Okay. Are you referring to the formula at the

161

top of Page 377?
A Yes, I am.
Q Okay. That's vertical?
A Yes.
Q What about horizontal?
A And then horizontal is --
Q Is it left limit of face and nose axis?
A Yes.
Q Okay. What is -- I don't mean to put words in your mouth.
A Yeah. It also refines that in the next line, but I think left limit of the face and nose axis is more than enough to meet the requirements of the claim.
Q And what is selected then? That was 39C. Let's do 39D. What pixels are selected?
Is it your opinion 39D is disclosed by Stringa?
A Stringa, yes. I'm pointing to the expectation zones of the two eyes.
Q Isn't that the same area you identified for 39C?
A Yeah. I believe so. If they need to be different areas, we could also use the subset of XN minus L3 and XN minus L4, where the L3 and L4 are suitable parameters for the left and right side of the eye. And that's illustrated by those bounds -- those

162

tighter bounds in Figure 9.
Q Are you referring, for 39D, to the rectangular boundaries in Figure 9, the rectangular shapes in Figure 9? I just want to make sure I understood you.
A Yeah. Yes.
Q And how are those rectangles shown in Figure 9 selected from the expectation zone?
A Through the parameters L3 and L4.
Q And what are L3 and L4?
A Those are suitable parameters.
Q Is there a disclosure in Stringa of how to come up with L3 and L4?
A Those are suitable. They're based on characteristics of a feature to be detected, in this case the eye. So if the boundaries of the sides of the face are where they're expected to be, then L3 and L4 would be based on some estimate of how far inset the eyes are from the side of the face.
Q How do you know that L3 and L4 are based on any particular characteristic?
Well, let's back up. So let me make sure I understand. The disclosure -- let me ask you just about the disclosure of Stringa.
The disclosure of Stringa for L3 and L4 is only this statement here on Page 377 where each L is a

163

suitable parameter; is that correct?
A Right. Suitable means anthropomorphic.
Q And how do you know that?
A It's suitable. The whole point of this is finding the eyes given the landmarks of the face. And so that distance from the sides of the face to the insides of the eyes is similar to some of the anthropomorphic measurements used -- used in '518, which I've got here someplace.
You've got Figure 32 where you're starting from a nostril and finding your way to an eye using measurements.
Q Is that your basis for saying suitable means anthropomorphic?
A I'm saying suitable means anthropomorphic because I'm reading this as a person of ordinary skill in the art at the time would read this.
Q Do you have any other evidence you could point to to support -- do you have any other evidence to support that other than Figure 32 in the '518 patent?
A Figure 32 is an example of a process in '518.
Q Let me just, to save time --
MR. WHILT: The witness hasn't finished his answer yet. I want to note that for the record. You're cutting him off.

164

BY MR. COULSON:
Q Anything other than the '518 patent?
A I'm showing an example in the '518 patent of similar anthropomorphic measurements that are used in the process disclosed in '518 to indicate that the choice of a suitable parameter in Stringa is also anthropomorphic.
Q Right. So anything other than the '518 patent?
A I was going to use that as an example.
Q Okay. Let me -- can you tell me the next element? We've covered 39D which you, I believe, said is the boxes shown in Figure 9?
A Uh-huh.
Q What is 39E for that example?
A So 39E -- sorry. So Stringa conducts a search for the pupil in that area based on the horizontal gray level distribution. That's on Page 377.
Q Is the horizontal gray level distribution on Page 377 what you're pointing to as satisfying the forming at least one histogram of the selected pixels?
A Yes. In Paragraph 105.
Q And how is the horizontal gray level distribution a histogram?
A It's a histogram of the intensity value for each pixel. For each line Y the relative horizontal

165

density is calculated and a band pass filter is applied. And part of that is a histogram of intensity values.

Q The band pass, is this -- is the horizontal gray level distribution described in formula Figure -- Formula 12 of Stringa on Page 377?

A Yes. That equation is used in the computation of the relative horizontal density.

Q And do I understand correctly that -- do I say G sub R and G sub -- what's that letter? -- S, would you understand -- yes. G sub R and G sub S to refer to the two things on the right of the equals on Equation 12?

A Yes. Sub R and sub S.

Q Are those filtration functions of the type of Equation 3 in Stringa? That's on Page 372.

A Yes. It says that it was obtained as an Equation 4 and Equation 4 is obtained through Equation 3.

Q So it's essentially -- do I understand correctly that the horizontal gray level distribution is essentially a smoothed plot of the intensity at a certain horizontal line Y within the box of Figure 9?

A Yes. It's an average intensity.

Q Is there anything being counted by the horizontal gray level distribution?

A Well, there's a summation in Formula 3. These

166

average densities could be computed through histograms. They represent the average value of the histogram, a weighted version of a histogram. I don't know specifically how they were computed, what machinery they were computed on. The details just aren't there.

Q Other than the filtered functions of Formula 3, is there any other way that horizontal gray level distribution is counting anything?

A The horizontal gray level distribution is going to be an average gray level distribution. That will basically be the weighted center bar of the -- of a histogram, for example, of those -- of those pixels. A gray level histogram of those pixels. So this could have been computed with a histogram.

Q There's no specific disclosure of that, right?

A No. It's a horizontal gray level distribution. That's the extent of the disclosure and the formula that it relates.

Q Is the horizontal gray level distribution a smooth intensity plot of only the intensities on the line Y or does it include intensity values from other Y values?

A No. I think it's just horizontal. It's just using the value X and it's indexed by Y.

Q Could the horizontal gray level distribution be

167

represented by one-dimensional array of intensity values for each value X on the line Y?

A Well, I think it's defined as it is here in 12. Is there something more specific than that that we need to address?

Q I'd like to address, to make sure I understand the horizontal gray level distribution you're pointing to, it's the values -- the smooth values of intensity at each X position on a particular line Y, right?

A Right.

Q So we --

A That's G super Y of X.

Q We could represent a smooth value -- a smooth intensity value for each value of X on a line Y by a one-dimensional array with Index X, right?

A Right. X is the parameter there.

Q Does the horizontal gray level distribution represent a frequency of occurrence of anything?

A I think it's being treated as a characteristic. I don't know that it measures -- other than as in the previous example, it's a smooth version of a measure of the intensity which is a sub of, for example, photons of radiometric power.

Q Why are you calling the horizontal gray level distribution a histogram?

168

A So Eriksson cites Stringa. Eriksson refers to a similar quantity as a histogram. And I was following Eriksson's nomenclature in looking at a similar quantity here as a histogram.

Q The disclosure in Eriksson, is that the material we covered earlier?

A Yes. Figure 5.

In addition, it's not referred to as a horizontal gray level scan line or horizontal gray level image. It's a horizontal gray level distribution. And it's being treated as a distribution.

A distribution is, you know, a statistical graph, and that's how histograms are treated, as distributions, so this is being characterized and utilized as a histogram.

And so I'm treating it as a distribution and referring to it with the same tools that you would use for a histogram, because that's how it's being used in Stringa. It's not being used as a simple scan line.

Q Is the way in which the data is being used important in characterizing it as a histogram according to the claim?

A Yes.

Q And how does it make sense to take a second derivative of the horizontal gray level distribution if

169

it's a histogram?
A A histogram is a distribution. It's not uncommon to take the second derivative of a distribution to find additional information about a distribution.
Q So it's -- again, the way the information is being treated that helps you in characterizing it as a histogram?
MR. COOK: Objection. Form.
THE WITNESS: I'm going by how Stringa characterizes the data, sets up the data. He very easily could have set this up, very simply could have set this up and described this as a smooth scan line. But he didn't. He set this up as a horizontal gray level distribution. That means it's being treated as a distribution, similar to how a histogram is a distribution, of various pixel characteristics.
And then the further analysis of that, in this case a second derivative is similar to the analysis we do of a histogram. For example, looking at the tails of the histogram to find appropriate boundaries of a target edge, for example.
BY MR. COULSON:
Q Let me mark -- you can put that aside. Let me hand out what's been previously marked as Exhibit 1009, Ando. We'll refer to Paragraph 130 of your declaration

170

in the '518. And I'm going to ask you to explain how the different -- how the, quote, differential gradation histogram is a histogram according to claim. Okay?
A Okay. So this is described in Column 35 in a paragraph starting at Row 52, 35, 52.
Q Okay.
A Differential gradation histogram is created from the region SD. The threshold value TH used for detection of the right eye is determined from the histogram.
So that's my determination of a differential gradation histogram, is from that paragraph.
Q Can you look at Column 18 of Ando, please, Line 15 and forward.
Is this providing more detail on the gradation that, quote, differential gradation histogram, or am I mistaken?
A No. It says then it creates a differential gradation histogram of the region SD.
Q The differential gradation histogram referred to, is that explained in this formula before it, Line 25, or no? Is that something else?
A So this forms a distribution, DFMi, Line 25 as the sums of the differences between the J pixel and the J minus one pixel squared divided by the number of

171

pixels. So that's why it's a gradation -- a differential gradation histogram, because of what it's representing the frequency of.
Q All right. So just a basic "what" question first. Do I understand then that the -- what's being called the differential gradation histogram is what's shown in the formula at approximately Line 25 of Column 18 of Ando, Exhibit 1009?
A Well, it goes on to say it's also possible to calculate the average of the absolute values of every difference.
Q Which one are you relying on as a histogram?
A I think they both work as histograms.
Q So do I understand that the -- what's being shown in the formula at Column 18 approximately at Line 25 is one of the things you're relying on as a histogram for Claim 39 based on Ando?
A Yes.
Q And what's the other thing you're relying on alternatively as a histogram for Claim 39 of Ando?
A The next sentence says it is also possible to calculate the average of the absolute values of every difference instead of the sum of the squares.
Q Just a variation on the formula?
A Yes.

172

Q And what's being counted by DMFi, Column 18, Line 25?
A The mean square of the difference.
Q Could you be more explicit? The mean square of the difference of what?
A The mean square of the difference of each pixel with a pixel beneath it in the image. Beneath it meaning having -- if it's on -- the -- sorry, the pixel next to it, it's the J and J minus one pixel located in the same Y direction.
Q So the Index I for DMF sub i is gray level, right, zero to 255?
A Yeah. It says that there on Line 21.
Q So, for example, for gray level ten, what is being -- what is being counted in that for Index 10?
A So it's the difference between the gray level I of the J pixel and the gray level of the J minus one pixel next to it. So it's only being computed for the pixels at the gray level I, and it's looking at the mean difference of the pixels next to those pixels.
So it's being computed over I which are the gray level values. The thing that's being computed is a mean square of the difference of neighboring pixels for pixels of that value.
Q And so sorry. What's being counted? Is

173

anything being counted?
A Yes. It's being counted because there's a summation there. It's also being counted per gray level. The thing that's being counted is the squared difference of the pixel next to it. So if you have a pixel of that value I, you're adding up the squared difference of the pixel next to it, and then taking an average of that over the total number of pixels of that same value.
Q Is what actually goes in, when the process is completed to the DMF sub i for a particular eye, an average single number that represents an average?
A So for each element DFMi, yes, it's a single number. It's not an average. I mean, it's computed as the sum of squares. It's a mean square just for the pixels -- just computed for the pixels whose value are i.
Q So each DMFi indirectly reflects a count of pixels through some mathematical process?
A Yes.
Q And that meets the definition of histogram in your opinion?
A It's not a count of pixels. But, yes, it matches the definition of a histogram and it's called a histogram here in the specification.

174

Q Let me give you -- you can put that aside. I'm going to give you Suenaga, exhibit previously marked 1007.
A Thank you.
Q Declaration Page 61, Paragraph 133, if you would.
A Okay.
Q I'll give you -- if you would open to Figure 2 just so you have it available.
And in Paragraph 133 of your '518 declaration you reproduced part of Figure 2, right?
A Yes.
Q What's being -- what are the black areas being shown in Figure 2?
A These black areas are thresholded images of, in this case, an eye.
Q The whole eye?
A The portion of the eye that satisfies the threshold.
Q Can you differentiate the iris, pupil or cornea within the black areas shown in Figure 2 of Ando? Let me reask that. Thank you.
Can you differentiate the iris, pupil or cornea from within the black area shown in Figure 2 of Suenaga, Exhibit 1007?

175

A No. And, in fact, I don't have an opinion of – to that effect. I show that in Ando, but it's the combination with Suenaga that renders that – Suenaga in combination with Ando makes that element obvious.
Q You explain that in your report?
A Only in stating in the ground that the combination meets the limitations.
MR. COULSON: Let's go off the record.
(Discussion held off the record from 5:36 - 5:42 p.m.)
MR. COULSON: Let's go back on.
I'm going to pass the witness. I thank you, Dr. Hart.
THE WITNESS: Thanks.
MR. COOK: We don't have any questions at this time either.
MR. COULSON: Thank you. Let's go off.
THE REPORTER: The time of the proceedings ending is 5:42.
And you guys wanted a rough?
MR. COOK: Yes, please.
MR. WHILT: Yes, please.
THE REPORTER: And you want this by the 2nd?
MR. COULSON: The 2nd would be great, if that's possible, if that's okay for you.

176

THE REPORTER: No problem.
And you guys wanted yours by the 2nd as well?
MR. COOK: That's fine.
MR. WHILT: That's fine.

(Whereupon, at 5:44 p.m., the deposition of JOHN C. HART, Ph.D. was concluded.)

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177

STATE OF CALIFORNIA)
COUNTY OF LOS ANGELES) ss.

I, the undersigned, hereby certify under penalty of perjury under the laws of the State of California that the foregoing testimony is true and correct.

Executed this _____ day of _____, 20_____, at _____, California.

_____

JOHN C. HART, Ph.D.

178

CERTIFICATE OF SHORTHAND REPORTER - NOTARY PUBLIC

I, KIMBERLY A. EDELEN, Certified Reporter and Notary Public within and for the State of California do hereby certify:

That JOHN C. HART, Ph.D., the witness whose deposition is hereinbefore set forth, was duly sworn by me before the commencement of such deposition and that such deposition was taken before me and is a true record of the testimony given by such witness.

I further certify that the adverse party, Samsung Electronics, was represented by counsel at the deposition.

I further certify that the deposition of JOHN C. HART, Ph.D., occurred at the offices of O'Melveny and Myers at 400 South Hope Street, Los Angeles, California on Friday, December 22, 2017, commencing at 9:24 to 5:44

IN WITNESS WHEREOF, I have hereunto set my hand this ___ day of _____, 201_.

My commission expires: January 30, 2019

KIMBERLY A. EDELEN, C.S.R. NO. 9042
NOTARY PUBLIC IN AND FOR THE
STATE OF CALIFORNIA

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