EXHIBIT T

BEFORE THE

UNITED STATES INTERNATIONAL TRADE COMMISSION

In the Matter of:	)	Investigation No.
CERTAIN MOBILE DEVICES	)	337-TA-750
AND RELATED SOFTWARE	)	

Hearing Room A

United States

International Trade Commission

500 E Street, Southwest

Washington, D.C.

Friday, September 23, 2011

PREHEARING AND TUTORIAL

The parties met, pursuant to the notice of the Judge, at 9:00 a.m.

BEFORE: THE HONORABLE THEODORE R. ESSEX

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O P E N S E S S I O N

MR. DAVIS: We're ready, Your Honor.

JUDGE ESSEX: You found him, did you?

MR. DAVIS: We did, indeed.

JUDGE ESSEX: If you would remain standing for just a moment and raise your right hand for me.

Whereupon--

WAYNE C. WESTERMAN,

having been first duly sworn, was examined and testified as follows:

JUDGE ESSEX: Please be seated.

DIRECT EXAMINATION

BY MR. DAVIS:

Q. Dr. Westerman, could you please state your entire name?

A. Wayne Carl Westerman.

Q. And you have in front of you a witness binder. Could you turn to the first exhibit? It is marked as CX-208C. It is entitled the witness statement of Wayne Westerman. Let me know when you find that.

A. Yes.

Q. And if you can look through that. Is that the witness statement that you submitted

in connection with this investigation?
A. Yes.
Q. And if you could turn to page 10. Is that your signature that appears there?
A. Yes.
Q. Okay. And does this witness statement contain your answers to the questions that are set forth therein?
A. Yes.
MR. DAVIS: Your Honor, we turn the witness over for cross.
MR. NELSON: Thank you, Your Honor.
CROSS-EXAMINATION
BY MR. NELSON:
Q. I think I have some material to pass out here. Good afternoon.
A. Good afternoon.
Q. I am Dave Nelson. I don't think we have met before, but I am going to ask you some questions, all right?
A. Okay.
Q. Good. Let's put JX-3 up here. Now, JX-3, a patent entitled ellipse fitting for multi-touch surfaces, 7,818,828. Do you see that?

A. Yes.
Q. You are a named inventor on this patent, correct?
A. That's correct.
Q. And you have one other joint inventor on that; is that right?
A. That's right.
Q. And what is that gentleman's name?
A. John G. Elias.
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Q. But the '828 patent, you agree that primarily concerns mathematical fitting of ellipses to pixel groups that are received from a touch sensing device; is that a fair characterization?
A. Yeah, that's a fair characterization of the claims.
Q. Okay. Of the claims of the '828 patent?
A. Yeah.
Q. Okay. So let's talk a little bit about this elliptical fitting. The primary reason that you wanted to do this elliptical fitting was so that you could distinguish one hand part from another on a touch device; is

that right?
A. I'd say that's the primary reason. It is not the only reason.
Q. But that is the primary reason?
A. Yeah.
Q. So let's look at this dissertation. Can we put up -- well, it is JX-291. You have it in the book if you want to look at the original. Sometimes that is easier than the screen.
A. Okay.
Q. Let's put up RDX-18.002. I have some excerpts from here.
So this excerpt that I have on RDX-18-002 is from your dissertation at page 19. So here you say, "nevertheless, distinguishing palm contacts from finger contacts on a large MTS is imperative for the motion recognition algorithms to ignore palm motions and allow palms to rest on the surface."
Do you see that?
A. Yes.
Q. So, first of all, MTS, is that multi-touch surface?

A. Yes.
Q. And so is that, that idea expressing this concept that we just talked about, the idea of being able to distinguish one hand part from another?
A. That's one example, yes.
Q. Okay. And, similarly, down here at the bottom, I have this sentence highlighted, "identifying the thumb and maintaining a consistent order for other finger contacts also aids extraction of hand motion parameters."
Is that, again, that idea of being able to recognize one --
A. That's one example.
Q. We have to get a little rhythm here. So I know that sometimes it doesn't seem like I am done with -- or it seems like I am done, but it takes me a little while sometimes. I apologize. So let me start that over.
So this last sentence here identifying thumb and finger contacts, that's, again, this notion of being able to distinguish one hand part from another, correct?
A. That's another example, yes.
Q. And if we look at page 84 now, it is

on the next slide, RDX-18.3, here it says, "while the user will not vary contact shape or orientation intentionally, such parameters will assist finger and hand identification in chapter 4."
Do you see that?
A. Yes.
Q. Now, if you look -- and why don't we put up the JX-291 at page 84 here.
So page 84 of your JX-291, this is your dissertation, correct?
A. Yes.
Q. And this is in the ellipse fitting section. So that sentence that I just pulled out, if I look at it again, we can highlight it here, Ryan. That's fine.
"While the user typically will not vary contact shape or orientation intentionally, such parameters will assist finger and hand identification in chapter 4." So are the parameters that you are referring to there the parameters that are generated from the ellipse fitting procedure?
A. Yes, contact shape and orientation generally, yes.

Q. So that, again, that's consistent with this idea that you talked about that you wanted to be able to precisely fit ellipses to the pixel group so you could identify one finger from another, right?
A. Right, but elsewhere, I do -- somewhere in the patent and the dissertation, I do, you know, mention the possibility of actually controlling something with the rotation of your thumb or the orientation of your thumb.
Q. Right. And that would be another thing that you might want to do, recognize exactly how the thumb is oriented and fitting this ellipse precisely to that thumb touch would help you do that, right? We've got to get your audible answer.
A. Yes.
Q. Okay. Thank you.
So let me go to RDX-4 now. So this is from your dissertation now into chapter 4 that we just saw referred to on the previous page that we looked at, page 84. This is now at page 116 of your dissertation.
Here you say, "if the MTS" -- again,

the multi-touch surface -- "was only to be used for typing, trying to identify each surface contact might not be worthwhile because key taps should be distinguished by their spatial location, not which finger strikes the key."
Do you see that?
A. Yes.
Q. So there, the idea, what you are saying at least in the dissertation is if all you are trying to do is detect key taps, then you don't necessarily need to be able to distinguish one finger from another, correct?
A. Yeah. I think you should keep in mind I am talking specifically there about fingers, and I don't think I would have said the same thing about palms because if a palm tapped a key, you would want to ignore it, right? But maybe it doesn't matter whether it is the index finger or the middle finger for typing.
Q. Right. You don't need to know which specific one, just generate the key taps.
Now, with the palm, there are ways you can detect the palm without knowing it as the palm, correct? Meaning it is a fairly large contact area, right?

A. Well, that's another big topic of the dissertation. I wouldn't simply -- want to oversimplify that, yeah, there is a lot of -- generally, for detecting palms, you need -- you often need multiple clues at once, but that's one of them, is the large size, yes.
Q. Okay. So then here, the next sentence, you say, "but recognition of the rich, bimanual chordic manipulations demonstrated in chapter 5, demands reliable clustering of surface contacts with their originating hand as well as reliable finger ordering and thumb identification within each hand."
Do you see that?
A. Yes.
Q. So the idea was that you wanted to be able to precisely detect which finger was touching the screen, multiple fingers touching the screen, the orientation of those fingers so that you could implement these bimanual chordic manipulations, right?
A. Yes, that was an important objective, but I believe all along at the same time I was -- another, as I say, another big part of doing

a good multi-touch system is ignoring things such as palms.
And so it is not just identifying the fingers. It is identifying palms and other instances where you want to -- fingers are applied and situations where you want to ignore contacts and reject them also.
Q. Sorry. I didn't mean to talk over you. Are you done?
A. Um-hum.
Q. So then what you are saying is what you wanted to be able to do was precisely identify fingers, hand parts, some of which you want to know their orientation and which finger it is, others you want to ignore, correct?
A. Um-hum, yes.
Q. Okay. And the way that you are able to distinguish these hand parts from one another -- let me start over.
In order to be able to do that, what you did was invented a very precise way to do the measurements of touch data and help the multi-touch system tell you useful things about those touches, right?
A. Yeah, it is a combination -- I did

measurements of the shape and orientation of individual touches and then another part of the dissertation is the overall arrangement of the touches relative to one another. That is sort of the inter-touch geometry is also -- also provides important clues.
Q. And at least part of that precise way to do this detection was this ellipse fitting procedure that we looked at in section 3, starts at around page 84 of your dissertation, correct?
A. Yes.
Q. Okay. And now in order for this ellipse fitting procedure to be useful and detect these various things, these precise touches and what part it is and what the orientation of the finger was, it needed to be precise, correct?
A. Yes.
Q. And if we look back at the dissertation at page 84, this would be JX-291, and let's just put it up there, no, page 84, you had it right. Okay, good.
So on page 84 here in the dissertation, this is the precise ellipse

fitting procedure that you described, correct?
A. I believe it continues on to the next page.
Q. Okay. It continues on to the next page.
A. To the end of that section, including the paragraph after equation 320.
Q. Yeah, okay. So we will talk about that in a minute. Let me go back up to the beginning of this.
So you say at the very end of that first paragraph in this ellipse fitting section, "the ellipse fitting procedure requires a unitary transformation of the group covariance matrix Gcov of second moments Gxx, Gxy, and Gyy, correct?
A. That's what I say, yes.
Q. So that's the precise ellipse fitting procedure that you were describing, correct?
A. Well, that's just the first step. Unitary transformation means a rotation of the coordinate system of the matrix.
Q. Then the rest of the steps are found from 3.12 down to 3.18?
A. Yeah, once you find the Eigenvalues

and Eigenvectors covariance matrix, which are part of doing a unitary transformation off of that -- the axis where the data is spread out the most, it would be like the long axis for thumb, the long axis, you rotate your coordinate system to there, and that procedure leads to Eigenvalues and Eigenvectors. Equations 316 through 318, I show how to get major radius, minor radius and orientation from those Eigenvalues.

Q. And those equations then will give you the parameters of the ellipse that you are trying to fit to the touch data, correct?

A. Yes, in this case.

Q. Now, let's go to JX-3. Column 26, Ryan, of JX-3. And let's pull that out a little bit. Yeah, start with the since -- about line 18, 17. Can you get the last three equations in there?

So then here in column 26 of the patent, this is from the application that you drafted, correct?

A. Yes.

Q. And the portion that's here, is that part of the application that you drafted?

A. Yes.

Q. So again, it says, the ellipse fitting procedure requires a unitary transformation of the group covariance matrix G -- where it says sub eov. Should that be sub cov?

A. It should.

Q. Of second moments Qxx, Qxy, Gyy?

A. That should be Gxx, Gxy, Gyy.

Q. So that shouldn't be a Q, that should be a G, and that should be a G (indicating)?

A. Yes, apparently there was clerical error during one of the many, I guess, retypings of later versions of the patent.

Q. But then the equations that are shown here in order to generate the ellipse parameters, those are the same equations that we just looked at from your dissertation, correct?

A. Yes.

Q. So let's step back through an example. Now we need to go up to the top of column 26. You can blow up all of 26 down to the arc tangent equation we were just looking at.

Now let's take an example where you have the pixel group that you want to fit an

ellipse to. So you have that data. We have the equations up here, Gz and there is a summation of all Ez's, do you see that?

A. Yes.

Q. I think in the patent it refers to this Gz as the group proximity value; is that right?

A. Yes.

Q. And essentially that's just an addition of all the points and the value of how close the touch object is to the touch sensor, correct?

A. Yeah, it is a sum of the sensor readings at each pixel in that group of pixels.

Q. Right. So you just add them all up?

A. Yeah.

Q. Basically is what you are doing. Now, this next one, we have Gx. And we have another summation of Ez times Ex divided by that group proximity value, correct?

A. Right.

Q. So basically -- and let me see if I get this right -- what you are doing is you are going through in the X direction, meaning let's just say X is horizontal and Y is vertical.

And I take my sense data and I sum up a row of that X data and I multiply the X, that coordinate value, that X value by the proximity value for that pixel and I get a product, correct?

A. Right.

Q. It gives me a number?

A. Yeah.

Q. And then I divide that by the total group proximity, right?

A. Yes.

Q. So essentially what is going on here is that at least for Gx, I am finding a weighted average of the proximity of that touch data, correct?

A. Right.

Q. So it kind of tells me in the X direction, where is the center of that pressure, essentially?

A. Right.

Q. That's a fair characterization?

A. Yeah. For -- it is sort of analogous to center of -- well, what lay people would hear of as center of mass, what is the center of mass of something. It is not mass, of

course, it is the touch proximity.
Q. Right. Basically how close the object is and that kind of equates to a pressure, right, is the idea? Is that fair?
A. I don't know if it -- it equates -- it is being the center of something, not whether it is the pressure, but it is the average center, center averaged over the object.
Q. The center of the average of how close the touch object is to the sensor in the X direction, correct?
A. Okay.
Q. Okay. And so then we have got the next equation here, 14, we have got Gy, and then I have a similar equation here, but this sums the product of Ez times Ey instead of Ex and then divides it by that group proximity value, right?
A. Yes.
Q. So that's doing exactly the same thing but now in the Y direction, in the vertical direction, correct?
A. Yes.
Q. So then basically what you get from this, I think you described, is the center of

mass or the center of proximity, let's say, you get a center of proximity for your touch data, correct?
A. Yes.
Q. In an X/Y coordinate system, correct?
A. Yes.
Q. All right. So then I take that information, that information being those X/Y coordinates that I just generated, and now I need to generate these second moments, correct?
A. Yeah. The centroid is sometimes called the first moment. So next we do the second moments.
Q. Okay. And with those second moments, can you tell us in some lay terms essentially what those second moments are?
A. Second moments are -- in statistics, they are kind of like -- they end up being sort of the spread, like if you have a statistical distribution like a bell curve, and your centroid is the center of the peak in the bell curve, and the second moment is going to tell you about how wide it is, the spread of it, and they also could -- you might know them as standard deviation or variants.

Q. So then essentially what you are getting here is a spread in the X direction off the center, a spread in the Y direction off the center, and then this, I think you said it would be Gxy, would be kind of a spread along the diagonal off the center, correct?
A. Something like that, yes.
Q. Okay. And that's going to give me the second moments that I am going to use in my covariance matrix, correct?
A. Yes.
Q. But so far the only thing I have found -- from going through the equations, the only thing I found in terms of anything I am going to use for ellipse parameters is that center, correct?
A. Well, the center, and I would also say where we started equation 12, the total signal that's also a very important parameter to characterize the touch.
Q. It tells you how close the touch is?
A. How strong it is. It also tells you -- it is a mix of how close it is and how big it is, how much area it has. It is really kind of of both.

Q. Is what you are saying is you sum it up over all the pixels, so if I have a wide touch that might not be so close, I will generate a value, but if I have a more narrow touch, so to speak, or smaller more pointed touch, that's very close, that will generate another value, correct?
A. Yeah.
Q. But in that example, those two values could be pretty similar, couldn't they?
A. They could, but oftentimes in practice you find that the large object -- I mean, theoretically they could be, but in practice you could often neglect that, you know, for palms or something that are really large.
I mean, they are just -- even if they are not real close, they are still going to have a huge signal compared to a finger, or tend to.
Q. Okay. So then after I have generated the second moments, what I end up doing is finding the first and second Eigenvalues of that covariance values, correct?
A. Yes.
Q. We're going to spare everybody. We're

not going to go ahead and explain what those Eigenvalues are, okay?
A. Okay.
Q. Fair?
A. Yes.
Q. Let's just assume that they are generated now, first one, second one, and those are going to give me essentially the square of the major and minor axes of the ellipse, correct?
A. Yes.
Q. And then finally, this last one is orientation, correct? I am figuring out the orientation G sub theta; is that right?
A. Yes.
Q. Theta, that's this little Greek letter here?
A. Right.
Q. Some engineers, mathematicians like to use that to denote angles, correct?
A. Yeah.
Q. Okay. Now what I am doing is I am taking the arc tangent of the first Eigenvalue less the spread in the X direction divided by the diagonal spread, correct?

A. Yes.
Q. And that will give me an angle that tells me how that ellipse that I am trying to fit is oriented, correct?
A. Yes.
Q. And when I say oriented, I am talking about with respect to my X/Y axis that we started with, correct?
A. Yes.
Q. So then from that process, I have now generated the X position of the center, correct?
A. Yes.
Q. That's here in 13. I have generated the Y position of the center, correct?
A. Yes.
Q. I have generated the major axis of my ellipse, correct, in equation 19?
A. Yes.
Q. I have generated a minor axis in equation 20, correct?
A. Yes.
Q. And I have generated the orientation in equation 21, correct?
A. Yes.

Q. So those that I just went through, those would be the five degrees of freedom, so to speak, of an ellipse, right?
A. Yes.
Q. Basically, the five parameters that you need to specify to specify an ellipse, correct?
A. Yes, for an arbitrary ellipse, yes.
Q. By arbitrary, you could always have special cases where you already know information beforehand, but assuming I don't know information beforehand, I don't know where the touch is going to be, then I need those five parameters, correct?
A. Yes.
Q. Now, you agree to mathematically fit an ellipse, you need to calculate the parameters that describe the ellipse, correct?
A. Yes. You need -- you need to calculate parameters for an ellipse.
Q. And you also agree that fitting an ellipse to a pixel group would not include obtaining, simply obtaining measured data from an object that is in general ellipse-like, correct?

A. Well, I would say it wouldn't include just, you know, copying measure -- I think the confusion and the words can come there is are you talking about measuring kind of in the Z axis in the pixel strength, if you are just copying a group of pixels that happen to have an ellipse shape and you aren't measuring the spread, the spatial extent of them, then you aren't fitting an ellipse. You are just making a copy of an image of pixels, right?
Is that clear?
Q. Yeah, yeah, no, I understand what you are saying. So, I mean, essentially what you are saying is you can't simply copy the data, you have to figure out these statistical spreads that we talked about so that you can actually fit an ellipse to that data as well?
A. Well, you have got to -- you have got to figure out the spread somehow. You have to make some sort of spatial measurement on it.
Q. And we talked a little bit before about, just a minute ago, about these five parameters to specify an ellipse, right?
A. Yeah.
Q. An arbitrary ellipse, I think you

called it. So the X position to Y position, the length of the major axis, the length of the minor axis, and the orientation, right?
A. Yeah.
Q. But in addition to that, even if I know all five of those things, I have to know that I am also fitting an ellipse to those five things, correct?
A. Well, hold on. What is -- I have to know it for what? What was the question?
Q. Because I could take those five parameters I just described and I could draw a rectangle, too, right?
A. Yeah, I mean, you can always take -- circumscribe a circle or a rectangle with an ellipse, and -- and I think the measurements you may do might really be the same in both cases, depending on what your source data looks like, you would do the same thing, and I think the result would seem to be kind of equivalent. To me, regardless of the objective, if it was the same process, I don't know.
Q. Okay. I am just trying to -- I mean, the idea is even if I have all those five things, in order to fit an ellipse, as opposed

to one of these other things, I need to know that I am fitting an ellipse, correct?
A. No, I am not sure I agree with that exactly.
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Page 321

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Page 322

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Page 323

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REDIRECT EXAMINATION

BY MR. DAVIS:

Q. Dr. Westerman, could I ask you to turn in your notebook to your thesis, JX-91.

A. Yes.

Q. Do you recall being asked questions about this at the beginning of your examination?

A. Yes, I do.

Q. Does your thesis describe fitting an ellipse to a pixel group?

A. Yes, I believe so.

Q. Can we -- and, indeed, counsel directed your attention to the section entitled 3.2.8.2, ellipse fitting, correct?

A. Yes.

Q. And that was page 84 of your thesis --

A. And 85.

Q. And 85. Starting at page 84, going on to 85 with JX-291.114 to 115. So how many ways of fitting an ellipse are described in that section?

A. Well, there is two ways. There is the more involved statistical approach that we stepped through on page 84. And then on page 85, it talks about situations where -- basically where the pixel group isn't big enough for those approaches to work as well, and that might be when you have a very small finger touch or a low resolution electrode array.

Q. Could you identify where in this section of ellipse fitting in section 3.2.8.2 that that second approach is described?

A. It is after equation 320, the paragraph there, yes.

Q. Could you describe how this method

works?

A. Well, it talks about what to do when basically the finger gets too small or the pixels too weak compared to the resolution of your image. And at this point, we don't want things to just kind of -- well, we find it advantageous to set some limits or defaults for the ellipse parameters, so that we can report consistent parameters always to other parts of the system.

So, for example, if the contact is very small, we can assume it is circular and set the eccentricity to one and implicitly since major radius and minor -- the ratio of major to minor radius is eccentricity, then you would set the major and minor radius equal to like a lower limit default value or it is suggested here you could also set them proportional to your total group proximity Gz.

Q. Okay. And what kind of shape do you get when you do that?

A. You would get a circle.

Q. Okay. And is a circle a form of ellipse?

A. Yes.

Q. And why set a default value? Why not just not use any value for those particular parameters?
A. Well, you have to remember we're building, you know, a multi-layered system. And other parts of the system, maybe they are trying to identify the fingers or whatever. We always kind of want to report good values or within ranges that make sense, and sometimes when you just take the textbook equations, and your data is insufficient, those equations produce values that don't make as much sense.
And so as a good engineer, you look -- you alter your method to take that into account and try to produce values for the parameters that make sense all the time, 100 percent of the time. And then that makes it easier to engineer the rest of the system.
Q. If you performed the second method described in your thesis rather than the first method, do you still get a circle or other form of ellipse that is indicative of where the touch event occurred?
A. Yes, yes, you do. You are still getting contact size, you get a circle

representative of like the smallest finger that you are expecting from the system and you get a fixed orientation. Really for circles, orientations don't matter but for other parts of the system it is better to have that orientation fixed vertical than to have it just spinning around randomly.
Q. Okay. Could you -- I want to talk now about your patent, the '828 that's at issue here, which is JX-3. Could you turn to figure 18?
A. Figure 18?
Q. Figure 18 of the patent, JX-3. Let me know when you have got it open.
A. Okay.
Q. Generally speaking, what does figure 18 show?
A. Figure 18 shows the segmentation of the whole proximity image into groups of pixels. And then in step 272, it shows fitting ellipses to the pixel groups and the output of a set of parameters for each pixel group.
Q. Okay. Let's turn now to the part of the specification that talks about step 272, which is fit ellipsis to combined groups.

Could you turn to column 25 of the patent. Do you see starting around like 54 where it states, "the last step, 272, of the segmentation process is to extract shape, size, and position parameters from each of the electrode -- from each electrode group." Do you see that?
A. Yes, I see that.
Q. For how long in the patent does the description of step 272 go on for?
A. It goes on through column 26 and the first paragraph of column 27.
Q. And let's talk about that top paragraph of column 27, since the question stopped with regard to the embodiments shown in column 26.
Does -- what is the method that is described here at the top of column 7?
A. Well, there is, in the first sentence, it is talking about, again, using the total proximity as an alternate indicator of contact size rather than the fitted ellipse parameters, which I'm kind of implicitly referring to the minor radius and major radius, which are other direct measures of the size.

And then I talk about, again, for your smaller contacts and in the situation where the size of your pixel group to the size of the finger is low, then we can set default values for some of the ellipse parameters.
Q. Okay. And what kind of shape do you get when you practice the methods shown at the top of column 27?
A. You would get a circle.
Q. I'm sorry, go ahead.
A. Assuming you -- I mean, in practice, what we -- we would set eccentricity to, say, one or a small value and then a major/minor radius have to be set to be equal again.
Q. Okay. And does the method described at the top of column 27 that we're looking at now, does that require that a unitary transformation of the covariance matrix be used to set all the ellipse parameters?
A. No, in this case, you are kind of bypassing or overriding all of that and you would most likely make this sort of alternate determination based on the thresholding, the Gz or maybe counting the number of pixels or something in your contact, you would decide

whether to use this alternate method.
Q. Okay. I want to turn now to the language that you were directed to on column 26, lines 18 or so where it says -- do you see where it says the ellipse fitting procedure requires a unitary transformation of the group covariance matrix and it goes on? Do you see that sentence?
A. Right.
Q. All right. If all you do is obtain a unitary transformation of the group covariance matrix, Gcov of second moments Gxx, Gxy and Gyy, do you -- would that by itself provide you any parameters for an ellipse?
A. No, not -- I mean, not by itself. That just means rotating the coordinate space of that matrix.
Q. And can you turn to claim 3 of the '828 patent, which should be column 60.
A. Okay.
Q. Do you see where it states, "the method of claim 2 wherein the one or more ellipse parameters is selected from the group consisting of position, shape, size, orientation, eccentricity, major radius, minor

radius, and any combination thereof"?
A. Yes.
Q. All right. So according to the specification, are the parameters, shape and size always computed from the covariance matrix transformation procedure that's described in column 26?
A. No, no, they are not. An example would be in figure 25 for contact size so here we're trying to create what we call this thumb size factor, and it is -- it is like a special detector for something that's sized more like a thumb than either a finger or a palm.
And here you will see we're using on the X axis the contact size, but in this case we're using the normalized total proximity, which is Gz or equation 12 that we talked about earlier as that indicator contact size.
And that was, you know, again, it is just an alternate way of doing things, because the prototypes at the time, the Gz was more reliable than the major and minor radius measurements explicitly output from the Eigenvalues.
Q. Okay. And speaking of the

Eigenvalues, are there any claims of the patent that specifically claim competing Eigenvalues or Eigenvectors to fit an ellipse?
A. Yes, I believe there are. That would be dependent claim number 5, dependent claim number 9, and then there is also dependent claim number 20.
Q. Okay. And let's go back to column 27 and the method that's described there. Is that an example of mathematically fitting an ellipse?
MR. NELSON: I am going to object as leading, Your Honor.
JUDGE ESSEX: I'm sorry, what is the nature of the objection?
MR. NELSON: I'm sorry. I don't have my mic on. I am going to object as leading, Your Honor.
JUDGE ESSEX: Let's rephrase it. What does this depict?
MR. DAVIS: It is a yes-or-no question.
JUDGE ESSEX: Give me the question again.
MR. DAVIS: The question I had asked

was, does that disclose mathematically fitting an ellipse? Or does that disclose some other way of fitting an ellipse?
JUDGE ESSEX: Why don't you tell me what that discloses, Doctor?
THE WITNESS: Yes, I believe it is an alternate way of fitting the ellipse parameters.
JUDGE ESSEX: What parameters?
THE WITNESS: Eccentricity, orientation, setting it to a default, and there is another example where we use, in figure 25, where we use the ratio of eccentricity to proximity as a stand-in for the width of the contact, which is like an alternate way of -- and another -- well, that's an alternate way of -- sorry. My words are backwards.
So the minor radius is sort of the first way of measuring the width, but if you divide -- if you interpret the total proximity as an area that's roughly the minor radius times the major radius, and you divide that by eccentricity, which is the major radius divided by the minor radius, then that value in, I think it is figure 25C, is basically equivalent

to a minor radius squared, but it is obtained without directly using the minor radius.

Again, we did that because for those prototypes and the noise characteristics of them, that actually gave you a more stable answer to kind of take this round-about method than to use the minor radius directly.

BY MR. DAVIS:

Q. Do you assign numbers to the, to the -- to each of the five parameters that you use to define an ellipse?

A. Yes. In this paragraph we do this, and we have basically always kind of had these limits then and still do in the code, to do this.

Q. And do you use the numbers to define the ellipse?

A. Yes, they become the ellipse parameters.

Q. And does it result in a circle or an ellipse of a certain size once you plug in those numbers?

A. Yeah, it --

MR. NELSON: Your Honor, I am just going to object. It is leading again. It is

the same exact issue we had before.

JUDGE ESSEX: You are kind of leading the witness. Can you rephrase and let him answer?

BY MR. DAVIS:

Q. Sure. Well, what do you get from the numbers that are assigned to the five parameters?

A. Well, what you get is a circle. We have limits like for the major/minor radius of something like 5 or 6 millimeters, that those values are not allowed to go -- regardless of what the equations originally put out, we don't let the numbers go below 5 or 6 millimeters in that same function. We limit them, sort of cap them at 5 or 6 millimeters and then those get transmitted as like a 5 or 6 millimeter circle throughout the system.

Q. Okay. When you were working on your Ph.D., were you aware of others who attempted to address the problems that you were addressing in your thesis?

A. Well, obviously, I think I have hundreds of references talking about earlier work, but no one had attempted to, I guess,

develop a multi-touch surface so ambitiously with identifying the fingers and trying to merge typing and pointing and gestures and many different modalities on the same surface.

Q. Did you -- did you refer to a Rubine reference in your thesis?

A. Yes, I find a quote by Rubine, I believe from his Master's or Ph.D. thesis in '93 where he was working with a sensor frame, which is another early -- it was a multi-touch device. Would you like me to --

Q. Could I ask you to turn to JX-291.150. What is shown there?

A. So this is my discussion of Rubine and his work with multi-path gestures on the sensor frame. And I quote him in the lower paragraphs there where he says that for the devices such as data gloves, which are attached to the hand, and you have actually got sensors, wires running down to each finger, then those devices know exactly which finger is which, which finger is associated with different sensor input.

And so, you know, he says they could build one class for thumb paths and one for

forefinger paths and you could easily assign a different operation to each finger. Then he says for the sensor frame and multi-finger tablets, they cannot tell which of the fingers is the thumb, this is the forefinger and so on. Thus, there is no a priori solution to the path sorting and he says the solution he adopted was to just try to apply a consistent ordering between the paths.

MR. DAVIS: Thank you, Your Honor. I have no further questions at this time.

MR. NELSON: Just a couple.

RECROSS-EXAMINATION

BY MR. NELSON:

Q. All right. Let's put column 27 back up there of JX-3, the '828 patent. In that paragraph we were just talking about, let's blow that up again.

The one right at the top there. There you go. The first sentence you just looked at with counsel, it says, "on low resolution electrode arrays, the total group proximity Gz is a more reliable indicator of contact size as well as finger pressure than the fitted ellipse parameters." Right?

Page 345

A. Yes.

Q. So I think you said that that's used instead of the fitted ellipse parameters in what's described here in this paragraph at column 27, correct?

A. Well, what I said is -- I mean, in practice, what it really means is it is used instead of minor radius and major radius individually. I mean, that's the intended meaning.

Q. Right. And instead of the fitted ellipse parameters, right?

A. That's what it says.

Q. Okay. And then if you go down below, you talked about in this next sentence, "therefore, if proximity images have low resolution" -- first of all, what is low resolution?

A. I don't define that. And that's why, you know, in practice, we still use this, and that's not to say that the resolution is low, but in practice what this means is it is, when the size of the fingertip contact gets so small relative to the resolution you have, whatever it is, that you only get a few pixels out, then

Page 346

you are probably in a situation where this applies.

Q. So but here in column 27, you don't tell people that are reading the patent when something is low resolution or when something is not low resolution, correct?

A. No, I don't.

Q. Okay. And then it goes on to say, "the orientation and the eccentricity of small contacts are set to default values rather than their measured values and total group proximity Gz is used as the primary measure of contact size instead of major and minor axis lengths," do you see that?

A. Yes.

Q. And so let's focus on the orientation and eccentricity. Set to default values, that means they are not calculated, correct?

A. I don't agree with that, because to me in the work that I do, we're always computing these things. And, as I say, having to place limits and sort of post-process. And to me that's part of the process is to keep values within a meaningful range. And that's what this is talking about.

Page 347

Q. Well, what this says is you set to default value, correct?

A. You do, but it is based on -- you are setting it to default value, but it is usually -- you know, it is based on a decision, which is, you know, all part of the calculation.

You are setting, you know, at the end of the equations your default value, too, but it is based on, you know, a set of decisions and formulas and this would be as well.

Q. Well, here in column 27, you don't tell anybody that's reading this patent, set it to a default value that's dependent upon something that you measure, do you?

A. I don't say it, but I say the eccentricity of small contacts, I don't say it is large, and so I think there is an implicit decision in there that you are only going to do this for the small ones, so implicitly you are making a decision somehow, as I suggested earlier, probably based on Gz, of what's small and what is large and whether to do this.

Q. But you don't say any of that here in the paragraph in 27, correct?

A. I don't give the details of that.

Page 348

Q. Okay. So then in the example that you were talking about with counsel, I think you said that what you do, what you did in practice is you set the eccentricity value to 1, correct?

A. Yep.

Q. Eccentricity value of 1 is a circle, correct?

A. Yep.

Q. So that's a value, right? That's not calculated, correct?

A. I mean, it is a value. To say it is not calculated, as I say, to me, the calculation is still -- the process you are taking to get there is still a calculation.

Q. So what you are saying is you calculated something to determine that I shouldn't use any of those values, I should set it to a default value?

A. Yes, I think so.

Q. But the determination of the default value is not a calculation in and of itself, correct?

A. Not -- not as explained here.

Q. Okay. Thank you very much for your

time.
MR. NELSON: I don't have any further questions at this time, Your Honor.
MS. KATTAN: No questions, Your Honor.
MR. DAVIS: Just a couple of questions, Your Honor.

REDIRECT EXAMINATION

BY MR. DAVIS:
Q. Could we pull back up column 27, JX-3. So in the example that's provided at the top of column 27, do you use the numbers that are assigned as default values to determine the size or shape of the circle?
MR. NELSON: I am going to object as leading, Your Honor. He can ask him what he uses the values for, but he can't keep suggesting the answers.
JUDGE ESSEX: Rephrase your question, please.
BY MR. DAVIS:
Q. Sure. So what is used to determine the size and shape of the circle?
A. That would be -- I mean, the default values become like, you know, they would become like the major radii and minor radii. And

those would have been chosen, as I said, probably like representative of the smallest fingertip you would reasonably expect to see, like, you know, a child's fingertip or something.
Q. Is the default value a number value or is it some other type of value?
A. It is a numeric measurement, like 5 or 6 millimeters.
Q. Okay. And are number values assigned to each parameter or are there certain parameters for which no number value is assigned?
A. Well, typically when we engineer these systems, in order to allow layering of them and, you know, or in order to keep the layers independent, you want your bottom layer, let's call it the ellipse-fitting layer, to always provide values for all parameters.
And you may have many different alternate ways that you calculate those in different conditions, but you always provide them, so the next layer of the system doesn't have to have any special knowledge about, oh, is this value good now or is it only -- it

doesn't have to worry about whatever -- all those different conditions. It can be 100 percent rock solid confident that values for all parameters are always provided from lower layers.
Q. Okay. And under the example that is provided at the top of column 27, what are you using the values to do?
A. Well, we can be using them -- sorry. I am not sure what level.
I mean, in that layer, you know, they are filling in the ellipse parameters. And then in the higher layers, they could be using them to decide if something is a finger or a palm or a thumb like on the edge of a phone or for debugging to display -- to display the touches for purposes of just seeing what touches are on the screen and how big they are.
Q. Okay. So is the example that's provided at the top of column 27, is that an example -- is that mathematically fitting an ellipse or not mathematically fitting an ellipse?
MR. NELSON: Objection, leading, Your Honor. It is exactly the same question you

have already sustained the objection to.
JUDGE ESSEX: Let me ask the question here from my -- having listened to the three of you go over this and that, is there a point where the contact seems so slight to the system that it fits a value and that value is always the same? Is that what is going on here?
THE WITNESS: Well, it is for particular parameters. It is not for all.
JUDGE ESSEX: I understand not for all parameters, but for particular parameters, if it is below a minimum, then it has a value that will always be the same value?
THE WITNESS: Yes.
JUDGE ESSEX: Is that what is going on?
THE WITNESS: Yes.
JUDGE ESSEX: Okay.
MR. DAVIS: Thank you.
JUDGE ESSEX: Are you happy with that?
MR. DAVIS: I am happy with that, Your Honor.
JUDGE ESSEX: Are you happy with that?
MS. KATTAN: Yes, Your Honor.
JUDGE ESSEX: All right. Anything

else?

MR. NELSON: Nothing from us, Your Honor.

JUDGE ESSEX: All right, Doctor. I think we're done with you. Thank you very much.

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