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Transcript of Dr. Eli Saber

Date: July 2, 2024

Case: TVision Insights, Inc. -v- The Nielsen Company (US), LLC (PTAB)

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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

1 IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

2
3 BEFORE THE PATENT TRIAL AND APPEAL BOARD

4
5 TVISION INSIGHTS, INC.,

6 Petitioner,

7 V.

8 THE NIELSEN COMPANY (US), LLC,

9 Patent Owner.

10
11 IPR2023-01014

12 U.S. Patent No. 11,470,243

13
14
15 DEPOSITION OF DR. ELI SABER

16 Conducted Virtually

17 Tuesday, July 2, 2024

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1 Deposition of DR. ELI SABER, conducted
2 virtually.

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6 Pursuant to notice, before CRYSTAL HEREFORD,
7 Registered Professional Reporter, Certificate No. 30819,
8 and California Certified Reporter, Certificate
9 No. 14416.

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E X H I B I T S

(Retained by counsel)

SABER	DEPOSITION EXHIBIT	PAGE
Exhibit 1001	US Patent No. 11,470,243	93
Exhibit 1005	Ying-Li Tian, Evaluation of	104
	Face Resolution for	
	Expression Analysis	
Exhibit 1008	US Patent No. 4,858,000	164
Exhibit 2001	SIGNED_Declaration of Saber	19
	for 243 Patent	
Exhibit 2020	Supplemental Declaration of	42
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1 P R O C E E D I N G S

2 THE REPORTER: We will go on the record.

3 Will counsel please announce your appearance
4 and state whom you represent?

5 MR. SNADER: Robin Snader with Erise for the
6 patent owner.

7 MR. QIU: Fred Qiu with Sheppard Mullin for
8 Petitioner TVision Insights, Inc. With me is my
9 colleague, Harper Batts.

10 DR. ELI SABER
11 a witness herein, having been first duly sworn by the
12 certified reporter to speak the truth and nothing but
13 the truth, was examined and testified as follows:

14 EXAMINATION

15 BY MR. QIU:

16 Q. Good morning, Dr. Saber.

17 A. Good morning to you.

18 Q. I want to go over a few -- to get started, I
19 want to go over a few ground rules.

20 So you understand you are under oath to tell
21 the truth here?

22 A. I do.

23 Q. For this deposition, we will need verbal
24 responses because this is being transcribed today. We
25 need to make sure the court reporter can get your

1 responses. Is that fair?

2 A. That is fair.

3 Q. And we can take breaks today when you need
4 to. I would just ask that there's no questions pending
5 when you take breaks. Is that fair?

6 A. That is fair.

7 Q. Do you understand you are not allowed to
8 discuss your testimony with your counsel during breaks
9 today?

10 A. I do.

11 Q. If you don't understand a question, let me
12 know, and I will rephrase. Unless you say otherwise, I
13 will assume you understand the question. Is that fair?

14 A. That is fair.

15 Q. You have to answer my questions today unless
16 your attorney instructs you otherwise. Is that fair?

17 A. Yes.

18 Q. Are you on any medication today?

19 A. No, I am not.

20 Q. Any reason that you wouldn't be able to
21 provide accurate and truthful testimony today?

22 A. No.

23 Q. Are you here to give testimony in the
24 inter partes review proceeding involving US Patent
25 Number 11,470,243?

1 A. I am.

2 Q. Today, we'll refer to that patent as the
3 '243 patent. Is that right?

4 A. That is fine.

5 Q. What documents do you have here with you?

6 A. I'm sorry?

7 Q. What documents do you have here with you?

8 A. Counsel has sent three binders that have all
9 the exhibits in them. They arrived a couple days ago.

10 Q. So you're referring to all the papers and
11 exhibits that have been filed with this proceeding?

12 A. That is correct.

13 Q. Are the documents clean copies?

14 A. Yes, they are.

15 Q. Are these documents hard copies or electronic
16 copies?

17 A. The three binders are all hard copies right
18 here.

19 Q. Do you have electronic copies on your
20 computer that you will be accessing?

21 A. No, I do not. I would ask that you would
22 upload all the exhibits that we are going to talk about
23 in electronic form to the chat box, please.

24 Q. Okay. That sounds good.

25 Do you have any other documents with you?

1 A. No, I do not.

2 Q. Does the -- do you have any notes with you?

3 A. No, I do not.

4 Q. Since we are conducting this deposition over
5 Zoom and we are not in the same room, I'd ask that you
6 don't use your computer for anything other than this
7 Zoom meeting. Is that okay?

8 A. That's perfectly fine.

9 Q. If you access any document on your computer,
10 including any document that I may upload, I'd ask you to
11 let me know that you are accessing the document. Is
12 that okay?

13 A. That's fine. I will only access the
14 documents that you upload.

15 Q. Okay. Now, one of the things that we are
16 probably going to talk about today is the concept of a
17 person of ordinary skill in the art. Are you familiar
18 with that phrase?

19 A. You cut out a little bit, so I didn't hear
20 you very well. Would you repeat, please, the question.

21 Q. Sure.

22 One of the things that we're going to talk
23 about today is the concept of a person of ordinary skill
24 in the art. Are you familiar with that concept?

25 A. I am.

1 Q. If we use the term "POSITA," P-O-S-I-T-A,
2 will you understand that refers to a person of ordinary
3 skill in the art?

4 A. I will.

5 Q. So you have had two declarations submitted
6 for this case. Is that right?

7 A. That is correct.

8 Q. Are there any errors in your declaration or
9 anything you want to change?

10 A. While I was reviewing the original
11 declaration, not the supplemental, on page 24, paragraph
12 48, the quote has been misquoted and should be --

13 Q. Let me -- give me a minute to go there.

14 Okay. Sorry. Please keep going.

15 A. Yes. Let me go to the declaration.

16 On page 24 of the original declaration, not
17 the supplemental, paragraph 48, the first sentence has a
18 quotation from Tian. And that quote should say "An
19 example in five different resolutions from the
20 Cohn-Kanade database," not "of." It should say "An
21 example in."

22 Q. Okay. Any other errors or changes you have
23 in the declarations?

24 A. Not that I noticed. There might be some
25 minor typos here and there, but this one I thought would

1 be important to point out.

2 Q. How much time did you spend preparing your
3 declaration?

4 A. I don't recall off the top of my head.

5 Q. Any ballpark estimate?

6 A. It's hard to estimate. I mean, I don't know.
7 Many hours. I don't remember off the top of my head.
8 It's been a while, and so I don't remember exactly off
9 the top of my head.

10 Q. Do you remember how much time you spent for
11 your supplemental declaration?

12 A. Again, I don't remember off the top of my
13 head. It's been a while.

14 Q. Did you prepare your original declaration
15 yourself?

16 A. So I have a process that works very well for
17 me. Obviously I looked at the materials. I read them
18 very carefully. I discuss details with counsel. I
19 provide a first draft, and then it's a collaborative and
20 iterative effort to come to the final revision, which I
21 review very carefully and sign.

22 Q. Did you use the same process for both
23 declarations?

24 A. Yes, I did.

25 Q. Is there any part of either declaration that

1 you didn't prepare yourself?

2 MR. SNADER: I'd caution the witness to not
3 reveal any information that might be protected by
4 privilege.

5 A. I don't remember off the top of my head. As
6 I mentioned, it's a collaborative and iterative effort
7 to come to the final document.

8 Q. So you're not sure whether there are any
9 portions of your declaration that you didn't prepare
10 yourself.

11 MR. SNADER: Objection; asked and answered.

12 A. Again, as I mentioned, it's a collaborative
13 and iterative effort, and I don't remember the details
14 off the top of my head. It's been quite a while.

15 Q. What documents did you review when preparing
16 your declaration?

17 A. The list of exhibits that I have reviewed
18 when preparing my declarations are listed in the
19 exhibits -- list of exhibits section of both
20 declarations.

21 Q. Did you review anything that's not listed in
22 the list of exhibits?

23 A. I don't recall off the top of my head, but
24 most likely not. Obviously I relied on my expertise and
25 knowledge and experience in the field as well.

1 Q. What did you do to prepare for this
2 deposition?

3 A. I read through my declarations. I read
4 through the patent and the prior art. And I had
5 meetings with counsel.

6 Q. How much time did you spend preparing for
7 this deposition with counsel?

8 A. How much time did I spend meeting with
9 counsel?

10 Q. Yes.

11 A. I don't know. Somewhere between eight to ten
12 hours between meetings and phone calls.

13 Q. How much time did you spend other than
14 meeting with counsel for prepping for this deposition?

15 A. Probably around 10 hours or so, 10 to
16 12 hours.

17 Q. Did you review any documents that's not
18 listed on the exhibit list for preparing for this
19 deposition?

20 MR. SNADER: Objection; asked and answered.

21 A. No, I did not.

22 Q. In total, how much time have you spent
23 reading and reviewing the '243 patent?

24 A. I don't remember off the top of my head.

25 Q. Have you ever reviewed the entire

1 specification of the '243 patent?

2 A. I'm sorry?

3 Q. Have you ever reviewed the entire
4 specification of the '243 patent?

5 A. I must be missing a word or so. Have you
6 reviewed the what?

7 Q. Have you reviewed the entire specification of
8 the '243 patent?

9 A. Okay. The entire specification, yes, I have.

10 Q. Do you believe you have an adequate
11 understanding of the '243 patent?

12 A. Yes, I do.

13 Q. Is there anything you think is unclear about
14 the '243 patent?

15 A. No, there's not.

16 Q. Do you believe you're qualified to testify as
17 an expert in the field of the '243 patent?

18 A. Yes, I am.

19 Q. What knowledge or expertise qualifies you as
20 an expert?

21 A. I have been working in the field of digital
22 image/video processing, computer vision, machine
23 learning for many years, since the early '90s.

24 Q. Do you believe your experiences are relevant
25 to the field of the '243 patent?

1 A. Yes, I do.

2 Q. Why are they relevant?

3 A. As I mentioned, I have been working in the
4 field of image processing, digital video processing,
5 object tracking, object detection, face recognition,
6 segmentation, classification, machine learning for --
7 since the early '90s, since the '93 time frame.

8 Q. So you mentioned multiple different subjects.
9 Are they all in the same field? Or are they different
10 fields?

11 MR. SNADER: Objection; form.

12 A. Well, there is a lot of overlap between a lot
13 of the fields. Like, computer vision, pattern
14 recognition, and machine learning have a lot of overlap.
15 So there's a lot of overlap in a variety of
16 methodologies, algorithms, et cetera.

17 Q. What does image processing entail?

18 A. Well, on a high-overview level, you know, the
19 processing of images, taking on, let's say, digital
20 images and performing segmentation or classification or
21 restoration, compression. So you're processing the
22 image to transform it from Domain A to Domain B, let's
23 say, as a general -- very high overview, general
24 explanation.

25 Q. How is image processing related to the field

1 of the '243 patent?

2 A. Well, obviously the '243 patent discusses an
3 audience measurement system. So there is the --
4 you know, identifying people, performing facial
5 recognition on audience members, counting people. So
6 acquiring imagery and processing that imagery to -- for
7 certain outcomes.

8 Q. What does digital video processing include?

9 A. Well, digital video processing essentially
10 starts to get into the temporal domain, so the
11 processing of sequences of images taken with, let's say,
12 a video camera -- I think. Let's say 30 frames a second
13 for discussion's sake. So you're acquiring images --
14 frames at 30 frames per second that constitute a video
15 of some object or scenery that you have acquired, so...

16 Q. What does computer vision entail?

17 A. Well, computer vision gets -- I mean, again,
18 I'm talking in general, very general here -- gets into
19 the algorithms of how would you view imagery or apply
20 stereo imaging or a variety of techniques to essentially
21 acquire imagery, whether it's still or video, and
22 perform certain actions.

23 Q. What are the actions?

24 A. Let's say I'm doing autonomous driving. So
25 I'm acquiring imagery, and then I am instructing a robot

1 or a vehicle to navigate an environment. So I have to
2 be able to process that.

3 Q. Does computer vision include analyzing the
4 images? Yeah. That's my question.

5 MR. SNADER: Objection; form.

6 A. I didn't quite follow your question. Would
7 you repeat that, please?

8 Q. Does computer vision include analyzing the
9 images to identify objects?

10 A. Yes, it does.

11 Q. Does computer vision include analyzing the
12 images to -- for other purposes?

13 A. Yes.

14 Q. What are some of the other purposes?

15 A. Segmentation, classification, recognition.
16 These are some applications.

17 Q. Why is computer vision relevant to the field
18 of the '243 patent?

19 MR. SNADER: Objection; assumes facts not in
20 evidence.

21 A. Well, I mean, the '243 patent is obviously
22 doing, you know, face recognition. It's doing,
23 you know, classification. So it would -- you know,
24 computer vision as a whole is a very big umbrella of a
25 field, so some of the techniques there would be relevant

1 to what's taking place in the '243.

2 Would you upload a copy of the '243, please?

3 Q. Sure.

4 MR. QIU: Counsel, would you like to upload?
5 Or should I?

6 MR. SNADER: If you have a copy at hand, that
7 would be convenient. Otherwise, I can upload.

8 Q. Dr. Saber, I have uploaded a copy of the
9 patent. Can you see that?

10 A. I do. I am in the process of downloading it.

11 Q. Okay.

12 A. I have an empty folder on my desktop that I
13 will download all the exhibits into.

14 All right. I do have it in front of me, and
15 it is -- I do have it open, and I also have a paper
16 copy.

17 Q. Are you a POSITA?

18 A. Well, I am an expert in the field, but I'm
19 very well aware of the knowledge and expertise of a
20 POSITA.

21 Q. So you would opine that you are a POSITA.

22 MR. SNADER: Objection; vague and ambiguous.

23 A. As I mentioned, obviously I'm an expert in
24 the field, but I'm also very well aware of the knowledge
25 and expertise of a POSITA.

1 Q. Do you believe you're -- do you believe you
2 are qualified as a POSITA?

3 A. Yes.

4 Q. And you explained that in your original
5 declaration, correct?

6 A. I'm sorry?

7 Q. You explained that in your original
8 declaration, correct?

9 A. I explained what?

10 Q. You explained that you qualify as a POSITA in
11 your original declaration, correct?

12 A. Could you upload a copy of the original
13 declaration, please.

14 Q. Actually, let me -- as it is uploading, let
15 me rephrase my question.

16 Why do you believe you qualify as a POSITA?

17 MR. SNADER: Counsel, can you clarify the
18 field of the -- of your question?

19 MR. QIU: Sorry? Could you repeat that?

20 MR. SNADER: You keep saying "POSITA." Just
21 for the record, can you clarify that you're talking
22 about a POSITA in the area of the -- say, the
23 '243 patent or...

24 MR. QIU: Sure.

25 Q. Dr. Saber, why do you believe you qualify as

1 a POSITA in this case?

2 A. Give me one moment. Let me download the
3 document and have it open.

4 Excuse me. So please repeat your question.

5 Q. Why do you believe you qualify as a POSITA
6 regarding the '243 patent?

7 A. Well, as I mentioned, I've been working in
8 this field for over 30 years. I've worked with
9 colleagues. I've worked with students. I've worked
10 with engineers during my time at the Xerox Corporation.
11 So I've interacted with colleagues, students, engineers,
12 other practitioners in the field. So I'm well aware of
13 the knowledge and expertise of a POSITA.

14 Q. You mentioned you have worked in this field
15 for over 30 years. Which field are you referring to?

16 A. The digital image -- digital -- well,
17 typically we refer to it as signal processing as an
18 umbrella, but basically the digital image/video
19 processing, computer vision, pattern recognition,
20 machine learning. I've been working in this field
21 for -- or these fields for over 30 years now.

22 Q. Can you please go to your declaration --
23 original declaration, which is Exhibit 2001, at
24 paragraph 28.

25 (Exhibit Number 2001 introduced.)

1 A. Yes, sir. Let me go there.

2 Q. Please let me know when you get there.

3 A. Yes, sir. I'm there.

4 Q. At the end of that paragraph, you explain
5 that you specialize in media analysis. Is that correct?

6 A. Yes, sir. You read that correctly.

7 Q. So you -- would you say the fields you
8 mentioned, like video processing, computer vision,
9 pattern recognition, machine learning, those are part of
10 media analysis?

11 MR. SNADER: Objection; form.

12 A. Well, you can apply the techniques in those
13 fields to a variety of different applications. Media
14 analysis is obviously one of those applications, but you
15 can apply digital video processing, for instance, to do
16 compression or, you know, to do a variety of
17 applications.

18 Q. Let me try to reframe my question, because,
19 Dr. Saber, I think you didn't quite understand it --
20 quite answer it.

21 Which of the fields that you mentioned where
22 you have over 30 years experience in are part of media
23 analysis?

24 MR. SNADER: Objection; form.

25 A. Well, again, they all apply depending on

1 what you -- what's the application that's involved. So
2 if I'm doing digital video processing, if I'm processing
3 a sequence of images or imagery, you know, you may apply
4 techniques from image and video processing or computer
5 vision, for instance. If I'm doing media analysis for
6 classification, if I'm trying to classify a variety of
7 patterns or classes, then those techniques from pattern
8 recognition might come into play. So it depends on the
9 application.

10 Q. What do you mean by "media analysis" when you
11 mention it in your declaration?

12 A. Well, analyzing digital media, digital
13 sequences of images -- images, analyzing, you know,
14 imagery that would be acquired through, you know,
15 cameras or...

16 Q. Are audio data also a part of media --
17 digital media?

18 A. Yeah. That could be -- that could be -- yes.
19 It would be part of it.

20 Q. But is the patent about media analysis?

21 A. Well -- so you see in -- I'm looking at the
22 patent, Column 1, lines between 35 and 40.

23 So you see the "Field of the Disclosure."
24 You see it says "This disclosure relates generally to
25 audience measurement and, more particularly, to methods

1 and apparatus to capture images."

2 Q. Dr. Saber, are you done with this?

3 A. Yes.

4 Q. So is the '243 patent about audience
5 measurement or about media analysis?

6 MR. SNADER: Objection; form.

7 A. Well, again, as you see in the field of the
8 disclosure, it discloses "The disclosure relates
9 generally to audience measurement and, more
10 particularly, to methods and apparatus to capture
11 images."

12 So you're capturing imagery, which you are
13 going to analyze for -- as they do in the '243 for the
14 purposes of the '243.

15 Q. So how does your expertise in media analysis
16 qualify you as a POSITA for the '243 patent?

17 A. I think I've answered that already. I mean,
18 I have been working in the field of image/video
19 processing, computer vision, pattern recognition,
20 machine learning for over 30 years now on a variety of
21 applications from segmentation to object detection,
22 tracking, classification, recognition, many
23 applications, printing applications.

24 Q. So what is your experience in audience
25 measurement?

1 A. I don't understand your question.

2 Q. Do you have any previous experience in
3 audience measurement?

4 A. I haven't done direct work in audience
5 measurement, because this is not one of the applications
6 I have targeted. But all the image processing
7 applications that go with what's being discussed in the
8 '243 is work that I've been involved with for over
9 30 years.

10 Q. By 2011, was it common to use cameras to take
11 photos of the audience?

12 A. Yes.

13 Q. Was it common for cameras to be connected to
14 a computer so that the computer can process and analyze
15 photos taken by the camera?

16 A. Yes.

17 Q. By 2011, would a POSITA have been able to
18 connect two cameras to a computer where the two cameras
19 pointed different directions?

20 MR. SNADER: Objection; calls for
21 speculation.

22 A. You mean hard-wiring -- you know, USB or
23 hard-wiring two cameras to computers to capture imagery?
24 Yes.

25 Q. By 2011, were there multi-directional cameras

1 that can capture images in different directions?

2 A. What do you mean "different directions"? And
3 what do you mean "multi-directional"? You have to be
4 more specific.

5 Q. By 2011, were there cameras with multiple
6 image sensors that can capture images in different
7 directions?

8 A. I would assume yes. I mean, if I
9 understand -- well, I'm not sure I understand your
10 question correctly.

11 But a camera obviously has a lens to it. The
12 lens can then capture imagery depending on the focal
13 length of the camera and the angle of view. And there
14 are cameras that have a fisheye lens that would capture
15 imagery, you know, close to 180 degrees. So you can
16 capture, you know, scenery in various directions.

17 Q. If we have two cameras in a living room
18 connected to the same computer, can we simultaneously
19 capture images of the audience and images of the TV in a
20 living room?

21 MR. SNADER: Objection; vague and ambiguous.
22 Objection; calls for speculation.

23 A. If you have -- let me see if I understand
24 your question correctly. Are you saying that you have
25 two cameras connected to a computer and placed in a

1 living room?

2 Q. Yes.

3 A. And the two cameras are potentially pointing
4 in different directions. Then, yes, you would be able
5 to capture imagery in different directions from a
6 different angle of view.

7 Q. And a POSITA would have been able to do this
8 in 2011, correct?

9 A. Yes.

10 Q. And by 2011, if you have a multi-directional
11 camera either by having multiple image sensors or by,
12 for example, a fisheye lens, that camera can
13 simultaneously capture an image of the audience and the
14 TV and living room, correct?

15 MR. SNADER: Objection; form.

16 A. Well, you are bringing in a lot of stuff that
17 you would have to qualify.

18 So if the camera is pointed in -- so you
19 would need to know the camera -- the angle of view of
20 the camera, how wide the angle of view is to be able to
21 capture, you know, the width of the scenery that you
22 want to capture. So if I have a fisheye lens, I may be
23 able to capture a wider angle than something that's a
24 hundred -- you know, 90 degrees, you know, field of
25 view. So I think your question is vague and very

1 general.

2 Q. By 2011, if a POSITA would like to use a
3 multi-directional camera in a living room to capture
4 both the audience and the TV, the POSITA would have been
5 capable of configuring the camera to do that, correct?

6 MR. SNADER: Objection; form.

7 A. Again, I mean, you're -- you know, you're
8 speculating and throwing hypotheticals, and we need to
9 be accurate and describe exactly how the setup is being
10 set up.

11 But if I have two cameras on a tripod, one
12 pointed at the TV and one pointed at the audience,
13 obviously I can capture imagery from the TV and from the
14 audience.

15 But, again, you have to qualify what's the
16 field of view of the cameras, what's the capabilities.
17 There are a lot of parameters and specifications that
18 would be -- that would come into play to define exactly
19 what's being captured.

20 Q. You mentioned the word "tripod." Can you
21 explain what that means?

22 A. I didn't mention the word "tracomb"
23 (phonetic). I mentioned the word "tripod."

24 Q. Sorry. That's what I was saying.

25 Can you please explain what that means?

1 A. So a tripod would be a mechanism that you can
2 mount the camera on, for instance, that has three legs
3 that would allow the camera to sit on top of it and be
4 stable and pointed in a certain direction.

5 Q. Were you familiar with the specifications and
6 capabilities of camera devices by 2011?

7 A. Yes, I am.

8 Q. Were there any camera back then -- so --
9 sorry. Strike the question I was just asking. Let me
10 reformulate.

11 What is the widest angle the fisheye camera
12 would have been capturing back then?

13 A. Well, I mean, the specifications typically
14 specify the angle that you can capture. And some of
15 them have, like, two sensors on them that you can
16 capture both the front and the back. So you'd have to
17 look at -- you'd have to tell me exactly what the camera
18 is, and we would look at the specification, and then we
19 would see exactly what the field of view is. But
20 typically a fisheye has a very large angle -- very large
21 field of view.

22 Q. But the camera that has two sensors, one on
23 the front, one on the back, can we place that camera in
24 the living room so that the front camera captures the TV
25 in the living room and the back camera captures the

1 audience in the living room?

2 MR. SNADER: Objection; form.

3 A. Again, as I mentioned, you know, fisheye
4 cameras have a fairly large field of view. But the
5 imagery that you capture are very distorted because of
6 the fisheye lenses, so you would have to do some
7 processing to adjust for different things because of the
8 distortion that comes from the fisheye.

9 Q. Is a fisheye camera the same type as the
10 camera with one sensor on the front and one sensor on
11 the back?

12 A. Again, I mean, that was an example that I
13 gave you is a fisheye with a sensor on the front and a
14 sensor on the back. So that's the example I was talking
15 about.

16 Q. Were there -- in 2011, were there non-fisheye
17 cameras with a sensor on the front and a sensor on the
18 back?

19 A. I don't remember exactly off the top of my
20 head what exact versions of cameras were available at
21 exactly the right time frame. I wouldn't want to --
22 wouldn't want to give you a specific inaccurate answer,
23 but obviously cameras were available long before 2011
24 for a variety of applications.

25 Q. So you are not sure whether there were

1 non-fisheye cameras with a sensor on the front and a
2 sensor on the back.

3 A. I would have to do a bit of searching. I
4 don't remember off the top of my head. But obviously,
5 as I mentioned, cameras were available long before 2011
6 to capture both still and video imagery.

7 Q. Are you familiar with the methods for
8 reducing image resolution?

9 A. Yes, I am.

10 Q. Have you done it before?

11 A. Yes, I have.

12 Q. What are some ways you have reduced the
13 resolution of images?

14 A. Well, one way to do it is to apply
15 anti-aliasing followed by downsampling.

16 Q. Are there other methods for reducing image
17 resolution?

18 A. Yes.

19 Q. What are they?

20 A. You can apply, for instance, bilinear
21 interpolation.

22 Q. Were there other methods existing in 2011
23 that allows you to reduce the image resolution?

24 A. Yes.

25 Q. Can you please give me a complete list of the

1 methods for reducing image resolution available in 2011
2 that you know?

3 A. Well, I don't know if I can give you a
4 complete list. I mean, there are tutorial papers
5 published on this that have a listing of all the
6 techniques. I don't know if I can give you a complete
7 list off the top of my head. I would have to, you know,
8 reference -- take a look at a tutorial paper to give you
9 that list.

10 But as I mentioned, you know, anti-aliasing
11 followed by downsampling is one technique. Bilinear
12 interpolation is another technique. Fitting, you know,
13 B-splines to the -- you know, locally to the imagery and
14 then, you know, downsampling from there is yet another
15 technique. You know, picking up -- grabbing a pixel out
16 of every X is another technique, although very crude.

17 So there are many different techniques for
18 doing it. I would have to consult, like, a tutorial
19 paper. I don't remember every single one of them off
20 the top of my head.

21 Q. You mentioned grabbing a pixel out of every
22 X. Could you explain that a little more?

23 A. Something as crude as I have an image that's
24 100-by-100 and I pick a pixel out of every four and
25 reduce the image to 50-by-50. That technique is

1 obviously very crude, and it's going to introduce
2 aliasing into the imagery.

3 THE REPORTER: I'm sorry. Use what?

4 A. That technique is very crude, and it's going
5 to introduce aliasing into the imagery.

6 Q. By 2011, would a POSITA have been capable of
7 using these methods to reduce the resolution of the
8 image?

9 A. Yes.

10 Q. By 2011, would a POSITA have been able to use
11 downsampling to reduce the resolution of the image?

12 A. Yes. Again, I mean, it depends on the
13 application that you are apply -- working with and
14 whether -- you know, the requirements for realtime and
15 not realtime. There are parameters that you have --
16 that has to be considered. But generally speaking, a
17 POSITA would be familiar with downsampling.

18 Q. Would a POSITA have been able to implement
19 downsampling using software running on a computer?

20 A. Again, depending on the application and the
21 parameters of the application. But generally speaking,
22 a POSITA would be able to implement downsampling using
23 software on a computer.

24 Q. By 2011, was a processor circuitry a common
25 component of computers?

1 A. I'm sorry?

2 Q. By 2011, was a processor circuitry a common
3 component of computers?

4 A. Yes.

5 Q. Is it fair to say that software generally
6 includes -- included instructions that can be read and
7 executed by a computer by 2011?

8 MR. SNADER: Objection; form.

9 A. Again, I think you're -- so when you write a
10 software program, like a C program, that has to be
11 compiled. It has to be linked and turned into a --
12 basically a binary code to be able to run on a computer.

13 Q. Are you familiar with the concept of
14 subsampling?

15 A. Subsampling?

16 Q. Correct.

17 A. Yes, I am.

18 Q. What does that mean?

19 MR. SNADER: Objection; form.

20 A. Again, it's -- you know, people use that
21 sometimes, you know, synonymously with downsampling. So
22 it depends on what you are doing, but essentially you're
23 reducing the sampling rate of a signal or an image.

24 Q. How do you reduce a sampling rate of an
25 image?

1 A. Well, the most straightforward way would be
2 as I pointed out in my declaration -- I think the
3 supplemental one. If you look at the book by Oppenheim
4 and Schafer, there are algorithms there to change the
5 sampling rate -- reduce, increase, or change the
6 sampling rate.

7 Q. In a layperson's term, does that mean
8 sampling selected pixels of the image and skipping
9 others?

10 MR. SNADER: Objection; form.

11 A. I'm not sure what you're asking. I don't
12 understand your question.

13 Q. What do you not understand about it?

14 A. I don't understand what you're asking.

15 Q. Let me repeat the question.

16 In a layperson's term, does subsampling mean
17 sampling selected pixels of the image and skipping other
18 pixels of the image?

19 MR. SNADER: Objection; form.

20 A. I don't know what you mean by "sampling some
21 pixels and skipping others." I don't know what you mean
22 by that.

23 But you could pick a pixel out of every four,
24 as I mentioned earlier, and obviously downsample the
25 image. But that would be a crude way of doing it, and

1 it would introduce anti -- and would introduce aliasing.

2 Q. In performing subsampling, do you need to
3 process each pixel in the image?

4 A. Well, as I mentioned in my supplemental
5 declaration, if you want to properly reduce the sampling
6 rate, you would have to perform anti-aliasing before you
7 downsample, and that would require processing pixel --
8 all the pixels of the image.

9 THE REPORTER: I'm sorry. Doctor, I'm
10 missing a word. When you say you would have to
11 perform -- what? Could you spell that word for me?

12 THE WITNESS: Anti-aliasing, if that's the
13 one you're referring to. Anti --

14 THE REPORTER: It is.

15 THE WITNESS: So it's kind of like against,
16 anti; aliasing, like an alias.

17 THE REPORTER: Thank you.

18 MR. SNADER: Fred, we've been going for about
19 an hour. Can we do a quick break?

20 MR. QIU: Let me finish my next question,
21 which is related to this one --

22 MR. SNADER: Sure.

23 MR. QIU: -- and then we can take a break.

24 Q. So, Dr. Saber, you were saying the step of
25 anti-aliasing involves analyzing all the pixels, and

1 then when you perform the step of subsampling or
2 downsampling, that does not include processing all the
3 pixels, correct?

4 MR. SNADER: Objection; mischaracterizes
5 testimony.

6 A. So, again, as I said, you would need to --
7 the anti-aliasing step would process -- you know, it
8 would be like a convolution, so it would process all the
9 images of the image. You would have to process the
10 pixels -- for each pixels, you would have to process the
11 pixels within a window or a kernel. Once you have done
12 that, you can then pick a pixel out of every four and
13 downsample the image. The process is considered
14 together. It's not just one -- so you would do the
15 anti-aliasing followed by the downsampling in order to
16 reduce the artifacts of aliasing that would show up when
17 you start downsampling the image.

18 Q. Taking a pixel out of every X number of
19 pixels does not involve processing each pixel in the
20 image, correct?

21 A. Well, I mean, if you're doing it by software,
22 obviously -- if you're doing it by software, you would
23 have to run a for loop on all -- on the rows and columns
24 and pick out a pixel out of every, let's say, four. So
25 your for loop would have to work through the rows and

1 columns of the image to acquire the appropriate pixels.
2 But you would still need to -- the anti-aliasing step
3 would require the processing of all the pixels before
4 you do the downsampling. Otherwise, you end up with a
5 significant amount of aliasing.

6 Q. Dr. Saber, I'm not asking about the
7 anti-aliasing step. I'm asking about the step of taking
8 a pixel off every X number of pixels. And that does not
9 involve processing each pixel in an image, correct?

10 A. So if you picked one of every four, you would
11 obviously skip over -- you would skip over every other
12 pixel in the row direction and the column direction.
13 But, again, that by itself is going to result in
14 aliasing artifacts introduced in the image without the
15 anti-aliasing step.

16 Q. So you are not able to give me a yes or no
17 question -- answer about whether the step of picking
18 every pixel from every X number of pixels involve
19 processing each pixel in the image.

20 MR. SNADER: Objection; form.

21 A. I believe I have answered your question. So
22 picking every pixel -- if I were to write a for loop
23 that would skip -- that would pick a pixel, skip a
24 pixel, pick a pixel, skip a pixel, pick a pixel in the
25 row direction and the column direction, I would be -- I

1 would be obviously picking a pixel out of four, so I'm
2 not processing all four of them.

3 But that result by itself will result in
4 aliasing artifacts. That would not -- that would be
5 objectionable. So you would need to provide the proper
6 anti-aliasing before you can do that step.

7 Q. What computations are involved in the
8 subsampling step, by which I mean the step of taking a
9 pixel from every X number of pixels?

10 A. As I already mentioned to you, if I were to
11 write a for loop for I equals zero, R less than 100,
12 I plus plus or J equals zero, J less than 100, J plus
13 plus, pick a pixel or -- you would have to increment by
14 two in each direction, so it really should be I plus
15 plus or J plus plus. So you would have to increment by
16 two and pick a pixel in the I direction, in the
17 horizontal direction, and then increment by two and pick
18 a pixel in the vertical direction.

19 But, again, that -- even though you're just
20 touching one out of every four, that results in aliasing
21 artifacts, which are not -- which are objectionable and
22 not desirable. So you would need to perform the
23 anti-aliasing step prior to doing that in order to have
24 a useful image for further processing.

25 Q. Is the algorithm you just described

1 computationally efficient?

2 MR. SNADER: Objection; form.

3 A. Which algorithm are you talking about?

4 Q. The algorithm for picking a pixel from every
5 X number of pixels.

6 A. If you're just looking at picking a pixel out
7 of every, let's say, four pixels, again, that can be
8 done computationally reasonably efficient, but that
9 would result in poor image quality due to aliasing and
10 not useful for further processing, because you're
11 introducing aliasing artifacts. So you would still need
12 to do the anti-aliasing step first, which will require
13 additional computational resources.

14 MR. QIU: Let's take a break.

15 THE WITNESS: What time --

16 MR. QIU: Maybe --

17 THE WITNESS: -- be back here?

18 MR. QIU: In five or ten minutes?

19 MR. SNADER: Five minutes?

20 MR. QIU: Do you have -- five minutes? Okay.

21 THE WITNESS: It's 11:38. I'll be on my desk
22 at 11:45.

23 MR. QIU: Yep. 11:45 sounds good.

24 (Off the record: 8:38 a.m. to 8:46 a.m.)

25 THE REPORTER: We're back on the record.

1 Q. Dr. Saber, you mentioned the term "aliasing."
2 So what is aliasing?

3 A. Well, in kind of an overview description,
4 it's basically taking a frequency and re-presenting it
5 as a different frequency.

6 Q. Can you elaborate a little more? What do you
7 mean by "taking a frequency and re-presenting it as a
8 different frequency"?

9 A. So when you subsample -- if you look at
10 Oppenheim, for instance, and Schafer, Chapter 4, this --
11 the chapter on sampling, this process is described very
12 well. So when you subsample the image in a spatial
13 domain -- so Oppenheim and Schafer talks about a
14 one-dimension signal, but the same process applies to
15 2D.

16 When you subsample the signal in 1D, you
17 increase its -- it would look like you increase its
18 bandwidth, because you're getting basically less -- it
19 looks like you're getting more samples in a given amount
20 of time. So you take certain frequencies and reposition
21 them or reproduce them as higher frequencies, which will
22 appear in the image as aliasing, and it's a well-known
23 artifact.

24 Q. So I can visualize what you're talking about
25 in wave form detected by a sensor. So how does that

1 apply to downsampling an image?

2 A. As I mentioned in my previous answer, the
3 same concepts apply. You know, images are sampled
4 spatially. So you have a pixel -- you know, so many
5 pixels per centimeter or millimeter. So there's a
6 spatial sampling of a -- let's say a wall or something.
7 The picture that you've taken, you've sampled some
8 scenery from the real world and -- based on your CCD
9 array resolution of the camera, and you provided a
10 spatial, basically, digital image that has been sampled
11 with so many samples per second -- per millimeter, let's
12 say, so many pixels per millimeter. So that essentially
13 defines the resolution of your image.

14 Q. In what situations does aliasing occur when
15 you process an image?

16 A. Aliasing will occur in all practical images
17 when you downsample them.

18 Q. Why does aliasing always occur when you
19 downsample an image?

20 MR. SNADER: Objection; form.

21 A. Well, you have to go look at the 48,
22 obviously, domain transforms and get into the
23 mathematics. But you can't -- if you're looking at a 1D
24 signal, you can't be time limited and band limited at
25 the same time. So for an image, you can't be spatially

1 limited and frequency limited at the same time.

2 So since an image has a subspatial
3 dimensionality to it, your -- ideally speaking, your
4 bandwidth has frequencies, you know, in all --
5 theoretically speaking, in all the frequencies. So when
6 you downsample it, you start to introduce -- without
7 proper anti-aliasing, you start to introduce aliasing
8 artifacts, and they get worse as you downsample further.

9 Q. What do you mean by "spatially limited" when
10 you talk about an image?

11 A. Well, an image has certain dimensions, right?
12 So it's spatially -- it's not an infinite space. It's
13 got a certain dimensionality. You have captured a scene
14 and have 512 pixels by 512 lines. So you're spatially
15 limited to that, essentially, domain.

16 Q. Why does that spatial limitation cause
17 aliasing?

18 A. I think I've already explained that to you.
19 So you can't be spatially limited and bandwidth limited
20 at the same time. There are theorems on that in
21 sampling that apply in 1D and 2D.

22 So when you're time limited on a
23 one-dimensional signal, you're not band limited. So
24 therefore, theoretically speaking, you have frequencies
25 in the entire bandwidth. You have content at the entire

1 bandwidth in the frequency domain.

2 Q. What does "band limited" mean?

3 A. Your bandwidth is limited to certain
4 frequencies. In this case, we're talking about
5 frequency bandwidth.

6 Q. Are you familiar with the Nyquist frequency?

7 A. Yes, I am.

8 Q. Can you please open your supplemental
9 declaration, which is Exhibit 2020.

10 A. I don't think you've uploaded that. I
11 don't -- the only thing I have from you right now is the
12 '243 patent and my original signed declaration.

13 Q. Okay. Let me upload that.

14 (Exhibit Number 2020 introduced.)

15 Q. What does the Nyquist frequency mean?

16 A. Hold on one second. I'm downloading.

17 So I do have the document, and I have it
18 open, and you were referencing the document for some
19 reason.

20 Q. Yes. For this question, we don't have to
21 refer to that document yet.

22 My question was: What does the Nyquist
23 frequency mean?

24 A. Well, if you're sampling at the Nyquist and
25 above, you can technically subsample the signal with a

1 minimal amount of aliasing -- well, theoretically, the
2 signal is infinite, obviously. That's a different
3 story. But for a time-limited signal, if you're
4 sampling at the Nyquist or above -- if I sample at twice
5 Nyquist, I can subsample to Nyquist with minimal
6 aliasing in a practical signal.

7 Q. So you are saying if we sample above the
8 Nyquist frequency, there would be minimal aliasing --

9 MR. SNADER: Objection; mischaracterizes
10 testimony.

11 Q. -- is that correct?

12 MR. SNADER: Objection; mischaracterizes
13 testimony.

14 A. So for a practical signal, if we're talking
15 1D, the signal is time limited, obviously. You capture
16 a certain -- you know, a few minutes of some audio
17 signal or something. So it's time limited. So it's not
18 band limited. Technically speaking, theoretically
19 speaking, it has infinite bandwidth.

20 If that signal was sampled above the Nyquist,
21 you can theoretically subsample it down to Nyquist with
22 minimal aliasing because it's a practical signal.
23 Theoretically speaking, if you assume the signal is
24 infinite, that's a different discussion.

25 Q. What does "practical signal" mean?

1 A. A signal that's time limited to a certain
2 amount of time. When I say "practical" in this case,
3 I'm saying a signal that's limited to a certain amount
4 of time that you have captured.

5 Q. Does the concept of Nyquist frequency apply
6 to images?

7 A. Yes, the same as 1D.

8 Q. Is it true that if we downsample an image at
9 twice the Nyquist frequency there would be little
10 aliasing?

11 MR. SNADER: Objection; form. Objection;
12 vague and ambiguous.

13 A. I don't understand your question. If you
14 downsample -- I think you're mixing up concepts,
15 Counselor.

16 Q. Okay. Let me ask another question.
17 Can you process an image at -- above the
18 Nyquist frequency?

19 A. Well, again, theoretically speaking and
20 practically speaking on a different -- practically
21 speaking, images of -- because the image is spatially
22 limited, it's not bandwidth limited, so it's --
23 theoretically, it has an infinite bandwidth, but
24 obviously you are not able to see all those frequencies.
25 So when you subsample it down to Nyquist, you will have

1 a minimal amount of aliasing if it is sampled well above
2 Nyquist.

3 Q. Was there a way to know how -- whether an
4 image is subsampled above Nyquist?

5 MR. SNADER: Objection; calls for
6 speculation.

7 A. I think you're mixing up concepts and
8 misstating concepts. You're saying "subsample," and
9 you're saying "above Nyquist," so you're mixing up
10 apples and oranges.

11 Q. You mentioned subsampling an image down to
12 Nyquist, didn't you?

13 A. Yes, if it is sampled, not subsampled. If it
14 is sampled above Nyquist, you can theoretically
15 subsample down to Nyquist with minimal amount of
16 aliasing but still present.

17 Q. Was there a way to make sure -- strike that
18 question. Sorry.

19 How do you subsample an image down to
20 Nyquist?

21 A. Well, you don't know where the image has been
22 sampled. You have an image. You don't know whether
23 that's been sampled above Nyquist or not, because if
24 there are things in the image that are very high
25 frequency of which you didn't properly sample, they

1 would have been already distorted. Like, for instance,
2 eyelashes. You know, very high frequency, very small
3 spatial, you know, space in a sense. So you don't
4 really know exactly where that is. That's why you apply
5 anti-aliasing prior to downsampling to the frequency
6 that you want.

7 Q. When you downsample an image, there are
8 certain cases where the downsampling causes it to go
9 below the Nyquist frequency, and there are some cases
10 where it does not go below the Nyquist frequency,
11 correct?

12 MR. SNADER: Objection; form.

13 A. Yes. But obviously you don't know that when
14 you're looking at the image. You don't know if the
15 image was originally improperly sampled and all the
16 high-frequency content was or was not captured properly.
17 That's why you apply anti-aliasing prior to subsampling.

18 Q. Whether the high-frequency content was
19 captured or not captured, does that depend on the
20 camera?

21 MR. SNADER: Objection; form.

22 A. I'm not sure I understand what you're asking
23 exactly about.

24 Q. What controls whether the high-frequency
25 content was or was not captured properly?

1 A. So the camera that you're utilizing has a
2 certain -- a digital camera you're utilizing has a
3 certain CCD array with a certain resolution of pixels
4 per millimeter. That obviously determines how many
5 pixels per millimeter is being captured from the scenery
6 that you have, you know, captured.

7 Q. Would a POSITA, by 2011, have been able to
8 determine the Nyquist frequency based on the
9 specifications of the camera?

10 MR. SNADER: Objection; incomplete
11 hypothetical.

12 A. So, again, I mean, it depends on the
13 application that you are targeting. You know, if you
14 were to know -- if you were -- if you purchased a camera
15 and it's got a certain specification to it, it would
16 list, you know, how many pixels per millimeter this
17 camera is rated for, and that's what it's rated to
18 capture.

19 Q. And based on that, a POSITA, by 2011, would
20 have been able to determine the Nyquist frequency. Is
21 that right?

22 MR. SNADER: Objection; mischaracterizes
23 testimony.

24 A. Well, a POSITA would know how many pixels per
25 unit, millimeter or inch or whatever, this camera is

1 capable of capturing. I think you're mixing concepts.

2 Q. How so?

3 A. Well, the scene that is being captured is
4 what determines the content and the frequency, not the
5 camera. So the camera has a certain resolution, but the
6 scene it's capturing -- if I'm capturing a white wall, a
7 white wall has lower frequency content than if I'm
8 capturing eyelashes or very high frequency -- let's say
9 it's text or things of that sort.

10 Q. For a POSITA who knows the specification of
11 the camera and who knows that the scene the camera is
12 capturing are human in a living room, would the POSITA
13 have been able to estimate the Nyquist frequency based
14 on those information?

15 A. Unlikely you can estimate the Nyquist
16 frequency, because as I mentioned to you, the scenery
17 has different frequency content. You'll be able to
18 capture that scenery using the spatial resolution of the
19 camera and have the images -- have the acquired images.

20 Q. If a POSITA had images taken by the camera on
21 the same scenery before, would the POSITA have been able
22 to analyze the images and estimate the Nyquist
23 frequency?

24 A. Again, you're mixing apples and oranges. So
25 once you've captured the image of the scene, you have

1 the resolution that the camera is capable of capturing.
2 That's the best it can do.

3 Q. If a number of images are taken on the same
4 scene using the same camera, would their Nyquist
5 frequency be similar?

6 MR. SNADER: Objection; incomplete
7 hypothetical.

8 A. I think you're still mixing apples and
9 oranges. So if you're taking pictures -- images of the
10 scene, the camera is going to acquire that imagery based
11 on the resolution that the camera is capable of
12 capturing. So it's going to capture points in space,
13 essentially. It's not going to -- different images
14 aren't going to capture the exact same point and space
15 of the scenery. So if I have ten images, theoretically
16 speaking and practically speaking, every pixel in
17 that image at that same location isn't going to be
18 exactly the same point in space and time, ideally. So
19 it's going to capture at the resolution of the camera.
20 So that's the sampling rate that you get with that
21 camera.

22 Q. Let me try to ask another way.

23 For a picture captured by the camera, does
24 that picture have a Nyquist frequency?

25 A. Again, you're mixing apples and oranges. A

1 picture doesn't have Nyquist frequency. The Nyquist
2 frequency is determined by the original signal. So the
3 analog -- the scenery that you're capturing has content
4 in it. That content has different frequency. You know,
5 my face, looking at you today, has a very smooth
6 forehead and eyelashes. So there's different frequency
7 content in my face versus, for instance, the white wall
8 behind me that is variable frequency content in
9 compare- -- relatively speaking, to my face.

10 So the content -- the frequency content of
11 the scenery is determined by the scenery, and what
12 content in that scenery determines where is the highest
13 frequency in that scenery.

14 Q. Got it. So --

15 A. Your camera only captures a certain spatial
16 resolution depending on the specification of the camera.

17 Q. So a person's face in the image will have a
18 Nyquist frequency. Is that right?

19 A. A person's face is not the same thing as a
20 person's face in the image. My face in the real world
21 has frequency content obviously on it, depending on what
22 is the structure of the signal that we're looking at.
23 When it's captured by a camera, the resolution of the
24 camera defines the spatial -- how many pixels per
25 millimeter you have captured.

1 Q. Just to understand, you're saying the face in
2 the real world has a Nyquist frequency. Is that right?

3 A. The face in the real world has frequency
4 content. Some of it is lower. Some of it is higher.
5 My eyelashes have a higher frequency content than the
6 top of my head. Right? So they're different frequency
7 content in the signal.

8 When you use a camera to capture a picture of
9 my face, if that camera has one pixel per inch -- I'm
10 exaggerating -- the camera has the resolution of one
11 pixel per inch -- which is obviously an exaggeration to
12 illustrate a point -- you're only going to capture one
13 pixel of every inch of my -- every inch of my face will
14 come in as one pixel. So any high-frequency content --
15 so my entire eyeball, it would make it look like one
16 pixel, assuming the eyeball is an inch by inch. So
17 you've destroyed all the high-frequency content around
18 my eyeball because of such a low resolution of the
19 camera.

20 Q. So where does the Nyquist frequency come in
21 in that situation?

22 A. Well, the Nyquist frequency is a theoretical
23 concept in sampling. Right? So the assumption is you
24 have a one-dimensional signal that's going on
25 infinitely. You take a fourier transform. You find the

1 highest frequency in that signal, theoretically
2 speaking. And that determines your Nyquist frequency,
3 so you can sample, technically, above that frequency.

4 But that's -- those are theoretical concepts.
5 Practically, you have aliasing in imagery at different
6 levels. Some of it is not visible to you, but
7 theoretically speaking, it exists.

8 Q. Is it true that the more you reduce the
9 resolution of the image, the more likely there is
10 aliasing?

11 A. As you reduce the resolution of the image,
12 you will introduce more and more aliasing into the
13 image.

14 Q. For example -- strike that.

15 You mentioned that certain levels of aliasing
16 are visible and certain other levels of aliasing are not
17 visible. Is that right?

18 A. Well, I mean, if the image is sampled at a
19 very high rate, aliasing will still exist. It's just
20 not -- given the -- that depends a lot on the content of
21 the image. If the image is very busy, it's not as
22 visible as if the image is very smooth. So it depends a
23 lot on the content of the image where do you start
24 seeing the aliasing. That's image dependent.

25 Q. Does it also depend on how much you reduce

1 the resolution of the image?

2 A. Yes. So as you -- if I were to pick a pixel
3 out of every four -- if that's what you mean by reducing
4 the resolution -- if I just pick a pixel out of every
5 four, I will start to introduce aliasing into the
6 imagery. And the more you reduce that resolution, the
7 more and more aliasing you will introduce, unless you've
8 done some, you know, anti-aliasing or something to
9 mitigate some of that.

10 Q. Do I understand it correctly that if we pick
11 a pixel out of every four, the aliasing effect is
12 unlikely to be visible, and if we pick a pixel out of a
13 larger number of pixels, such as 32, there will be more
14 likely visible aliasing?

15 MR. SNADER: Objection; mischaracterizes
16 testimony.

17 A. You're mixing multiple concepts together,
18 apples and oranges. And no, that is not true.

19 Q. What am I mixing?

20 A. If you pick a pixel out of every four, you
21 introduce aliasing.

22 Q. Is it true that when there is less aliasing
23 it is unlikely to be visible and when there's more
24 aliasing it is more likely to be visible?

25 A. Again, that's image dependent, as I mentioned

1 to you. Smoother areas of the image, you are going to
2 see aliasing more visible to your eye than busy areas of
3 the image. So it exists in the image in different
4 levels depending on the content of the image.

5 Q. Is the human face usually considered a smooth
6 area or busy area?

7 A. Well, if you look at my face, my head is
8 fairly smooth, as you may have noticed. My eyelashes
9 and my eyes are not. The mustache is not. So the face
10 has angles on it, so there are areas of the face that
11 have lower frequency and areas of the face that have
12 higher frequencies. So it contains a mixture of them.
13 I mean, I'm generally speaking, of course.

14 Q. So let's -- thank you for giving your own
15 face as an example. Let's talk about a general face in
16 terms of image analysis.

17 Do people's face -- are people's face
18 generally considered a busy area or a smooth area in
19 images?

20 A. Well --

21 MR. SNADER: Objection; asked and answered.

22 THE WITNESS: Go ahead.

23 MR. SNADER: Objection; asked and answered.

24 A. Faces, as I've already mentioned to you, have
25 high-frequency content in certain areas. Like your

1 hair, if it's got a mixture of gray and black, it's
2 going to have higher frequency content than if it's all
3 black. People's skin, some people have pimples on the
4 skin, different -- or whatever, marks on the skin.
5 Those are going to be high-frequency content. Regions
6 around the eyes, you know, the nose and whatever,
7 there's going to be edges and corners, and so those are
8 going to be -- have high-frequency content. So it's a
9 mixture of high and -- higher and lower frequency
10 content depending on where you look at the face.

11 Q. How do you remove aliasing?

12 A. I think we've already discussed that already.
13 You don't remove it. You reduce it by using
14 anti-aliasing.

15 Q. Can you please give me a list of
16 anti-aliasing techniques that you can think of?

17 A. Well, the simplest one would be to apply a
18 filter to the image to reduce the frequency content to a
19 certain bandwidth. Practically speaking, you reduce it
20 to a certain bandwidth so then when you subsample it,
21 essentially -- if I wanted to subsample the image by
22 two, I would try to reduce it to half the frequencies
23 that it contains so I can subsample it by two and
24 minimize the amount of aliasing.

25 But as you apply the anti-aliasing, you

1 essentially are removing high-frequency content from the
2 image, which introduces a little bit of blurring. So
3 you're essentially balancing blurring and aliasing.

4 Q. Are there other techniques for anti-aliasing?

5 A. Well, I mean, there are many different
6 techniques, you know. I can't give you a list off the
7 top of my head.

8 But I can also set the function to the
9 location and then reduce the frequency content of that
10 function. Typically it's done with filtering
11 techniques, convolutions in the spatial domain or
12 filtering in the frequency domain.

13 Q. What computations are involved in filtering?

14 A. Well, if you're doing it in the spatial
15 domain, you would be applying a kernel, say a
16 five-by-five, across -- convolution across the image.
17 So you would have basically a sliding window that goes
18 across the image in row-to-column or something. And at
19 every location, you would multiply and add to get the
20 output.

21 If you're doing it in the frequency domain,
22 you would have to convert the image to the frequency
23 domain. So you have to transform -- you do a fourier
24 transform -- a forward fourier transform. You then
25 multiply that by the forward fourier transform of the

1 kernel. And then you would do an inverse fourier
2 transform to come back to the spatial domain.

3 Q. Do different anti-aliasing techniques differ
4 in terms of computational complexity?

5 A. Certainly.

6 Q. Are there computationally efficient ways to
7 perform anti-aliasing?

8 A. Well, again, it depends on what technique are
9 you applying. Then you would have to sit down and do
10 the computational demands of that particular technique
11 and whether it's being done in software or hardware and
12 whether you're doing floating-point operations or
13 integer operations. There's a lot of things involved in
14 this discussion.

15 Q. So it is possible to perform anti-aliasing
16 computationally efficiently.

17 MR. SNADER: Objection; mischaracterizes
18 testimony.

19 A. Again, that's not what I said. What I said
20 is if I'm doing convolution -- as I stated in my
21 supplemental declaration, if you're doing a convolution
22 with, let's say, a five-by-five filter -- a five-by-five
23 kernel, you have 25 multiplications and 24 additions at
24 every pixel throughout the entire image, which obviously
25 constitute floating-point operations. So you would have

1 to do that across the entire image from top to bottom in
2 rest-to-scan format. That obviously has a certain
3 amount of computational complexity to it.

4 Q. So it is not possible to perform
5 anti-aliasing computationally efficiently?

6 MR. SNADER: Objection; mischaracterizes
7 prior testimony.

8 A. Again, you would have to know the exact
9 operation that you are doing and whether it's being done
10 in software or hardware. And once you understand the
11 parameters, you can then define the computational
12 complexity of the technique that you're applying.

13 Q. I'm asking a yes or no question, whether it
14 is possible to perform anti-aliasing computationally
15 efficiently. Can you provide a yes or no answer to that
16 question?

17 A. Again, it depends on what anti-aliasing
18 operation you are performing for you to answer that
19 question. You know, if I'm doing it in hardware, I'm
20 going to be more computationally efficient, generally
21 speaking, if you design the hardware properly.

22 There's a lot of parameters involved, so you
23 have to be specific on what's the technique that's
24 involved, what are the details. You know, you and I can
25 both write different software programs where mine can be

1 slower than yours to do the same thing.

2 Q. Among all of the hardware and software
3 configurations available in 2011, were there any of them
4 that is able to perform anti-aliasing computationally
5 efficiently?

6 MR. SNADER: Objection; asked and answered.

7 A. Again, I would need to know -- you'd have to
8 specifically show me what the technique is, how it's
9 being done, the algorithm that's being utilized, how
10 it's being implemented. Is it in software or hardware?
11 And I would have to analyze that to basically tell you
12 the computational complexity of that technique is XYZ.

13 Q. Were anti-aliasing techniques known in the
14 art before 2011?

15 A. Yes, they were.

16 Q. Are anti-aliasing operations always performed
17 when reducing the resolution of images?

18 A. I think you have asked that before also. So
19 practically speaking, before you reduce the resolution,
20 you would want to perform anti-aliasing to ensure that
21 you don't introduce objectionable artifacts in the
22 image -- aliasing artifacts in the image.

23 Q. So you're saying anti-aliasing operations are
24 always performed -- were always performed when reducing
25 the resolution of images?

1 MR. SNADER: Objection; mischaracterizes
2 testimony.

3 A. "Always" is a very strong word. Practically
4 speaking, anti-aliasing is performed before doing
5 downsampling on a given image to avoid introduction of
6 objectionable artifacts of aliasing.

7 Q. So anti-aliasing operations are not always
8 performed before reducing the resolution of images. Is
9 that correct?

10 A. I think I've already answered that.
11 Anti-aliasing is practically recommended technically to
12 be performed on an image prior to downsampling to
13 prevent -- to reduce or minimize the objectionable
14 artifacts of aliasing.

15 Q. Is anti-aliasing practically recommended in
16 all scenarios?

17 A. Well, it's practically recommended -- it
18 depends, obviously, on the imagery that you are
19 capturing. It depends on the application that you are
20 working with. Your question is very vague and very
21 general. You would have to be specific with specific
22 applications.

23 Q. So based on factors like the imagery and the
24 application, a POSITA would have been determining
25 whether anti-aliasing is recommended for the scenario.

1 Is that correct?

2 A. In real life-type applications that involve
3 real life-type imagery, anti-aliasing is practically and
4 technically recommended before downsampling to prevent
5 the objectionable artifacts of aliasing.

6 Q. Were there image analysis operations that can
7 tolerate aliasing?

8 A. I don't know what you mean.

9 Q. What's confusing about that question?

10 A. I don't know what you're asking. You know,
11 aliasing is an artifact that you're introducing into the
12 imagery that you typically do not want to introduce.
13 It's like saying "Can I put a lot of noise in the image
14 and see if I can work on it?" Well, theoretically
15 speaking, I guess you could try that, but practically
16 and technically, anti-aliasing would be recommended on
17 real-life imagery prior to downsampling to prevent the
18 objectionable artifacts of aliasing.

19 Q. Were there any image analysis operations that
20 can be successfully performed on images with aliasing
21 effect?

22 MR. SNADER: Objection; calls for
23 speculation.

24 A. Well, again, I mean, is it possible to do
25 something? You'd have to show me what specifically are

1 you doing, what exactly is being done. So you're asking
2 a very general question.

3 Could it be possible to do something? If I
4 take a picture of a white piece of paper, I suppose I
5 can downsample it without too much aliasing, because it
6 has very low frequency content. But I think your
7 question is too general, too vague, and doesn't consider
8 the complexity of the applications that we're talking
9 about here.

10 Q. So you cannot tell me whether there were any
11 image analysis operations that can be successfully
12 performed on images with aliasing effect.

13 MR. SNADER: Objection; mischaracterizes
14 prior testimony.

15 A. Again, I would have to sit down and look and
16 see if there is one potential application out there that
17 does that. But for the context of what we are talking
18 about here and the applications that we're talking about
19 here, anti-aliasing would be technically recommended
20 prior to downsampling the imagery, especially in the
21 audience measurement-type systems where the cameras are
22 a certain distance from the subjects.

23 Q. How does the aliasing effect depend on the
24 distance of the camera from the audience?

25 A. Well, if I -- if my face is 10 meters away

1 from the camera, it's going to be a lot smaller than if
2 my face is 5 meters away from the camera or 2 meters
3 away from the camera. So the farther my space is
4 away -- my face is away from the camera, the smaller it
5 is in the view -- field of view of the camera, the more
6 aliasing artifacts would cause issues, because I have
7 less pixels across my face in that image.

8 Q. For a high-resolution image that has a large
9 number of pixels for the face, the aliasing effect would
10 be less likely to have -- to impact image analysis. Is
11 that correct?

12 MR. SNADER: Objection; incomplete
13 hypothetical.

14 A. Well, aliasing is undesirable at any
15 distance. It is more pronounced as you move, let's say,
16 the face away from the camera. So you're going to have
17 more pronounced aliasing, let's say, for the face if you
18 move it away from the camera. But it's still
19 objectionable -- it's undesirable at any distance. You
20 don't want to introduce aliasing into the imagery,
21 because that introduces objectionable artifacts that
22 could cause issues and interfere with your feature
23 detection algorithms.

24 Q. But when you have a high resolution for the
25 face region, the undesirable aliasing effect will have a

1 lower impact for analysis tasks, correct?

2 MR. SNADER: Objection; asked and answered.
3 Objection; incomplete hypothetical.

4 A. Again, I think I've answered that question.
5 So whether you have a high resolution or a lower
6 resolution, aliasing artifacts are not desirable. Even
7 at a higher resolution, if you introduce aliasing by
8 subsampling the image, that's going to interfere in your
9 feature detection processes and cause errors and issues.
10 You don't -- it's undesirable to introduce aliasing at
11 any level in your processing.

12 Q. Dr. Saber, would you like to take a break,
13 since it has been another hour since the last one?

14 A. That would be fantastic. How about I'm back
15 in my seat at 12:45?

16 Q. Yep. That sounds good.

17 A. Thank you very much.

18 Q. Thank you.

19 (Off the record: 9:39 a.m. to 9:46 a.m.)

20 MR. QIU: Let's go back on the record.

21 Q. Dr. Saber, are you familiar with the
22 '243 patent?

23 A. Yes, I am.

24 Q. Does the '243 patent mention the concept of
25 anti-aliasing?

1 A. Well, the word "anti-aliasing" doesn't appear
2 directly in the patent. But as you notice, the patent,
3 in Column 11, discussing a process of binning to
4 increase contrast.

5 Q. Is binning a technique for anti-aliasing?

6 A. Well, it's -- as you look -- if you look at
7 Column 11, starting on line 10, you see it says "Binning
8 is a process in which a neighborhood of pixels, e.g., a
9 first pixel and a number of adjacent pixels, is summed
10 together. Example binning procedures sum pixels
11 according to a two-by-two neighborhood of pixels,"
12 et cetera.

13 So when you're summing pixels together,
14 you're essentially applying, like, a blurring operation,
15 which essentially reduces the high-frequency content in
16 the image.

17 Q. So I take that as meaning binning is a
18 technique for anti-aliasing. Is that correct?

19 A. Well, it's being applied here for a specific
20 purpose, to increase contrast. But as you add the
21 pixels together in a two-by-two neighborhood or a
22 three-by-three neighborhood -- when you add them
23 together and you get a sum, that essentially amounts to
24 an amount of blurring, which essentially has equivalence
25 to anti-aliasing.

1 Q. Do you need to perform prefiltering before
2 pixel binning?

3 A. Obviously it's not being done in here. So
4 pixel binning is a form of filtering. So technically
5 speaking, it's a form of filtering to increase contrast
6 in a low illumination-type of imagery.

7 Q. Does binning reduce the resolution of the
8 image?

9 A. Well, technically speaking, you are adding a
10 two-by-two neighborhood of pixels together, in a sense,
11 to increase the contrast. So you are going to blur the
12 imagery by -- you can introduce, essentially, a level of
13 blurring by the addition, but that's being done for a
14 purpose here, because the imagery is captured at low
15 illumination or minimal illumination, and you're trying
16 to increase the amount of illumination, so...

17 Q. So does binning reduce the resolution of the
18 image?

19 A. Well, you're not technically reducing the
20 resolution unless you go ahead and follow up with
21 subsampling. But you're -- when you're doing the
22 binning, you're essentially trying to increase the
23 contrast, leaving the spatial size of the image
24 essentially the same. So if you -- let me -- if you --
25 the way it's being applied here...

1 Now, when you -- the way it's being applied
2 here, in a sense, you're adding a two-by-two
3 neighborhood together and providing one pixel for the
4 two-by-two. So that essentially will reduce the
5 resolution.

6 So you see on Column 11 -- I'm looking at
7 lines 18 to 23-ish or so. So the way it's being applied
8 there -- you can see "The additional light per block
9 pixel increases the contrast level of the image data.
10 After the pixel procedure performed by the example pixel
11 binner of Figure 3, the frames are of lower resolution."

12 So the way they're performing it here,
13 they're summing the two-by-two or the three-by-three,
14 and they're getting one sum value that represents that
15 two-by-two block, in a sense.

16 Q. If you reduce the resolution of the image
17 using binning, you do not need a separate anti-aliasing
18 step, correct?

19 A. So essentially, I mean, you have to consider
20 the application. So when you're summing the two-by-two,
21 you're adding up all four pixels. If you were to divide
22 that by four, it would be averaging. So if you just
23 summed all four pixels, you essentially are applying,
24 like, a blurring operation. But since you're not
25 dividing by four, you're not averaging. That blurring

1 operation is essentially reducing the, you know,
2 potential anti-aliasing.

3 But the point that you're trying to get at
4 here is you're trying to increase the contrast by
5 looking at four pixels in a two-by-two and getting,
6 you know, the light -- the illumination from all four of
7 them as much as you can.

8 Q. That doesn't quite answer my question. Let
9 me repeat my question.

10 If you reduce the resolution of the image
11 using binning, you do not need a separate anti-aliasing
12 step, correct?

13 A. Well, they're not utilizing a separate
14 anti-aliasing step here.

15 Q. Were head detection techniques known by 2011?

16 A. I missed the first part of your question.

17 Q. Let me repeat.

18 Were head detection techniques known by 2011?

19 A. Yes, they were.

20 I think sometimes when you step back from the
21 microphone I don't hear you as well.

22 Q. Okay. Let me make sure.

23 How do I sound now?

24 A. Right now you sound good.

25 Q. Okay. Thank you. I'll try to be louder.

1 Do you have experience working with head
2 detection?

3 A. Yes.

4 Q. What kind of experience do you have?

5 A. Well, that goes all the way back to the '90s.
6 I did some work on face recognition -- or face detection
7 back in the '90s. I think I have a publication way back
8 on that in the mid-'90s, perhaps. We've done a lot of
9 object tracking, which obviously involves faces, cars,
10 you know, various objects. So yes. We have worked in
11 this field -- I have worked in this field for many
12 years.

13 Q. Are there different methods for face
14 detection or head detection?

15 A. Of course.

16 Q. Can you please give me a list of such methods
17 that you can think of?

18 A. Well, there are tutorial papers that will
19 provide you with a complete list of that, so I can't
20 remember every possible one off the top of my head. But
21 obviously, you know, there are view-based techniques.
22 There are feature-based techniques. There are
23 geometric-based techniques. There are different
24 techniques.

25 So there are tutorial papers that will

1 provide you with, you know, a good summary of the
2 techniques that have been published in the field over
3 the years.

4 Q. Do different techniques have different levels
5 of computational complexity?

6 A. Certainly.

7 Q. Which method was a computationally complex
8 method?

9 MR. SNADER: Objection; vague and ambiguous.

10 A. Well, I mean, you would have to -- you know,
11 I'd have to see the details of the method to tell you
12 the computational -- I couldn't tell you off the top of
13 my head "Here's a listing of all methods in
14 computational priority order." I would have to see the
15 methodology, analyze what is being done, and then
16 discuss the computational complexity of it.

17 Q. Among the methods you listed, can you think
18 of any that's computationally relatively simple?

19 A. Well, that depends a lot on how it's being
20 done, how it's being applied. Even a technique such as
21 edge detection that could be simpler with one
22 implementation could be more complicated with another
23 implementation. So I could implement it using
24 convolutional kernels, which might be more expensive,
25 and somebody else might implement it using, you know,

1 frequency domain approaches.

2 So it depends on the technique. It depends
3 on the application that's being done. It depends on
4 whether it's floating-point operations or integer
5 operations or unsigned characters. There's a lot that
6 goes into this. It's not an easy question to answer.

7 Q. In preparing your declarations for this case,
8 did you look into the computational complexity of
9 different face detection methods?

10 A. I mean, I'm aware of, obviously, face
11 detection methods in general. I did not sit down and do
12 a computational complexity analysis.

13 Q. In general, is face detection computationally
14 complex?

15 MR. SNADER: Objection; vague and ambiguous.

16 A. Again, it depends on the technique that
17 you're utilizing -- that would dictate the level of
18 complexity of the technique -- and whether it's being
19 handled at different scales. Are you're normalizing?
20 Not normalizing? Are you rotating the face? There's a
21 lot of parameters that go into this. I think your
22 question is too general, vague, and not specific enough
23 to provide technical details.

24 Q. Why did you not perform a computational
25 complexity analysis when preparing your declarations?

1 A. It's not needed for my analysis.

2 Q. Why is it not needed for your analysis?

3 A. Well, I'm responding to a petition that the
4 petitioner put forth and the corresponding declaration
5 from Dr. Doermann, and I'm responding, essentially, to
6 that petition and that declaration, and that's -- that
7 was -- it's not essential for that to provide a
8 response.

9 Q. Is it your opinion that the computational
10 complexity of face detection is not at issue in this
11 case?

12 MR. SNADER: Objection; calls for legal
13 opinion.

14 A. So I'm not an attorney, so I don't -- I don't
15 believe I'm responding or have responded anywhere in my
16 declaration to a legal discussion.

17 Is there something specific in my declaration
18 that you are referring to? Let's be specific and
19 accurate.

20 Q. Let me reframe my question.

21 Is it your opinion that the computational
22 complexity of face detection is not relevant to the
23 opinions you rendered in your declarations?

24 A. Well, again, I'm responding to the petitioner
25 and Dr. Doermann's declaration in this particular case,

1 and I'm responding to their analysis. And my responses
2 are in my declarations, both the original and
3 supplemental.

4 Is there something specific in the
5 declaration that you're responding to so we can be
6 specific and accurate in the response? You're asking
7 too general of a question. It's hard to answer.

8 Q. Are there computations performed that's
9 common to different face detection methods?

10 MR. SNADER: Objection; vague and ambiguous.

11 A. I'm not sure I understand your question. Are
12 there computational methods that were what?

13 Q. Okay. Let me reframe my question.

14 Can you please open Exhibit 2034. You have a
15 paper copy, and I can upload it to the Zoom.

16 (Exhibit Number 2034 introduced.)

17 A. Please go ahead. Upload it. 2034?

18 Q. Yes.

19 A. So I'm going to step over here and look at
20 the three-ring binders to see what's in there.

21 So 2034. Have you uploaded it?

22 Q. Yes.

23 A. Okay. Let me go ahead and download it.

24 Yes. What about that exhibit?

25 Q. Can you please go to page 14. By

1 "page number," I am referring to the Bates number at the
2 lower right corner of the pages.

3 A. Page 14. Yes. Go ahead.

4 Q. At the bottom of page 14, there's a paragraph
5 starting with "Face detection" -- oh. Let me strike
6 that question.

7 You cited Exhibit 2034 in your declaration,
8 correct?

9 A. That is correct.

10 Q. What is this document?

11 A. The title of this document is called "Face
12 Recognition Algorithms."

13 Q. Do you agree with the disclosure of this
14 document?

15 A. What do you mean "do I agree"?

16 Q. So this document includes text. Do you agree
17 with the content of this document?

18 MR. SNADER: Objection; vague and ambiguous.

19 A. I don't know what you mean by "do I agree."
20 The document -- I agree that the document talks about
21 face recognition algorithms.

22 Q. Let's go to page 14. I'm talking about a
23 paragraph at the bottom of page 14. Please let me know
24 when you are there.

25 A. Okay. I am at page 14.

1 Q. There's a paragraph at the bottom starting
2 with "Face detection algorithms usually share common
3 steps."

4 A. Yes.

5 Q. And that goes into -- that paragraph goes
6 into page 15.

7 Can you please read this paragraph to
8 yourself and let me know when you're done.

9 A. Okay. So what is your question?

10 Q. This paragraph talks about some common steps
11 for face detection algorithms, correct?

12 A. Yes. Generally speaking, yes.

13 Q. Do you agree that the steps mentioned in the
14 paragraph are common steps for face detection
15 algorithms?

16 A. Well, generally speaking, I mean, from a
17 general perspective, yeah. That's -- they seem
18 reasonable.

19 Q. Okay. So the first step it mentioned is
20 "some data dimension reduction is done in order to
21 achieve a admissible response time." Is that correct?

22 A. Well, that's what he typically mentions as a
23 first step. There are algorithms that would have a
24 different first step.

25 Q. What does "data dimension reduction" mean?

1 A. Well, one way to characterize it -- I mean,
2 it depends, obviously, a lot on the application. But if
3 I have a space that's a hundred dimension and I want to
4 reduce it to a space that -- ten dimension, that would
5 be characterized as data dimension reduction. And
6 obviously, you want to do that carefully.

7 Q. The next sentence mentions pre-processing
8 being done as part of face detection, correct?

9 MR. SNADER: Objection; mischaracterizes the
10 document.

11 A. I don't know which sentence you're talking
12 about.

13 Q. Okay. The paragraph includes the sentence
14 "Some pre-processing could also be done to adapt the
15 input image to the algorithm prerequisites," correct?

16 A. You read that correctly. Your previous
17 statement of that was incorrect, but now you've read it
18 correctly.

19 Q. What does "pre-processing" mean?

20 A. Technically, pre-processing is usually
21 referred to as some prior processing before you get into
22 your meat of your application, in a sense. In this
23 case, it could be, for instance, doing histogram
24 equalization to improve the quality of the image or
25 normalization, that kind of thing. So you're doing some

1 pre-processing to try to improve your face detection, in
2 a sense.

3 Q. I'm not familiar with histogram equalization.
4 Can you please explain what computations are involved in
5 there?

6 A. Well, if, for instance, your image -- the
7 image that you are taking is dark -- let's just say the
8 camera took the image. There wasn't enough
9 illumination. The image is dark. So when you look at
10 the histogram -- let's just talk grayscale for now.
11 You're looking at a histogram of an image, and the
12 grayscale is zero to 255. Maybe most of the pixels
13 appear between zero and 50, let's just say.

14 So then what you want to do -- so obviously,
15 the image is dark. To make it more attractive to your
16 remaining algorithms and improve your chances and
17 increase your accuracy, you might take that histogram
18 and stretch it across the image a little bit more,
19 essentially bringing some of those pixels into higher
20 gray values so that you can get a better -- you know,
21 equalize the histogram across the image so that it's not
22 bunched in the lower, you know, zero to 50 gray levels.

23 It's a very common technique for image
24 processing.

25 Q. What computations are involved in

1 normalization?

2 A. What do you mean by -- what normalization are
3 you talking about?

4 Q. You mentioned normalization in your previous
5 answer as one of the pre-processing steps.

6 A. Yes. So if you're trying to normalize --
7 you know, faces appear in images at different distances.
8 Right? So my face is rotated. It could be this way,
9 that way. It could be way back here, way up here, which
10 has different scale to it, different rotations in and
11 out of the image plane, different rotations up and down.
12 So faces appear in different orientations, in a sense,
13 in the image.

14 To increase your accuracy of face detection,
15 you might want to try to normalize some of that. To
16 increase your accuracy, let's say, of face recognition,
17 you might want to get the face to a certain scale and a
18 certain viewpoint in the imagery. Maybe I want it
19 straight on and roughly X size of the image.

20 Q. The paragraph then -- I'm talking about the
21 paragraph at the bottom of page 14 and the beginning of
22 page 15 of Exhibit 2034. That paragraph includes the
23 sentence "The next phase usually involves extracting
24 facial features or measurements," correct?

25 A. That is correct. You read that correctly.

1 Q. How were facial feature extraction performed
2 back in 2011?

3 A. Well, it depends on what facial features are
4 you targeting with your algorithms. I may -- it depends
5 on what facial features are you targeting.

6 Q. What are some facial features that are
7 targeted?

8 A. Well, edges of the face, corners, pupils of
9 the eye, tip of the nose, corners of the mouth,
10 eyebrows.

11 Q. How do you extract a facial feature such as
12 edges of the face?

13 A. Well, if you're looking for generic edges,
14 you would utilize an edge-detection algorithm.

15 Q. How does an edge-detection algorithm work?

16 A. Well, there are many different types of
17 edge-detection algorithms. So probably the simplest one
18 for this discussion would be a gradient-based edge
19 detection.

20 Q. Okay. How does a gradient-based
21 edge-detection algorithm work?

22 A. Well, you're looking for changes in grayscale
23 values. So as you're -- let's say you have a smooth
24 surface and then it changes to a different surface. So
25 that drop has a high derivative to it, high gradient.

1 So you're looking for that -- you know, "gradient" is
2 defined as partial -- if I assume the image is
3 function F -- let's assume the image is a function FMN
4 or XY . The gradient would be defined as the partial
5 derivative of F with respect to X and a partial
6 derivative of F with respect to Y . So essentially, the
7 derivative in each dimension, you're looking for higher
8 derivative values, which would indicate rapid changes.

9 Q. Do you look for edges in the whole image? Or
10 do you look for it at local areas within the image?

11 MR. SNADER: Objection; vague and ambiguous.

12 A. Well, it depends on the application of what
13 you would look for, but typically you would do edge
14 detection across the entire frame or image. Because you
15 don't know where the face is in the image, so you would
16 have to perform edge detection, but if, you know --
17 typically -- generally speaking -- I mean, I would have
18 to see the application and the specifics of it, but
19 generally speaking, you would perform edge detection
20 across the entire image.

21 Q. Does edge detection include defining windows
22 in the image and looking within the windows?

23 A. You could. Again, it depends on the
24 application whether you would define windows or not. It
25 depends on what are you trying to do. If I'm looking at

1 an anchor scene where I know the anchor is in the middle
2 of the picture all the time, I may focus that more on
3 the middle of the picture. It depends on the
4 application.

5 Q. When you detect edges within the entire
6 image, do you single out local areas and analyze them
7 one at a time?

8 A. I didn't understand the first part of your
9 question. You cut out on the first part of your
10 question.

11 Q. Sorry. Let me repeat.

12 A. You're too far from the microphone, perhaps.

13 Q. When you detect edges within the entire
14 image, do you single out local areas and analyze them
15 one at a time?

16 A. So when you detect edges in the entire image,
17 you have an edge map, in a sense. You have a gradient
18 map, in a sense, which you would convert -- depending on
19 the application and what you're trying to do. But
20 typically you would convert that into an edge map where
21 you would say anything above a threshold of alpha is
22 considered to be an edge. So you take the gradient map
23 and convert it into an edge map.

24 Q. How do you generate a gradient map?

25 A. You perform filtering across the image using

1 properly designed filters, you know.

2 Q. Does the generation of the gradient map
3 include analyzing all the pixels in the image?

4 A. Yes. You would have to basically run the --
5 you'd run your algorithm across the entire image for you
6 to be able to, you know, determine the gradient. You
7 would take your kernel of gradient, and you would run
8 that across the entire image. In the X -- for the
9 partial with respect to X, you would have to run that
10 across the entire image, and for the partial with
11 respect to Y, you have to also do the same thing to get
12 both directions, in a sense, or -- and there are edge
13 operators that do that.

14 Q. Does edge detection -- strike that.

15 Edge detection includes processing each pixel
16 of an image multiple times, correct?

17 MR. SNADER: Objection; asked and answered.

18 A. So if you're using, for instance, a Sobel
19 operator, one of the edge detectors -- say you're using
20 a three-by-three kernel. That three-by-three kernel,
21 you would use that in a sliding window across the entire
22 image in row-to-column format. So every time you place
23 it -- let's say it's three-by-three. You're multiply --
24 you're doing nine multiplications and eight additions to
25 get the value for the center pixel. Then you would move

1 over by one. You would do again nine multiplications
2 and eight additions to get the next value.

3 So pixels are involved in that basically -- a
4 given pixel could be involved -- depending on the size
5 of the window, it could be involved in multiplication
6 and addition more than once.

7 Q. In performing that computation, is the amount
8 of computation proportional to the number of pixels in
9 the image?

10 A. Well, maybe you didn't understand my answer
11 correctly.

12 So as I'm taking the three-by-three window
13 across the entire image -- so if the image is
14 512-by-512, it would be so many operations. If the
15 image is 1024-by-1024, obviously it's going to be a lot
16 more operations because it's a bigger image. So it's
17 related to the size of the image and the size of the
18 kernel.

19 Q. Based on the edges, how do you determine a
20 person's face?

21 A. Well, if you performed edge detection, you
22 now have the edges. You now have to start modeling
23 these edges. Like, a person's face might be -- have a
24 model like, say, closer in the lips, in a sense, an
25 elliptical kind of shape. Like, if you look at mine,

1 it's probably more elliptically oriented than yours,
2 because the top of the head doesn't have a lot of hair.

3 So it depends on -- you know, you would have
4 to start modeling, like, what is the -- what is the
5 shape of the object I'm looking for. So you have to do
6 some edge linking and start modeling that edge map, in a
7 sense, to see if it matches the models of what you are
8 looking for.

9 Q. Are there other types of feature extraction
10 methods for face detection?

11 A. Of course. Besides edge maps -- besides edge
12 detection, you mean?

13 Q. That's correct.

14 A. Yes.

15 Q. What are other methods?

16 A. Well, if you look at the paper that you just,
17 for instance -- I mean, there are geometric
18 feature-based methods. There are a viewpoint-based
19 methods. There are -- based methods. There are
20 structural-based -- there is all sorts of others.

21 Q. Do different types of feature extraction
22 generally require processing all the pixels in the
23 image?

24 MR. SNADER: Objection; vague and ambiguous.

25 A. So I'm not sure what you -- what you're

1 trying to ask here. But if I'm looking for a face in an
2 image, I would have to process the frame or the image to
3 see where that face is located, unless, you know, I'm
4 looking, let's say, at an anchor scene or somebody is
5 telling me "Well, it's only located in this location."
6 But generally speaking, you are processing the entire
7 frame or image to find the face, detect, and then
8 recognize.

9 Q. So the answer is yes, correct?

10 MR. SNADER: Objection; mischaracterizes
11 testimony.

12 A. What was your question exactly again, please?
13 Could you repeat it?

14 Q. Do feature extraction techniques generally
15 require processing all the pixels in the image?

16 A. Generally speaking, for applications, that's
17 a yes. But you'd have to give me more specifics of a
18 given application, what are the exact circumstances,
19 what are the details, so we can provide specifics for
20 that particular instance. But generally speaking, you
21 would have to process the pixels in the image to detect
22 the face.

23 Q. And for most of these -- sorry. Strike my
24 question. Let me rephrase.

25 Feature extraction techniques generally

1 require processing all the pixels in the image multiple
2 times, correct?

3 A. Well, it depends on the features that we're
4 talking about. I think you're asking too general of
5 questions that are very hard to answer. It depends on
6 the technique and the application, what's being done.

7 You know, as I explained to you, if you're
8 doing edge detection, you need to process both the
9 horizontal, let's say, Prewitt operators or Sobel
10 operators and then the vertical Sobel or Prewitt
11 operators. So you'd have to process the horizontal and
12 vertical to get to the gradient and then compute the
13 gradient manually.

14 Q. Is any feature extraction method
15 computationally more simple than the edge-detection
16 method you mentioned?

17 A. I don't know what you mean "is any." Well,
18 different techniques have different computational
19 complexity associated with them. I don't know what you
20 mean "is any." I think your questions are too vague,
21 sir.

22 Q. Can you give me an example feature extraction
23 method that's computationally more simple than the
24 edge-detection method you mentioned?

25 A. Well, if I am, for instance, looking for a

1 corner, I may use a filter of a certain size, a
2 five-by-five, run that across the image, and that's
3 going to detect corners across the entire image. But
4 that's only going to give me points that have changes of
5 gradient in both directions.

6 Q. How is that simpler than the edge-detection
7 method you talked about?

8 A. Well, that would be one template, say, a
9 five-by-five running across the image, versus two
10 three-by-three to get the horizontal and vertical edges.

11 So it depends on, essentially, what you're
12 looking for. I think you have to be more specific with
13 details.

14 Q. What kind of computation do you need within a
15 five-by-five kernel?

16 A. Well, if you're doing a five-by-five kernel
17 with floating-point operations, you will need 25 if --
18 you're doing a convolution, you will need
19 25 multiplications and 24 additions for every pixel you
20 place that kernel over. With a five-by-five, when you
21 flip the kernel over, you would have to multiply
22 25 times and add 24 times and then divide by 25.

23 Q. So you'd perform a convolution within each
24 kernel?

25 A. That's generally the case. Yes.

1 Q. And there's a kernel for each pixel?

2 A. It's the same kernel that you slide across
3 the whole image. So the kernel values are the same.
4 You're sliding them across the entire image and are
5 asked to scan -- to compute the output given -- the
6 input is the image. The filter is your kernel. And the
7 outputs -- so the input is XMN. The filter is HMN. The
8 output will be YMN. For you to get YMN, you will have
9 to pass that HMN across the entire image in
10 rest-to-scan, sliding from left to right and top to
11 bottom.

12 Q. This includes computing -- strike that.

13 This includes computing a convolution for
14 each pixel in the image, correct?

15 MR. SNADER: Objection; vague and ambiguous.

16 A. I mean, I'm not sure what you're asking
17 exactly. But if you were to compute a convolution all
18 across correlation for a particular image with a
19 particular filter, you would have to slide that filter
20 across the entire image in rest-to-scan left to right,
21 top to bottom to compute the output.

22 Q. The amount of computing resources for
23 performing this computation is proportional to the
24 number of pixels in the image, correct?

25 A. In a way, yes. I mean, obviously the more

1 pixels -- the larger the image, the more computation.

2 MR. SNADER: Counsel, if you've got a good
3 stopping point coming up, maybe we could take a lunch
4 break.

5 MR. QIU: Okay. Let me finish -- I probably
6 have two or three questions in this line of questioning.

7 MR. SNADER: Sure.

8 Q. Let's go back to Exhibit 2034.

9 A. Yes, sir.

10 Q. The paragraph at the bottom of page 14, top
11 of page 15 includes the sentence "The next phase usually
12 involves extracting facial features or measurements,"
13 correct -- oh. Sorry. I'm looking at the wrong
14 sentence.

15 The next sentence states "These will then be
16 weighted, evaluated, or compared to decide if there is a
17 face and where is it." That sentence is in the
18 paragraph, correct?

19 A. You read it correctly.

20 Q. What does that step entail?

21 A. So if you read the paragraph -- and obviously
22 this is very general. So this paragraph is a general,
23 high, high overview description.

24 So you see he says -- if you step back a
25 couple of sentences, you see it says -- where it starts

1 with "then." "Then some algorithms analyze the image as
2 it is, and some others try to extract certain relevant
3 facial regions."

4 Then the next sentence you pointed to says
5 "The next phase usually involves extracting facial
6 features or measurements."

7 So you've extracted facial features, pupils
8 of the eyes, corners of the eyes, tip of the nose,
9 corners of the mouth, that kind of thing. These are
10 examples, obviously. And you might have collected some
11 measurements, like the distance between, you know, the
12 pupils of the eyes or corners of the mouth or whatever.
13 You've completed some measurements.

14 These will then be weighted. So you're going
15 to weight these, because typically pixels on the outside
16 of the face -- because I could have a beard on my face
17 and the next day I don't have to have a beard. So
18 pixels on the outside of the face typically change more
19 drastically than pixels on the inside of my face.

20 So, for instance, if you look at the -- like,
21 the triangle, as we sometimes refer to it, the eyes and
22 the nose and the mouth. That part of your face -- at
23 least the eyes and the nose don't change that much. You
24 could grow a mustache, obviously, but the eyes and the
25 nose are typically the same -- much harder to change

1 than the peripheral of the face. So you have to
2 properly weight things, evaluate, and compare to decide
3 to see whether this is a face and where it is in the
4 image.

5 Q. Were head orientation determination
6 techniques known by 2011?

7 A. Head orientation determination?

8 Q. Correct.

9 A. Yes.

10 Q. Does head orientation determination depend on
11 features extracted on an image?

12 MR. SNADER: Objection; vague and ambiguous.

13 A. Well, if your algorithm is involving features
14 to detect the head, then it would depend on those set of
15 features to detect the head and the orientation of the
16 head. I think your question is too general and vague.

17 Q. Do you know of any head orientation
18 determination method that does not depend on feature
19 extraction?

20 A. Well, neural network-type techniques usually
21 have a different type of approach to them. They still
22 depend on some kind of features, but they're generally a
23 little different where you have potentially -- if you're
24 doing a supervised type of thing, you've shown the
25 network some input, the corresponding output, and you

1 have essentially tried to converge the network to give
2 you that kind of thing, it still has to depend on
3 features, in a sense. You need to have some type of
4 features to start with, whether it's the pixel gray
5 levels themselves or edges or corners or whatever. But
6 you need to have some type of features. Different
7 algorithms have different ways of analyzing those
8 features.

9 MR. QIU: Okay. I think we can take the
10 lunch break.

11 Can we have a short lunch break, since
12 Dr. Saber, you -- we understand you need to leave by
13 5:00 p.m. your time.

14 THE WITNESS: Yes. I have a hard stop at
15 5:00 p.m.

16 How long of a break would you like?

17 MR. QIU: Will a half-hour break be
18 acceptable?

19 THE WITNESS: Perfect. So I will be sitting
20 in my chair at 2:15.

21 MR. QIU: Okay.

22 THE WITNESS: Thank you.

23 MR. QIU: Thank you.

24 (Off the record: 10:46 a.m. to 11:15 a.m.)

25 THE REPORTER: We're back on the record.

1 Q. Dr. Saber, did you communicate with anyone
2 during the lunch break?

3 A. No, I did not.

4 Q. Did you communicate with anyone during the
5 previous two breaks?

6 A. No, I have not.

7 Q. Can you please open Exhibit 1001, which is
8 the '243 patent.

9 (Exhibit Number 1001 introduced.)

10 A. Okay. I have that open.

11 Are we done with Exhibit 2034?

12 Q. I may use it later, but I think you can put
13 it away for now.

14 A. Okay.

15 Q. Thank you.

16 Can you please go to Column 15 and line 54 of
17 the '243 patent.

18 A. Column 15, line 54.

19 Q. Can you please read Claim 4 to yourself, and
20 let me know when you are done.

21 A. I have read Claim 4.

22 Q. Have you reviewed this claim before?

23 A. Yes, I have.

24 Q. Are you familiar with this claim?

25 A. Yes, I am.

1 Q. And this claim is one of the claims at issue
2 in this IPR, correct?

3 A. That is correct.

4 Q. Do you see that this claim states "Reduce a
5 resolution of a first image of the one or more images"?

6 A. Yes, I see that.

7 Q. Is it your opinion that Claim 4 requires
8 anti-aliasing?

9 A. Claim 4 states that it reduces a resolution
10 of a first image.

11 Q. That doesn't answer my question. My question
12 is: Is it your opinion that Claim 4 requires
13 anti-aliasing?

14 A. Well, the claim states that it reduces a
15 resolution. So any technique that would reduce a
16 resolution would meet the claim element. It reduces a
17 resolution.

18 Q. So that still doesn't answer my question.
19 Let me try it again.

20 Does Claim 4 require anti-aliasing?

21 A. Well, the claim doesn't have the words
22 "anti-aliasing" in it. The claim element just says
23 "reduce a resolution of a first image."

24 Q. So is that a yes or no?

25 A. Well, again, the claim doesn't -- the words

1 "anti-aliasing" are not part of the claim element. The
2 claim element just states "reduce a resolution."

3 Q. So I'm not -- so I'm not asking whether the
4 claim includes the words. I'm asking, in your opinion,
5 does Claim 4 require anti-aliasing?

6 A. As I said, the claim -- the words
7 "anti-aliasing" are not part of the claim element, so
8 they're not there in the claim. The claim element just
9 states you reduce a resolution.

10 Q. So Claim 4 does not require anti-aliasing.

11 MR. SNADER: Objection; asked and answered.

12 Q. Is that correct?

13 MR. SNADER: Objection; asked and answered.

14 A. As I stated, the words "anti-aliasing" are
15 not part of the claim element. So it doesn't say
16 anything about anti-aliasing. All it says is "reduce a
17 resolution."

18 Q. In your view, can Claim 4 be met without
19 performing anti-aliasing?

20 A. Well, if you reduce the resolution, you've
21 met the claim element. There are obviously different
22 ways of doing the resolution. The resolution would
23 be -- have better quality how you've done it. But if
24 you reduce the resolution, you've met the claim element,
25 on a first image.

1 Q. So if you reduce the resolution without
2 performing anti-aliasing, that would meet the
3 requirement of Claim 4, correct?

4 A. Well, I'm not, obviously, an attorney. But
5 if you reduce the resolution, however you've done it, it
6 would meet the claim element. But if you've done it
7 without doing the proper steps, obviously you're not --
8 the result isn't going to be as accurate then.

9 Q. Can you reduce resolution without performing
10 anti-aliasing?

11 A. Yes. I can just pick a pixel out of every
12 four and reduce the resolution. But obviously the
13 result of that would, as we discussed earlier
14 extensively -- would introduce aliasing artifacts in the
15 imagery.

16 Q. Bilinear interpolation is a method for
17 reducing the resolution of an image, correct?

18 A. Well, technically speaking, bilinear
19 interpolation is an interpolation technique. You can
20 use it to reduce a resolution, but technically speaking,
21 it's -- it's basically linear interpolation in
22 two-dimension. That's why it's called bilinear.

23 Q. What kind of computations are involved in
24 bilinear interpolation?

25 A. Well, if you look at the 1D version, linear

1 interpolation means I have a point on the left end. I
2 have a point on the right end. I fit a line between
3 those two points, and then I can interpolate between
4 them using that equation of that line. So that would be
5 the 1D version. So I have two points. I fit a line
6 between them. And then I can interpolate using that
7 line in between the two points in a one-dimensional,
8 let's say, signal.

9 In 2D, bilinear would involve fitting a plane
10 to four points and then interpolating essentially on the
11 surface of the plane.

12 Q. Does that include adding the four points up?

13 A. Well, it's not quite adding the four points
14 up, because it depends where -- how close you are to one
15 of the points or both of the points. So you would have
16 to weight your interpolation based on your proximity to
17 the four corners of those -- of the points, your
18 proximity to the points.

19 Q. Let me see if I understand this correctly.

20 Does that include making four computations on
21 multiplication and one addition?

22 A. No. You would have to weight -- so if I've
23 got four points and I want to interpolate a point in
24 between those four, I would need to know the distance of
25 that point to each of those four. That would be inverse

1 proportional to my weighting. And when I weight them, I
2 can basically have multiplications -- four
3 multiplications and three additions.

4 Q. By 2011, would a POSITA have been able to use
5 pixel binning to reduce the resolution of an image?

6 A. Say that again.

7 Q. By 2011, would a POSITA have been able to use
8 pixel binning to reduce the resolution of an image?

9 A. Well, if you're stating pixel binning as
10 meaning adding four pixels together and essentially
11 summing them or summing them and dividing by four, yes,
12 a POSITA would know how to do that.

13 Q. And according to your description of the
14 pixel binning method of adding four pixels together,
15 does that include three summation operations?

16 A. Yes. If you're just strictly adding them
17 together, yes.

18 Q. Generally, is face detection computationally
19 more complex than downsampling?

20 MR. SNADER: Objection; vague and ambiguous.

21 A. I didn't follow your question. Can you
22 rephrase?

23 Q. Sure.

24 I'm asking about the relative computational
25 complexity of two operations. One operation is face

1 detection. Another operation is downsampling.

2 And that question is: Is face detection
3 generally computationally more complex than
4 downsampling?

5 A. So your question is too general. So if
6 you're saying downsampling is just picking one out of
7 every four pixels -- that's downsampling -- that would
8 be relatively easier than doing face detection. But I
9 would have to see exactly what the algorithms are
10 specifically to be able to comment with specifics.

11 Q. Taking your example where downsampling means
12 sampling or taking one out of every four pixels, is that
13 significantly more simple than most face detection
14 methods?

15 A. Generally speaking, it's fairly simple for
16 you to skip every other pixel in the horizontal and
17 vertical direction and just select one.

18 Q. How about the computational complexity of
19 face detection versus pixel binning?

20 MR. SNADER: Objection; vague and ambiguous.

21 A. So if pixel binning is defined as the
22 addition of four pixels and computing the sum, then that
23 would be relatively easier than a face detection
24 algorithm, generally speaking. But, again, we would
25 have to see the details of exactly what you're doing to

1 provide specifics and, you know, accurate technical
2 discussions.

3 Q. How about the relative computational
4 complexity of face detection versus bilinear
5 interpolation?

6 MR. SNADER: Objection; vague and ambiguous.

7 A. Again, for you to do this technically
8 accurately, you would have to know exactly the steps of
9 how it's being done and who is doing it and how the
10 algorithm is doing it. But generally speaking, bilinear
11 interpolation would be relatively easier to do than face
12 detection, generally speaking. But, again, I would have
13 to see the details of the algorithms to be able to give
14 you specific computational complexities.

15 Q. Next, I want to ask about the computational
16 complexity of post estimation or face orientation
17 determination. How does the computational complexity of
18 post estimation compare to that of subsampling?

19 MR. SNADER: Objection; vague and ambiguous.

20 A. I don't know what you mean by "post
21 estimation." What are you estimating? What is -- post
22 what? Your question is too vague, sir.

23 Q. Let me use another word.

24 How does the computational complexity of face
25 orientation determination compare with subsampling an

1 image to reduce its resolution?

2 MR. SNADER: Objection; vague and ambiguous.

3 A. Again, to be specific and accurate, you would
4 have to look at the algorithm details specifically. But
5 face orientation determination would be, relatively
6 speaking, more complex than subsampling. But, again,
7 I'd have to see the details of what exactly the
8 algorithms are doing, how it's being done to comment
9 with specifically on that -- with specificity on it.

10 Q. How does the computational complexity of face
11 orientation determination compare with pixel binning?

12 MR. SNADER: Objection; vague and ambiguous.

13 A. Again, I mean, generally speaking, to be
14 accurate, I would have to see the exact algorithms. But
15 pixel binning, if you're just summing four pixels, it
16 would be relatively easier computationally-wise than
17 face orientation detection.

18 Q. How does the computational complexity of face
19 orientation determination compare with bilinear
20 interpolation?

21 MR. SNADER: Objection; vague and ambiguous.

22 A. Again, the same answer as before. I would
23 need to see the details of the algorithms to give you
24 things more specific. But bilinear interpolation would
25 probably relatively be easier -- if it's properly

1 implemented, it would probably be easily -- easier than
2 face orientation determination.

3 Q. How does the computational complexity of face
4 detection compare with anti-aliasing?

5 MR. SNADER: Objection; vague and ambiguous.

6 A. Again, the same answer. I mean, it depends
7 on what you are detecting, how you -- if I'm just
8 detecting front-based faces with one convolutional
9 kernel -- so it depends on how the algorithms are
10 structured and implemented. So it's hard to answer that
11 question with specifics. I would need to see the
12 details of the algorithms to give you exact answers with
13 specificity.

14 Q. How does the computational complexity of face
15 orientation determination compare with anti-aliasing
16 techniques?

17 MR. SNADER: Objection; vague and ambiguous.
18 Objection; asked and answered, I believe.

19 A. So, I mean, again, you would need -- I would
20 need to have specifics to answer. You're asking very
21 general questions of a very general nature. You know,
22 am I looking at the face orientation for one
23 orientation? Am I looking for two? Am I looking for
24 1 degree orientation steps from all the way 360?

25 So I need to see specifics to discuss details

1 compared to other techniques and discuss the details of
2 those algorithms. So it's hard to say directly "this is
3 what it would be." It depends a lot on what you're
4 doing, what exactly are the steps of the algorithms.

5 Q. Taking face detection in an audience
6 measurement scenario, for example, how does the
7 computational complexity of the face detection in that
8 scenario compare with that of prefiltering for
9 anti-aliasing?

10 A. I didn't get the first part of your question.
11 You broke up.

12 Q. Taking face detection for audience
13 measurement in a living room, for example, how does --

14 A. What kind of measurement? For what?

15 Q. Face detection.

16 A. Yes. For audience measurement, okay.

17 Q. Audience measurement.

18 A. Okay.

19 Q. Taking that example, how does the
20 computational complexity of face detection compare with
21 that of low-pass filtering for anti-aliasing?

22 A. Well, I would need to see what the
23 algorithms -- the details of the algorithms that you are
24 applying, what conditions you're applying them in,
25 what -- are you detecting the faces for any orientation,

1 a single orientation? So there's a lot of specifics in
2 these questions. You need to know the specifics to
3 really give a proper answer to these questions.

4 Q. Are you familiar with the Tian reference,
5 which is Exhibit 1005?

6 (Exhibit Number 1005 introduced.)

7 A. Yes, I am.

8 Q. What is this reference about?

9 A. Do you want -- I don't believe you've
10 uploaded that reference. Would you like to upload it,
11 please.

12 Q. Yeah. I'm doing it now.

13 A. I have the reference.

14 Q. What is the Tian reference about?

15 A. Well, if you look at the title, it says
16 "Evaluation of Face Resolution for Expression Analysis."

17 Q. Tian teaches using the Cohn-Kanade face
18 expression database. Is that correct?

19 A. Tian is referring to the Cohn-Kanade
20 database. That is correct.

21 Q. Is it your understanding that this database
22 includes images in five different resolutions?

23 A. Well, if you look at Table 1 of Tian, Tian
24 states that "An example in five different resolutions
25 from the Cohn-Kanade database." So a POSITA reading

1 that would understand that Tian is providing an example
2 in five different resolutions from the Cohn-Kanade
3 database.

4 Q. And based on this understanding, you believe
5 Tian does not teach the process of reducing the
6 resolution of an image. Is that correct?

7 MR. SNADER: Objection; mischaracterizes
8 testimony.

9 A. Well, as I mentioned to you, Tian says "An
10 example in five different resolutions from the
11 Cohn-Kanade database." Tian does not teach -- does not
12 provide a system or circuitry or any hardware or
13 algorithms to perform different -- to convert the
14 different resolutions. Tian makes a statement "An
15 example in five different resolutions from the
16 Cohn-Kanade database."

17 Q. Are you familiar with the Cohn-Kanade
18 database?

19 A. Yes, I am. I mean, I understand the database
20 has obviously facial expression -- facial expressions.

21 Q. Did you know this database before your
22 engagement on this case?

23 A. Well --

24 MR. SNADER: Objection; scope.

25 A. I don't remember off the top of my head if I

1 ran across it at some point in time. I don't remember.

2 Q. Where did you get your knowledge about this
3 database?

4 MR. SNADER: Objection; scope.

5 A. Well, obviously Petitioner has filed a
6 petition in this case with a declaration from
7 Dr. Doermann. I am responding to that petition with the
8 proper analysis.

9 Q. So you got your knowledge about the database
10 based on your analysis of Dr. Doermann's declaration?

11 MR. SNADER: Objection; mischaracterizes
12 testimony.

13 A. Again, I don't remember off the top of my
14 head whether I've ran across the database before. It's
15 been, you know -- I've been working in this field for
16 30 years.

17 But I reviewed the prior art that was
18 provided in the petition. Obviously I've reviewed the
19 petition. I've reviewed the patent. I've reviewed the
20 prior art. And based on Tian, a POSITA would not
21 understand Tian to teach reducing a resolution.

22 Q. So you got your knowledge about this database
23 from the Tian reference. Is that correct?

24 MR. SNADER: Objection; mischaracterizes
25 testimony.

1 A. Again, as I mentioned, I don't remember off
2 the top of my head if I've ran across the database
3 before. But in the time of this, essentially,
4 investigation, if you want to call it, I reviewed the
5 prior art that was provided in the petition. And based
6 on Tian, a POSITA would not understand Tian to teach
7 reducing a resolution.

8 You look, for instance, at Figure 1 of Tian.
9 You can see Tian provides a module or -- for face
10 acquisition. And within -- underneath that module, you
11 can see Tian provides face detection and head pose
12 estimation. So let's call those a submodule.

13 And then the next kind of elliptical looking
14 thing in Tian shows facial data extraction and
15 representation and underneath that provides geometric
16 and appearance feature submodules.

17 And then it goes to the next step for facial
18 expression recognition, and under that, you have two
19 submodules, basic expression and action units.

20 There's no discussion at all in any of these
21 modules about reducing the resolution or any type of
22 algorithms, methodologies, anything that says anything
23 about resolution.

24 Q. Did you get any knowledge about the
25 Cohn-Kanade database from anything other than Tian?

1 A. As I mentioned earlier, I have reviewed in
2 this case -- I have reviewed the prior art that you
3 provided -- that was provided in this petition. And
4 based on Tian, a POSITA would not understand Tian to
5 teach reducing a resolution. Tian clearly states "An
6 example in five different resolutions from the
7 Cohn-Kanade database."

8 Q. Let's go to the abstract of Tian.

9 A. Okay.

10 Q. The last sentence of the abstract states "The
11 lower resolution images are downsampled from the
12 originals," correct?

13 A. That is correct. You read it correctly.

14 Q. Is downsampling a method to reduce the
15 resolution of the image?

16 A. Well, downsampling, as we discussed earlier,
17 is a methodology to reduce the resolution of the images.
18 But as I've mentioned already, Tian does not provide any
19 methodology, any circuitry, any hardware, any algorithms
20 to say anything about downsampling. And obviously Tian
21 provides description of all his other modules that I --
22 from Figure 1. There's no discussion of downsampling
23 anywhere in Tian.

24 Q. Can you please go to page 5 of Tian. By
25 "page," I mean the Bates number in the lower right

1 corner.

2 A. Yes, sir.

3 Q. Let me first follow up with the answer you
4 just had.

5 So is it your opinion that because Tian does
6 not provide hardware or software for downsampling, a
7 POSITA reading Tian would not have known how to do that?

8 A. A POSITA reading Tian would not understand
9 Tian to teach reducing a resolution. A POSITA reading
10 Tian would not understand Tian to be reducing -- to
11 teach reducing a resolution since there is no disclosure
12 in Tian of any resolution reduction, circuitry,
13 hardware, methodology, details.

14 Q. Why not? Why does Tian not disclose reducing
15 a resolution --

16 MR. SNADER: Objection -- objection; calls
17 for speculation.

18 A. You would have to ask Tian that. I'm just
19 reading Tian's paper. I can't speculate on why Tian
20 doesn't disclose that. But Tian does not disclose any
21 methodology or algorithms to reduce resolution. It's
22 just a passive statement that's being discussed there.
23 There's no active methodology or algorithms of any kind.

24 Q. Why is Tian's disclosure of downsampling not
25 a disclose of reducing the resolution of an image?

1 A. All that Tian states is "The lower resolution
2 images are downsampled from the original." There's no
3 disclosure -- Tian does not provide any -- and the same
4 sentence is repeated again in Table 1. So if you look
5 at Table 1 and you look at the abstract, you see the
6 same sentence repeated there, "The lower resolution
7 images are downsampled from the originals." It's kind
8 of like a cut and paste. There's no disclosure of any
9 methodology or algorithms of how that is done, just a
10 passive statement.

11 Q. Can you please go to the first -- very first
12 paragraph on page 5 of Tian.

13 A. Page 5? Are we talking about the left column
14 or the right column?

15 Q. The left column.

16 A. Okay.

17 Q. Do you see a section that starts with "3.1.
18 Database"?

19 A. I do.

20 Q. That section includes a paragraph that
21 describes the Cohn-Kanade database, correct?

22 A. Are you talking about the first paragraph
23 above Table 3?

24 Q. That's correct, the paragraph starting with
25 "The DFAT subset of Cohn-Kanade expression database."

1 A. Yes.

2 Q. So you agree that is a paragraph describing
3 the Cohn-Kanade database, correct?

4 A. Well, that paragraph provides a summarized
5 discussion of the database. You notice it says -- it
6 talks about the subset. It talks about the database
7 contains 704 image sequences from 97 subjects. So it
8 gives a summarized overview of the database. It doesn't
9 give any specifications or any details of the imagery
10 besides just the summarized overview.

11 Q. The paragraph mentions 640-times-480 pixel
12 arrays. Is that correct?

13 A. If you're referring to the sentence halfway
14 down the paragraph, the sentence reads "The image
15 sequences began with a neutral face and were digitized
16 into 640-by-480 pixel arrays with either 8-bit grayscale
17 values."

18 Q. Does that sentence refer to the resolution of
19 images in the database?

20 A. It refers to a resolution of image sequences
21 in the database.

22 Q. The sentence starts with the term "The image
23 sequences," correct?

24 A. Yes.

25 Q. What does that refer to?

1 MR. SNADER: Objection; vague and ambiguous.

2 A. Image sequences? Sequences of images. Like,
3 you would take a video sequence, in a sense. Image
4 sequences.

5 Q. Does that refer -- does the image sequences
6 in the sentence you just read out refer to the 704 image
7 sequences from 97 subjects?

8 A. I would say -- you know, if you look at it --
9 I would have to -- I would say yes. "The database
10 contains 704 image sequences from 97 subjects."

11 And then later on, he states "The image
12 sequences," so he's referring to the 704 image sequences
13 from the 97 subjects.

14 And then two sentences later, he says "The
15 length of the image sequences are varying from 9 to
16 47 frames."

17 Q. The second-to-last sentence of this paragraph
18 says "The size of the head region is about
19 280-times-380 pixels." Is that correct?

20 A. You read that correctly.

21 Q. Does that refer to the resolution of the head
22 regions of the images that have a resolution of
23 640-times-480?

24 A. Well, it's generally referring to the size of
25 the head region is about 280-by-380 pixels in those

1 image sequences that he's describing, that Tian is
2 describing.

3 Q. Does this paragraph discuss any other
4 resolutions for images in the Cohn-Kanade database?

5 A. Well, those numbers that we've talked about
6 are the only numbers stated in that paragraph.

7 Q. If this database -- if the Cohn-Kanade
8 database includes images of other resolutions, why does
9 this paragraph not describe those other resolutions?

10 MR. SNADER: Objection; calls for
11 speculation.

12 A. I didn't write the paper, sir. I'm just
13 responding to the paper as a POSITA. You would have to
14 ask Tian that question of, you know, how -- what he
15 described and why he described it the way -- it could be
16 space limitations in the paper. It could be a lot of
17 different reasons. That question, you'd have to ask
18 Tian. I'm just responding to what is in the paper.

19 Q. Is the Cohn-Kanade database well known in
20 your field?

21 A. Well --

22 MR. SNADER: Objection; vague and ambiguous.

23 A. I don't know what you mean by "well known."
24 It depends on whether you're doing an expression
25 analysis or not. "Well known" is a very general term.

1 Q. So you don't know what "well known" means in
2 your field?

3 A. Well, "well known" to one person means
4 something else to a different person. So "well known"
5 is a very relative term. So...

6 Q. What does "well known" mean to you?

7 A. It depends on, you know, the field that
8 you're working in. You know, well known could be a
9 database that's being practiced by most professionals.
10 It could be, you know -- for the person that's doing
11 facial expression analysis, that database is well known.
12 If you're not doing facial expression analysis, perhaps
13 it's not so well known.

14 Q. Oh, so it is well known for facial analysis.
15 Is that right?

16 MR. SNADER: Objection; mischaracterizes
17 testimony.

18 A. Well, the field -- if you look at this paper,
19 this paper is about facial expression analysis. Right?
20 This paper is about evaluation of face resolution for
21 expression analysis. So it's specific. Tian is
22 essentially evaluating facial resolutions for face --
23 for expression analysis. So for people working in this
24 field directly, this database would be more well known.

25 Q. The Cohn-Kanade -- okay. So with -- sorry.

1 Strike my question.

2 In your opinion, the Cohn-Kanade database
3 would have been known to a POSITA in 2011, correct?

4 MR. SNADER: Objection; mischaracterizes
5 testimony.

6 A. A POSITA that would be working in this area
7 would be familiar with, obviously, the literature in
8 this area so would know about this facial -- a POSITA
9 working in facial expression analysis would know about
10 the database.

11 Q. But you are not sure about whether you
12 were -- you know the Cohn-Kanade database before this
13 case, correct?

14 A. I said I don't remember off the top of my
15 head if I ran into it. I mean, I've been working for
16 30 years in this field. I don't remember every single
17 database and every single algorithm and every single
18 image that I've looked at. So I don't remember off the
19 top of my head. I don't recall whether I've come across
20 this database at some point or not.

21 But a POSITA working -- you know, this paper
22 is about facial expression analysis, and that database
23 is in that field.

24 Q. Do you know what's in the database?

25 A. I'm sorry?

1 Q. Do you know what is in the Cohn-Kanade
2 database?

3 A. I don't know what you mean by do I know
4 what's in the database.

5 Q. Do you know what data is in the Cohn-Kanade
6 database?

7 A. I can't remember off the top of my head
8 what's in the database. Again, I'm reacting -- I'm
9 responding to a petition that was filed by Petitioner
10 that -- where, you know -- I've reviewed the petition.
11 I've reviewed the prior art. And based on Tian and as a
12 POSITA reading Tian, a POSITA would not understand Tian
13 to teach reducing a resolution. So I'm responding based
14 on the four corners of Tian, in a sense, of what Tian
15 has disclosed and what's been provided in the petition
16 and declaration.

17 Q. In preparing for your response -- sorry.
18 In preparing your expert declarations, did
19 you look at what was in the database?

20 A. No, I did not.

21 Q. Did you ask the attorneys that you are
22 working with to give you --

23 MR. SNADER: Objection --

24 Q. -- information about the database?

25 MR. SNADER: Objection; calls for privileged

1 information.

2 Dr. Saber, I'll instruct you not to answer.

3 MR. QIU: What's the basis of the objection?

4 MR. SNADER: You're asking for contents of
5 discussion between attorneys and experts. That's
6 privileged information, expert work product.

7 MR. QIU: I think I'm just trying to ask for
8 whether Dr. Saber was given access to the database. I'm
9 not asking for the discussions of Dr. Saber and any
10 members of counsel.

11 MR. SNADER: You did. If you'd care to
12 rephrase your question as whether he accessed the
13 database -- which I believe you asked and he answered --
14 I won't object to that. If you're asking about what
15 information was exchanged between attorneys and
16 Dr. Saber, I will object to that, and I will instruct
17 him not to answer.

18 Q. Did you request information about the
19 Cohn-Kanade database from the attorneys --

20 MR. SNADER: Objection; calls for privileged
21 information.

22 Dr. Saber, please don't answer.

23 Q. Did you ask anyone for access to the
24 Cohn-Kanade database?

25 MR. SNADER: To the extent that that

1 implicates privileged information, I'll instruct you not
2 to answer with respect to any discussions between
3 yourself and counsel. Other than that, you may answer.

4 A. As I mentioned already to you earlier in my
5 previous answer -- which is not going to change if you
6 ask me the same question a hundred times. I've already
7 answered that question for you multiple times -- I've
8 reviewed the prior art that was provided in the
9 petition. I've reviewed Tian. And based on the four
10 corners of Tian and on the prior art and the petition
11 and the declaration, a POSITA would not understand Tian
12 to teach reducing a resolution based on -- I'm looking
13 at the four corners of the petition, the declaration,
14 Tian, and the prior art. That is what I was instructed
15 to perform.

16 Q. Did you in any way confirm your understanding
17 that the Cohn-Kanade database include images in five
18 different resolutions?

19 MR. SNADER: Objection; asked and answered.
20 I believe we've covered this topic, Counsel.

21 A. I agree, Counsel. I think I've already
22 answered your question multiple times.

23 I have reviewed Tian and the four corners of
24 Tian, along with the prior art and the declarations and
25 the petitions. And a POSITA would not understand Tian

1 to teach any reduction of a resolution.

2 MR. QIU: Move to strike as non-responsive.

3 Q. I'm not asking about the four corners of
4 Tian. My question, which I will repeat, is: Did you in
5 any way confirm your understanding that the Cohn-Kanade
6 database include images in five different resolutions?

7 MR. SNADER: Objection; asked and answered.

8 A. I think I've already answered your question.

9 Q. So is it a yes or no?

10 A. As I've told you, a POSITA would not
11 understand Tian to teach reducing a resolution. So the
12 disclosures of Tian, a POSITA reading Tian would not
13 understand that Tian as doing any resolution reduction.
14 So Tian's disclosure clearly state "The lower resolution
15 images are downsampled from the originals," as you
16 mentioned in your opening line of this questioning. And
17 Table 1 of Tian provides "An example in five different
18 resolutions from Cohn-Kanade database."

19 MR. QIU: Move to strike as non-responsive.

20 Q. Dr. Saber, I asked a simple question. Did
21 you in any way confirm your understanding that the
22 Cohn-Kanade database include the images in five
23 different resolutions?

24 MR. SNADER: Objection; asked and answered.

25 Counsel, move on.

1 MR. QIU: Counsel, like, Dr. Saber still has
2 not answered the question I asked. It's a very simple
3 yes or no question. He either did verify or he didn't.

4 A. I didn't need to. Tian clearly states in
5 Table 1 -- again, I'm reading Tian as a POSITA and
6 responding to your petition, the prior art, and the four
7 corners of Tian.

8 Tian states "An example in five different
9 resolutions from Cohn-Kanade database." So a POSITA
10 reading Tian would not understand Tian to teach reducing
11 a resolution.

12 Q. Will you please go to page 5 of Tian.

13 A. Page 5. Yes, sir.

14 Q. The first paragraph on the left column, the
15 last sentence states "More details about the database
16 can be found at paper 16." Is that correct?

17 A. That is correct. You read that correctly.

18 Q. Did you access paper 16?

19 A. No, I did not.

20 Q. Are you aware that the database -- the
21 Cohn-Kanade database does not contain images in five
22 different resolutions?

23 MR. SNADER: Objection; scope. Objection;
24 relevance. Objection; argumentative.

25 A. Again, I'm analyzing here based on

1 instructions from counsel to analyze the petition, the
2 prior art, the four corners of Tian. And as I've
3 informed you earlier, if you look at Tian's Figure 1,
4 the table that we just discussed, in Tian there's no
5 discussion of reducing a resolution in any of the steps
6 in Figure 1. There's no discussion of reducing a
7 resolution anywhere in Tian. There's no process, no
8 procedure, no methodology, no circuitry, no hardware.
9 There's no disclosure of any reduction of resolution in
10 Tian.

11 MR. QIU: Move to strike as non-responsive.

12 Q. Dr. Saber, I'm not asking you about the four
13 corners of Tian. I'm asking about your knowledge about
14 the Cohn-Kanade database. Let me repeat my question.

15 Are you aware that the Cohn-Kanade database
16 does not contain images in five different resolutions?

17 MR. SNADER: Objection -- same objections.
18 Further objection; assumes facts not in evidence.

19 A. As I mentioned to you, I did not need to look
20 at the database for my analysis given the context of the
21 petition, declaration, and the four corners of Tian.
22 I'm responding to the petitioner's analysis based on the
23 prior art that's in front of me.

24 Q. So before you were engaged for this case, did
25 you know whether the Cohn-Kanade database include images

1 in five different resolutions?

2 MR. SNADER: Objection; asked and answered.

3 A. As I said to you earlier, I have been working
4 in this field for over 30 years. I don't know off the
5 top of my head what every database out there that we
6 have access to or looked at exactly includes. So I
7 would have to look specifically at each database for me
8 to respond to a given database.

9 MR. SNADER: Counsel, I realize you're in the
10 middle of a line. But we have been going for about an
11 hour, so if you have a good stopping point coming up, we
12 could take maybe a five-minute...

13 MR. QIU: Okay. Let's take a five-minute
14 break.

15 THE WITNESS: Okay. It's 3:15. I will be on
16 my desk at 3:20.

17 MR. QIU: See you then.

18 (Off the record: 12:15 p.m. to 12:21 p.m.)

19 Q. Exhibit 1005, which is Tian, it is a research
20 paper, correct?

21 A. Yeah. It's a paper published by Tian.

22 Q. Can you please go to page 5 of Tian.

23 A. Page 5. Yes, sir.

24 Q. There's a table shown there, right?

25 A. Are you referring to Table 3? Yes.

1 Q. Table 3 shows experimental results of Tian,
2 correct?

3 A. Well, Table 3 -- let's just be very specific
4 and accurate. Table 3 shows a summary of the effects of
5 faces at different resolution for expression analysis.

6 Q. Do you have any reason to doubt or challenge
7 the credibility of these results?

8 A. No. Not necessarily, no. I mean, these are
9 results that Tian -- based on Tian's analysis, these are
10 the results that Tian has published.

11 Q. Do you have any reason to question the
12 credibility of Tian's results in general?

13 A. Well --

14 MR. SNADER: Objection; vague and ambiguous.

15 A. I think your question is kind of vague. I
16 mean, people conduct experiments and publish results.
17 If you construct the experiment in a different way, the
18 results might change.

19 So I don't have any doubt that Tian has
20 constructed this experiment and published these results
21 with the images that Tian has, you know, experimented
22 on.

23 Q. Can you please open your supplemental
24 declaration.

25 A. Supplemental declaration. Yes, sir.

1 Q. It is Exhibit 2020.

2 A. Yes, sir. I have that open.

3 Q. Can you please go to page 16 and paragraph 20
4 of this declaration.

5 A. You said page 16?

6 Q. Yep, and paragraph 20.

7 A. Paragraph 20. Yes, sir.

8 Q. The first sentence of that paragraph states
9 "Tian's disclosure of using images that are only
10 downsampled, without any other disclosed pre-processing
11 steps, would not result in a usable audience measurement
12 system, because the downsampled image would not be ready
13 for analysis," correct?

14 A. That is correct. You read that sentence
15 correctly.

16 Q. What kind of analysis are you referring to
17 there?

18 A. See, you have to put this in the context of
19 what is being described in a media -- in an audience
20 measurement system versus what Tian is describing.

21 See, if you look at Tian, the Table 3 that
22 you mentioned, Tian is studying a problem in the context
23 of facial expression analysis. And if you look at the
24 faces on those images, they almost occupy the entire
25 size of the image. See, the face occupies the majority

1 of that image, say above 80 percent.

2 If you look at an audience measurement system
3 where audience are sitting down and watching TV -- like,
4 if you look at the example I give you on page 41 of the
5 supplemental declaration -- if you go to my declaration,
6 supplemental, page 41. Let me know, Counsel, when
7 you're there.

8 Q. Yep. I'm at page 41.

9 A. So let me just bring it up on my screen here.

10 So if you see, when you look at that picture,
11 that's a more realistic picture of an audience
12 measurement system in the context of the '243 patent
13 where this family is obviously watching TV, where the TV
14 obviously would be on this side of the screen -- or
15 these people in this case are reading from some
16 document, but a similar scenario would be for people
17 sitting and watching TV where you are 5 -- 4 or 5 meters
18 away from the television, say 3 to 4 meters away.

19 So you can see the size of the faces in that
20 screen are much, much smaller, significantly more than
21 what you see in Tian's disclosures. So if you were to
22 subsample this image, obviously it would be a completely
23 different scenario than we're talking about in Tian.

24 Q. Let's go back to paragraph 20 of your
25 declaration.

1 A. Paragraph 20?

2 Q. Yep.

3 A. Okay.

4 Q. The first sentence -- at the end of the first
5 sentence it states "analysis," correct?

6 A. Yes. The word "analysis" is at the end of
7 that sentence.

8 Q. Does the word "analysis" include face
9 detection here?

10 A. Well, the word "analysis" would -- is
11 referring to analysis in the context of an audience
12 measurement system like the context of the '243. So you
13 would have to do face detection, orientation, and
14 recognition. So that's what it's referring to.

15 Q. Is it your opinion that Tian does not apply
16 anti-aliasing techniques when downsampling images?

17 A. I think we've been over this ground a few
18 times, Counselor.

19 Tian does not discuss anything about
20 downsampling. It doesn't -- besides that sentence that
21 you read in the abstract that's repeated again in
22 Table 1, there is no disclosure in Tian of any
23 downsampling, any anti-aliasing, any type of
24 downsampling whatsoever. A POSITA would not understand
25 Tian to teach reducing the resolution or doing any kind

1 of downsampling.

2 Q. Hence, lower resolution images are
3 downsampled, correct?

4 A. I'm sorry. I didn't hear you.

5 Q. Hence, lower resolution images are
6 downsampled, correct?

7 A. Being lower resolution images -- well, as
8 Tian states, the lower -- if you look at Table 1 of
9 Tian, Tian states that "The lower resolution images are
10 downsampled from the originals." That's all the
11 disclosure that Tian states.

12 Q. Is it your opinion that those images were
13 downsampled without applying anti-aliasing steps?

14 MR. SNADER: Objection; calls for
15 speculation.

16 A. Tian does not state anything about how those
17 images are acquired besides -- or how they are
18 downsampled besides the statement that says "The lower
19 resolution images are downsampled from the original."
20 That's all it says.

21 Q. In paragraph 20, the first sentence states
22 "Tian's disclosure of using images that are only
23 downsampled without any other disclosed pre-processing
24 steps." What do you mean by "pre-processing steps"?

25 A. Well, Tian doesn't say whether anti-aliasing

1 was applied to these images or anything about how these
2 downsampled images are arrived at. We don't know
3 what -- how those images are arrived at. There's no
4 disclosure in Tian of how those images are arrived at.

5 Q. How did you reach the conclusion that it was
6 without any other disclosed pre-processing steps?

7 A. Well, the conclusion -- if you look at Tian,
8 there's two sentences there. One that says "The lower
9 resolution images are downsampled from the originals."
10 And the next -- it's the same sentence repeated in
11 Table 1. And then the other sentence says -- it says
12 "An example in five different resolutions from
13 Cohn-Kanade database."

14 That's all Tian discloses. So if Tian was
15 applying downsampling or doing anti-aliasing or doing
16 histogram equalization or any type of processing, Tian
17 should have disclosed that. You see in Figure 1, Tian
18 discloses all the steps, all the sub -- modules and
19 submodules. Nothing in Figure 1 says anything about
20 resolution, downsampling, anti-aliasing, pre-processing
21 in regards to any kind of downsampling. So there's no
22 discussion at all, and Tian does not disclose anything
23 in that regard.

24 Q. Is it your opinion that downsampling without
25 prefiltering, according to Tian's teachings, will create

1 aliasing effect?

2 A. I didn't understand your question.

3 Q. Let me repeat it.

4 Is it --

5 A. I didn't hear your question very well. It
6 sounds like there's some kind of noise coming from
7 somebody speaking somewhere.

8 MR. QIU: Counsel, do you have trouble
9 hearing my questions?

10 MR. SNADER: There's a little bit of -- like,
11 I think -- as Dr. Saber indicated earlier, as you're
12 coming closer and further to your microphone, you're
13 kind of fading in and out a little bit.

14 Q. Okay. Let me try again now.

15 Is it your opinion that downsampling without
16 prefiltering will create aliasing effect?

17 A. I think we've discussed that at length in the
18 morning. If you downsample an image without proper
19 anti-aliasing, you will create aliasing artifacts.

20 Q. Can we please -- can you please go to Table 1
21 of Tian.

22 A. Table 1. Okay.

23 Q. It is on page 3 -- oh, sorry. It's on
24 page 2.

25 A. I am there, sir.

1 Q. Do you believe any of the five images include
2 aliasing effect?

3 A. Well, it's hard to see that from the small
4 images that are disclosed in the paper. I mean, you
5 have small images disclosed in the paper in that table,
6 so it's hard to see that from the images, whether -- to
7 say whether there's been aliasing effects or not.

8 But, again, Tian doesn't disclose anything
9 about doing any pre-processing or any anti-aliasing or
10 anything to do with reducing the resolution or
11 downsampling besides those -- that one passive sentence.

12 Q. So you are not sure whether the images in
13 Tian have aliasing effect, correct?

14 A. Well, again, I mean, I'm looking at a small
15 picture in Table 1 of five different pictures of some
16 person, and they are various -- they are probably about
17 1 centimeter by 1.2 centimeter. So it's very hard to
18 see whether around -- you can't even see the eyebrows
19 very well or the eyelashes. So it's hard to see to what
20 extent there is any kind of aliasing there or how that
21 has been arrived at.

22 So I can't say -- thumbnails whether there is
23 or isn't aliasing. But as I mentioned to you earlier,
24 whenever you downsample and without doing proper
25 anti-aliasing, you will introduce aliasing artifacts in

1 the images.

2 Q. Do you know if the five images in Tian have
3 low resolution?

4 MR. SNADER: Objection; vague and ambiguous.

5 A. I don't know what you mean "do I know." I
6 don't understand your question.

7 Q. What do you not understand, sir?

8 A. I don't understand what you're asking.
9 You know, Tian --

10 Q. The question is very simple and
11 straightforward. Do you know if the images in Tian have
12 low resolution?

13 A. Well, if you look at Table 1 -- if I
14 understand your question correctly, if you look at
15 Table 1, it says "An example in five different
16 resolutions from Cohn-Kanade database." So he's
17 provided five different resolutions; the original, the
18 next one, the next one, the next one, the next one going
19 from left to right. So there's five different
20 resolutions there, as Tian clearly states in the caption
21 of the table.

22 Q. Do you know if the five images in Table 1
23 have low contrast?

24 MR. SNADER: Objection; vague and ambiguous.

25 A. Well, again, you're looking at thumbnails,

1 obviously, of the images, so it's hard to determine
2 exactly the level of contrast that's there. But, like,
3 you can see, for instance, the 18-by-24 is fairly
4 blurred and hard to see the eyes or, you know, the
5 details I'm talking about. As you go from right to
6 left, you get more details in the images.

7 But they seem to have reasonable contrast for
8 what Tian is doing, but it's hard to see that from the
9 thumbnails.

10 THE WITNESS: Do you hear someone else on the
11 line, Counselor? Can you hear, like, some kind of noise
12 on the line?

13 THE REPORTER: I think we're getting some
14 noise from Mr. Snader's background.

15 MR. SNADER: Oh, jeez. I can put myself
16 generally on mute.

17 THE REPORTER: Thank you.

18 MR. SNADER: Dr. Saber, I'd ask you to give
19 me -- give me a little bit of extra time to object
20 before you start to answer so I can unmute myself.

21 THE WITNESS: I will do so. Thank you.

22 Q. Please go to paragraph 16 of your
23 supplemental declaration, which is Exhibit 2020.

24 A. Okay. I'm on paragraph 16.

25 Q. There you stated that -- oh. There you

1 stated that "Media exposure environment is a low-lit
2 environment." Is that correct?

3 A. Well, if you're referring to the second
4 sentence, the second sentence, to be accurate for the
5 record, says "This is important, as images captured in a
6 low-lit environment, such as a media exposure
7 environment, have low contrast." Is that the sentence
8 you're referring to?

9 Q. Yes.

10 So you did state that media exposure
11 environments are low-light environments. Is that
12 correct?

13 MR. SNADER: Objection; mischaracterizes
14 prior testimony.

15 A. I think I -- I read that sentence. What I
16 stated is exactly in that sentence.

17 Q. How do you determine if an environment is low
18 lit?

19 A. Well, if you have -- typically, I mean, you
20 can look at the histograms of the images to see, as we
21 were discussing earlier this morning about histogram
22 equalization. So if we're talking about a grayscale
23 image for now just for this purpose of this
24 illustration, if the histogram is -- assuming zero is
25 black and 255 is white, if the histogram is bunched in

1 between zero and 30, obviously one of the reasons for
2 that being the image is low lit. I mean, obviously the
3 image could be made up of black stones and the histogram
4 would be there. But in a media exposure environment
5 where people are sitting down and watching television,
6 if you were to see a histogram that's bunched, let's
7 say, between zero and 20, grayscale, whatever, that's an
8 indication of a low-lit environment.

9 Q. Are all images taken in media exposure
10 environments low lit?

11 A. Well, if you turn the lights on and take the
12 picture, it wouldn't be low lit. So if your lights are
13 off and you're watching television or you have very dim
14 lighting and you're watching television, as typically
15 people would do, then the images taking pictures of that
16 audience would be in a low-lit environment. But if you
17 turn all the lights on and take the picture, obviously
18 it wouldn't be low lit.

19 Q. If you turn the lights off in the room but
20 the camera has its own illumination, will the camera be
21 able to take well-lit images in the room?

22 MR. SNADER: Objection; calls for
23 speculation.

24 A. Well, I would have to see the environment of
25 the room. Is it pitch black? Or is there lighting

1 from, you know, potentially windows or stray lighting?
2 It's hard to answer that question.

3 If you have enough light, you would be able
4 to acquire a picture. If it's pitch black and you put a
5 camera there that doesn't have any lights, you wouldn't
6 see anything.

7 Q. Can well-light images be taken with natural
8 light?

9 A. I'm sorry?

10 Q. Can well-lit images be taken with natural
11 light?

12 A. Certainly. I mean, we take images outdoors
13 in natural light.

14 Q. Can well-lit images be taken with indoor
15 light sources such as lamps?

16 A. Yes, assuming you're providing the proper
17 illumination.

18 Q. Can well-lit images be taken with light
19 sources on a camera?

20 A. Assuming you provide a proper light source,
21 you can take an image.

22 Q. I understand you can take an image in that
23 situation. My question was: Can well-lit images be
24 taken with light sources on a camera?

25 A. Can well-lit images be taken with light

1 sources on a camera?

2 Q. Correct.

3 A. Well, if you have a camera with the
4 appropriate light source designed into the camera and
5 you put that light source on appropriately, you can take
6 a picture with it.

7 Q. And the picture would be well lit?

8 A. Again, assuming that you have provided the
9 proper illumination at the proper levels, the picture
10 will be appropriately lit. Where in the -- on the
11 spectrum that is depends on the type of illumination
12 you've provided and the length of time that you've
13 provided it.

14 Q. In 2011, were flashlights available on
15 cameras?

16 A. Yes.

17 Q. In 2011, were there cameras that can be
18 configured such that the flashlight is triggered each
19 time a photo is taken?

20 A. Yes. You could do that.

21 Q. In 2011, were there cameras that can sense
22 the ambient light to decide whether to trigger the
23 flashlight?

24 A. Generally speaking, yes.

25 Q. For digital cameras in 2011, was it common

1 for them to apply time stamps on images taken?

2 A. Was it common for them to apply what?

3 Q. Apply time stamps on images.

4 A. Are you saying -- are you saying "time
5 stamps"? Like time?

6 Q. Yes.

7 A. Assuming the camera is designed to do it, I
8 would assume yes. I don't understand what the relevance
9 of that is to this investigation.

10 Q. Was it common to place the time stamps in
11 metadata associated with the images?

12 MR. SNADER: Objection; scope.

13 A. I would presume so. Generally speaking, yes.

14 Q. Please go to Exhibit 1001, the '243 patent.

15 A. The '243 patent. Yes, sir.

16 Q. Can you go to Column 15 and line 13.

17 A. Column 15, line 13. Is that what you said,
18 sir?

19 Q. Yes.

20 A. Yes, I'm there.

21 Q. That's Claim 1 of the '243 patent, correct?

22 A. That is correct.

23 Q. Can you please go to line 28.

24 A. Line 28. Yes, sir.

25 Q. There it states "Analyze a sequence of images

1 of the media exposure environment," correct?

2 A. Yes, sir.

3 Q. Does Claim 1 encompass the scenario where the
4 sequence of images are consecutive frames taken by a
5 camera or video camera?

6 A. It talks about a sequence of images. So a
7 sequence of images of the media exposure environment.
8 So you have a sequence of images that would be taken by
9 an image-capturing device.

10 Q. If we have a piece of video with a number of
11 frames, will the number of frames satisfy the sequence
12 of images?

13 A. Well, if you have a sequence of images -- I
14 have 15 images, it's a sequence of images. They don't
15 necessarily have to be consequent -- sequential in a
16 sense, but it's a sequence of images. Typically in a
17 video sequence, they would be obviously sequential.

18 Q. So a sequence of images in a video would
19 satisfy this limitation, correct?

20 A. I guess I don't understand what you're
21 asking, but a series of frames in a video is a sequence
22 of images.

23 Q. Does Claim 1 require detecting a head in an
24 image before capturing the next image?

25 A. I don't understand your question. I mean,

1 Claim 1 states that you analyze a sequence of images of
2 the media exposure environment to detect a head
3 appearing in one or more of the images. So you're going
4 to detect the head that would be appearing in one or
5 more of the images of the sequence of images you just
6 analyzed.

7 Q. If I take a sequence of images first before
8 analyzing them and then analyze them to detect a head,
9 will that satisfy this limitation?

10 A. Yes. You can take a sequence of images -- I
11 mean, I'm not an attorney, so I'm not doing a claim
12 construction here, so to speak. But as a POSITA reading
13 this, you have -- you analyze a sequence of images of
14 the media exposure environment to detect the head. So
15 you have a sequence of images, and you're detecting the
16 head appearing in one or more of the images. So it
17 could appear in just one of the sequence of ten. It
18 could appear in five out of the ten. It could appear in
19 all ten. So you'd have to analyze the head in each of
20 these -- in each of these -- you would need to analyze
21 the sequence of images to detect a head appearing in one
22 or more of the images.

23 Q. And in this case, the sequence of images can
24 be taken before the analyzing starts. Is that right?

25 MR. SNADER: Objection; vague and ambiguous.

1 A. It doesn't say one way or the other. It just
2 says "Analyze the sequence of images of the media
3 exposure environment to detect a head." So you're going
4 to analyze the sequence of images to detect a head.

5 Q. Can you please go to Column 15 and line 61.

6 A. Line 61. Yes, sir.

7 Q. This is Claim 5, correct?

8 A. You are correct.

9 Q. Do you see the claim language "Region of a
10 second image of the one or more of the images
11 corresponding to a location of the head in the
12 reduced-resolution image"?

13 A. I must have missed something. Could you
14 point --

15 Q. Yeah.

16 A. Which line are you looking at?

17 Q. Yeah. It is the first -- under the first
18 bullet point or -- and it's around line 64. It says "A
19 region of a second image of the one or more of the
20 images corresponding to a location of the head in the
21 reduced-resolution image."

22 A. Yes, I see that sentence.

23 Q. What does the word "corresponding" mean in
24 this limitation?

25 MR. SNADER: Objection; vague and ambiguous.

1 A. Well, see, the Claim 5 depends from Claim 4,
2 which depends from Claim 1. So it's kind of a series of
3 descriptions here.

4 So Claim 4, if you look at line 56, it says
5 "Reduce a resolution of a first image to obtain" --
6 you know, "of the one or more images," et cetera -- "to
7 obtain a reduced-resolution image." So you reduce a
8 resolution of a first image to obtain a
9 reduced-resolution image.

10 Then you go to Claim 5. The element
11 labeled "i" on line 63 says "Generating a facial
12 signature from a region of a second image of the one or
13 more -- of the one or more of the images corresponding
14 to the location of the head in the reduced-resolution
15 image."

16 The reduced-resolution image is the one that
17 we're talking about in Claim 4, which says "a
18 reduced-resolution image" and then "the
19 reduced-resolution image," in Claim 4 on line 60 and 58.
20 So it's referring to a reduced-resolution image, and
21 then the element "i" that you read is essentially
22 referring back to the reduced-resolution image which was
23 obtained -- which was, you know, computed in Claim 4.

24 Q. Claim 5 requires the region in the second
25 image to correspond to the location of the head in the

1 reduced-resolution image, correct?

2 A. Yes.

3 Q. Where does the region in the second image
4 need to be for it to correspond to the location of the
5 head in the reduced-resolution image?

6 A. Well, you reduce -- so if you look at
7 Claim 4, you reduce the resolution of a first image.
8 You have a first image. You reduce this resolution, and
9 now you have a reduced-resolution image.

10 You determine the orientation of the head
11 with respect to the camera based on the
12 reduced-resolution image. So you know where the head is
13 in the image, and you know its orientation.

14 So now you go to Claim 5. You're going to
15 generate a facial signature from a region of a second
16 image of the one or more of the images corresponding to
17 a location of the head in the reduced-resolution image.
18 So the reduced-resolution image, you know the location
19 of the head, and you know its orientation. You know
20 where it is located within the image.

21 You are going to go to the second image, to
22 the appropriate location once you apply the proper
23 resolution, and generate the facial signature from the
24 region of the second image of the one or more images
25 corresponding to the location of the head.

1 Q. How do you determine the appropriate location
2 in the second image?

3 A. Well, you have the reduced-resolution --
4 excuse me.

5 You have the reduced-resolution image, so
6 you know the location of the head in that image from
7 Claim 4. You know where it is. So let's just say that
8 image is reduced by half in each direction. So within
9 that image, you know the head is located at XYZ
10 coordinates --

11 Q. So when the location in the second image is
12 the same -- sorry. Strike that question.

13 So when the region in the second image is the
14 same as the location of the head in the first image, we
15 can say that the region in the second image corresponds
16 to the location of the head.

17 A. Well, you've got to remember the second image
18 is not a reduced-resolution image. So the second --
19 this doesn't -- this just says "a second image." So you
20 have a second image that's not at the same resolution as
21 the reduced-resolution image. So you would have to
22 apply the proper scaling between the two images to
23 appropriately locate the head. That's why they say
24 "corresponding to a location of the head." It's not the
25 exact XYZ values or XY values. You have to look at the

1 corresponding resolution between the two images.

2 Q. And after the adjustment of the scaling, the
3 region in the second image would be the same as the
4 location of the head in the first image?

5 A. Well, the region from the second image would
6 correspond to the location of the head in the
7 reduced-resolution image, because you created a
8 correspondence between them. You know this is where the
9 head in the reduced-resolution image. This is where the
10 corresponding location is in the second image given the
11 resolution difference.

12 Q. In a first and second image -- between a
13 first and a second image, if a person's head is at the
14 same place and then we reduce the resolution of the
15 first image and determine the location of the head in
16 that image, can we say the location of the head in the
17 second image corresponds to that of the location of the
18 head in the first image?

19 A. I didn't understand your question.

20 Q. Okay.

21 A. It's too convoluted, sir.

22 Q. Okay. So how would you say the meaning is
23 for the word "corresponding" in Claim 5?

24 MR. SNADER: Objection; asked and answered.

25 A. As I've explained to you, it's corresponding.

1 It's -- you have two different images. You have a
2 reduced-resolution image, and you have a second image
3 that is not necessarily at the same resolution. So you
4 have to correspond -- you have to have a correspondence
5 between them to correspond to basically say "In the
6 reduced-resolution image, the head is located at this
7 location. In the second image, this would be in this
8 location." So there's a correspondence there. It's not
9 the exact same XY values, because there's a difference
10 in resolution between them.

11 Q. Please open your supplemental declaration,
12 which is Exhibit 2020.

13 A. Yes, sir.

14 Q. Can you please go to paragraph 39 of your
15 supplemental declaration.

16 A. Paragraph 39.

17 Q. Yep.

18 A. Yes, sir.

19 Q. Can you please read this paragraph to
20 yourself and let me know when you're done.

21 A. Yes, sir. I've read the paragraph.

22 Q. The second sentence of the paragraph states
23 "This extra step would require additional computational
24 resources, which likely outweigh any reduction in
25 resource consumption from Petitioner's proposed

1 modification of performing head detection and
2 orientation determination on a reduced-resolution image
3 and potentially result in lower accuracy in performing
4 head detection given the lower resolution image." Is
5 that correct?

6 A. You read it correctly.

7 Q. In reaching this conclusion, which method for
8 reducing the resolution did you have in mind?

9 A. Well, if you look at the previous sentence,
10 you see it says "Thus, in order to reduce the
11 resolution." So obviously this is building on
12 discussion from previous paragraphs with -- under the
13 heading "Tian's Resolution Reduction Requires Additional
14 Processing Resources."

15 So if you look at paragraph 39, it says
16 "Thus, in order to reduce the resolution of an image via
17 Tian's suggested downsampling without introducing
18 artifacts that negatively affect subsequent
19 processes" -- so we want to do this without introducing
20 artifacts -- "a POSITA would understand that a
21 prefiltering process would be applied prior to
22 downsampling the image."

23 So you would need to do some type of
24 prefiltering, like anti-aliasing or maybe you were going
25 to model this with some function and then subsample the

1 function or bilinear -- you've got to do some kind of a
2 prefiltering to ensure that you don't introduce aliasing
3 artifacts with the downsampling process. This extra
4 step of prefiltering would require additional
5 computational resources. You need to do more
6 computation.

7 Q. Did you consider the scenario where no
8 prefiltering is performed in reaching this conclusion?

9 A. Yes. I considered that scenario, because in
10 that scenario, obviously you would be introducing a
11 significant amount of artifacts due to aliasing. So
12 that scenario would not be a practical and valid
13 scenario.

14 Q. Does this conclusion apply to all methods of
15 anti-aliasing?

16 MR. SNADER: Objection; vague and ambiguous.

17 A. So, again, I mean, we are talking about the
18 context of an audience measurement system here. And as
19 I described to you from my supplemental, on page 41, I
20 showed you a picture there of a typical, practical
21 audience measurement system environment where the faces
22 are fairly small compared to the size of the image.

23 So you have to put this in the context of
24 what we're discussing here. So in the context of an
25 audience measurement system where the faces are

1 relatively small entities in the image, you would need
2 to do appropriate prefiltering before downsampling.
3 Otherwise, you would introduce aliasing artifacts, which
4 will distort the features and basically significantly
5 reduce the accuracy of your head detection, face --
6 you know, head orientation, face recognition algorithm.

7 Q. Will your opinion in paragraph 39 change
8 depending on the method of anti-aliasing you use?

9 A. I don't know what you mean by that answer
10 [sic]. You would need to use anti-aliasing regardless
11 of -- whatever method you use --

12 Q. Let me clarify this question.

13 You opined that the additional computational
14 resources outweigh any reduction in resource
15 consumption. So in reaching this conclusion of one type
16 of computational resources outweighing another type of
17 resources, does that depend on the type of anti-aliasing
18 you use?

19 MR. SNADER: Objection; mischaracterizes the
20 testimony.

21 A. Well, you would need to do anti-aliasing. So
22 if you did one -- your question is very vague and very
23 general. It depends on how you've implemented
24 anti-aliasing algorithm A versus algorithm B versus
25 algorithm C. It depends on the efficiency of the

1 implementation, how well it was implemented by a POSITA,
2 how the software was written. Was it done in software
3 or hardware? There's a lot of open parameters here that
4 you'd have to specify.

5 But the point is here that you have to apply
6 prefiltering prior to downsampling in the context of
7 what we're discussing here, which is an audience
8 measurement system where the faces occupy a small --
9 relatively small portion of the figure, as I showed you
10 on page 41, compared to what Tian is doing, which is the
11 face occupies more than 80 percent of the picture.
12 There's a significance difference here.

13 Q. Is it your opinion that, depending on the
14 configuration, the additional computational resources of
15 anti-aliasing may or may not outweigh the reduction in
16 resource consumption from performing head detection and
17 orientation determination on a reduced-resolution image?

18 A. I don't understand what you're asking. I
19 don't understand your question.

20 Q. Is it your opinion that the additional
21 computational resources required for anti-aliasing
22 always outweigh any reduction in resource consumption
23 from performing head detection and orientation
24 determination following a reduced-resolution image?

25 A. Again, "always" and "never" are absolutes

1 that you would never use in the field that we practice.
2 There's always different ways of doing things. There
3 are different ways of approaching things. So "always"
4 and "never" is something that's -- until you have an
5 exact equation, you can't really specify always or
6 never.

7 What this says is the extra step would
8 require additional computational resources, because you
9 need to do the prefiltering whether it's anti-aliasing,
10 by convolution, or bilinear or functional fit through
11 B-splines. You need to do -- you have to put in
12 additional computational resources to do this properly.

13 And that will likely outweigh any reduction
14 in resource consumption from your Petitioner's proposed
15 modifications of performing head detection and
16 orientation in a reduced-resolution image and result in
17 lower accuracy. Because you -- if you don't do the
18 step, you are going to have aliasing, which are going to
19 significantly affect your accuracy of your image.

20 If you look at my figure on page 41, you see
21 the face is less than 1 percent or whatever -- less than
22 5 percent, maybe less than 1 percent of the image. So
23 it's a very small percentage of an image for a practical
24 scenario audience measurement system. To introduce
25 aliasing to that image would significantly affect the

1 accuracy of face recognition.

2 Q. In this sentence, you mentioned head
3 detection. Did you assume a certain method of head
4 detection?

5 A. Well, I mean, generally speaking, I'm
6 assuming you were using some methodology of head
7 detection.

8 Q. Did you assume a certain method of
9 orientation determination?

10 A. Again, generally speaking, you have -- I'm
11 assuming a certain methodology of orientation that's
12 obviously not taking a hundred years to do, but -- so
13 you're assuming we are in a room of practice in the
14 context of what we're talking about here. You're
15 acquiring video sequences. You're trying to process
16 them in near realtime or realtime. So there's a lot of
17 context to this situation. It's not an absolute in a
18 vacuum.

19 Q. So you didn't make any specific assumptions
20 here, correct?

21 MR. SNADER: Objection; asked and answered.

22 A. I think I've already answered that question
23 for you by stating -- I mean, the discussion here
24 assumes the context of the situation that we are in
25 here. It's an audience measurement system. The

1 audience are sitting on a couch or somewhere 3, 4 meters
2 from the TV where the camera might be sitting -- or the
3 camera is 3 to 4 meters away from where they are. So
4 there are certain constraints of this environment,
5 certain context that these discussions are in that
6 context.

7 Q. Did you make any calculations about the
8 additional computational resources or the reduction in
9 resource consumption in your sentence?

10 A. I didn't need to make any calculations. I
11 relied on my experience and expertise in the field for
12 30 years -- 30-plus years.

13 Q. What would you say is a typical example of a
14 media exposure environment?

15 A. What's discussed in '243.

16 Q. That doesn't answer my question.

17 Can you give me an example of a media
18 exposure environment?

19 A. You have a room, let's say, designed for you
20 to have people -- I mean, if you look at the patent --
21 let's go to -- if you look at the '243 patent.

22 So if you look at the patent -- I'm at the
23 '243 patent. I'm looking at Figure 1 and Column 4,
24 line 52.

25 So you can see "Figure 1 is an illustration

1 of an example media exposure environment including a
2 media presentation device and an example audience
3 measurement device for measuring and/or identifying an
4 audience of the media presentation device."

5 So if you look at Figure 1 that they provided
6 for you, you see Number 100 is the media -- is an
7 example media exposure environment where you can see
8 kind of an illustration of a room, including a media
9 presentation device, 102. Let's just say that's a TV.
10 But you have the media presentation device and an
11 example audience device -- measurement device. And
12 that's 104 that you see sitting above 102 there with a
13 field of view of the room. We're measuring and
14 identifying an audience, 106. So you can see there are
15 three people, two sitting on the couch and one looks
16 like they're standing. And you can see a couple of
17 windows in the room and the portraying of the walls of
18 the room, so to speak.

19 So that's an example of a media exposure
20 environment in the context of what's being discussed
21 here.

22 Q. In the example Figure 1, does the camera take
23 the entirety of the media exposure environment? Or does
24 it take a portion of it?

25 MR. SNADER: Objection; calls for

1 speculation.

2 A. Well, again, I mean, you're -- when you're
3 constructing your media exposure environment, you have
4 to account for where people are going to be entering,
5 leaving, sitting. So you're probably not going to take
6 a picture of the ceiling. So your camera has to be
7 placed at the appropriate angle to collect the proper
8 field of view where you expect people to be entering,
9 leaving, sitting, and watching TV.

10 Q. In your supplemental declaration, you analyze
11 Figure 1 of the '243 patent and estimated the resolution
12 of the people's heads in the image, correct?

13 A. Yeah. I mean, I've just -- these are
14 ballpark estimates, but that's fairly practical.

15 Q. How did you perform the estimation?

16 A. Well, I mean, this is kind of a quick kind of
17 an estimation, as you can see in paragraph 56.

18 Q. Okay.

19 A. So you can see "With the image scaled to
20 1280 wide, the head region is about 60-by-60 pixels."
21 So if you consider the image to be at that scale,
22 you know, this is the size of that head, and you see
23 those boxes around the illustration of the heads there.
24 So the boxes are highlighted in red, if you wish.

25 Q. Why did you assume the resolution of the

1 whole image is 1280-times-960?

2 A. Just a typical resolution, just to be -- to
3 provide a reasonable example for practical description.

4 Q. If you assume Figure 1 to have a resolution
5 that's larger than 1280-times-960, the resolution for
6 the head regions would be larger, correct?

7 A. Yeah, occupying more pixels. Percentage-wise
8 will be about the same. It will occupy more pixels in
9 the image.

10 Q. Does Figure 1 illustrate a picture taken by
11 the camera in the media exposure environment?

12 A. Well, Figure 1 provides an illustration.
13 Figure -- the next figure on page 41 gives you a more
14 practical illustration where you see people are sitting
15 on the couch. In that case, obviously they're reading
16 some notebook, but that's a typical environment where
17 people would be sitting there. And then assume a TV is
18 across from where they're at. So instead of looking at
19 the document in their hand, they're looking at the TV,
20 which is probably about, you know, 2 to 3 meters away.

21 Q. So Figure 1 does not illustrate a picture
22 taken by the camera in the media exposure environment,
23 correct?

24 A. I think you're misrepresenting what I just
25 said.

1 Q. Sir, I'm not trying to rephrase what you are
2 saying. This is a new question.

3 A. So you see in '243, as I read to you on
4 Column 4, line 52, "Figure 1 is an illustration of an
5 example media exposure environment, 100, including a
6 media presentation device," et cetera, et cetera.

7 So clearly, the patent owner has intended
8 Figure 1 to be an illustration of an example media
9 exposure environment.

10 Q. Figure 1 includes the camera in the media
11 exposure environment, correct?

12 A. I'm sorry?

13 Q. Figure 1 includes the camera in the media
14 exposure environment, correct?

15 A. That is correct. The device labeled "104" is
16 essentially your audience measurement device.

17 Q. So it does not illustrate a picture taken by
18 that device, correct?

19 A. I think you're misrepresenting what the
20 patent is saying. So if you look at Column 4 and you
21 continue reading from line 52 on, you can see "Figure 1
22 is an illustration of an example media exposure
23 environment," labeled "100." You have a media
24 presentation device. "An example audience" --

25 Q. Sir, my question is a yes or no question. Do

1 you have a yes or no answer to that?

2 A. It's not a yes or no question. I'm
3 describing to you what the -- what they're describing.

4 So you see -- starting at line 56, you see it
5 says "In the illustrated example of Figure 1, the media
6 exposure environment is a room of a household,"
7 et cetera, et cetera.

8 "The example" -- if you go down to line 62,
9 "The example audience measurement device, 104" -- that
10 you see there in the picture -- "can be implemented in
11 additional and/or alternative types of environments such
12 as, for example, a room in a statistical" -- whatever --
13 et cetera, et cetera -- "theatre," et cetera, et cetera.

14 MR. QIU: Strike as non-responsive.

15 Q. So your opinion is Figure 1 illustrates a
16 picture that would have been taken by the camera in the
17 media exposure environment, correct?

18 MR. SNADER: Objection; mischaracterizes
19 prior testimony.

20 A. So look at Column 5, line 9. So you see
21 where it says "The example audience measurement device,
22 104, of Figure 1 utilizes a camera, 110, to capture a
23 plurality of time-stamped frames of image data of the
24 environment, 100."

25 Q. Let's go to your -- paragraph 57 of your

1 supplemental declaration.

2 A. Paragraph 57.

3 Q. There you include an image of two adults and
4 two children. Is that correct?

5 A. That is correct.

6 Q. The picture was taken from an online shopping
7 webpage for the sofa in the image. Is that correct?

8 A. I don't remember, but that seems correct.

9 Q. Does the image include a television?

10 A. Well, the image doesn't show a television,
11 obviously, because the television is assumed to be
12 across from where the people are at. This image is
13 meant to illustrate the scaling of faces in a typical
14 scenario of audience -- in a typical, you know -- where
15 people would be sitting and watching TV.

16 Q. The image you used has a resolution of
17 1200-times-960. Is that correct?

18 A. That's what it states on page 41. That is
19 correct.

20 Q. By 2011, were there cameras that were able to
21 take photos of 5 megapixels?

22 A. I believe that's correct. Yes.

23 Q. By 2011, were there cameras that were able to
24 take photos of 10 megapixels?

25 A. I would have to look. Off the top of my

1 head, I can't tell you exactly when each cameras were
2 introduced. I would have to look to be more specific.

3 Q. If an image of a media exposure environment
4 has a resolution significantly greater than the
5 resolution of the picture shown in paragraph 57 of your
6 supplemental declaration, will your estimation reach a
7 greater resolution for the heads in the image?

8 MR. SNADER: Objection; calls for
9 speculation.

10 A. I think you're missing the point here,
11 Counselor. So that image is trying to show you the
12 relative scale of a head/face in comparison to a typical
13 viewing environment. So it doesn't really matter what
14 resolution you take the image at. The proportion will
15 be fairly similar. So it's the percentage that's more
16 important here than the specific resolution.

17 Q. Is it your opinion that all poses are
18 suitable for performing face recognition?

19 A. All --

20 MR. SNADER: Objection to form.

21 A. I didn't hear your question, sir.

22 Q. Is it your opinion that all poses are
23 suitable for face recognition?

24 A. All poses?

25 Q. Right, all poses or all orientations of the

1 head are suitable for face recognition.

2 A. There's a difference between poses and
3 orientation, so I have to be specific and careful. So
4 the more you turn away from the camera, the more
5 challenging it becomes to do face recognition.

6 Q. What orientations of the face are not
7 suitable for performing face recognition?

8 MR. SNADER: Objection; calls for
9 speculation.

10 A. Do you mean orientation of the head?

11 Q. Yes.

12 A. So if I'm looking backwards, obviously it's
13 not going to be suitable for face recognition.

14 Q. Why does -- why is it harder to perform face
15 recognition when a person turns away from the camera?

16 A. Well, you don't see the facial features as
17 clearly. You don't see the symmetry of the face. I
18 mean, most faces -- 99.99 of faces -- unless there's,
19 you know, God forbid, deformities, most faces have a
20 symmetry to them, and some algorithms will utilize that
21 symmetry to do face recognition.

22 But, you know, as you start to turn away from
23 the camera, it becomes more challenging to take that
24 head orientation of the, say, 30 degrees from the camera
25 and match it to a face in the database that's looking

1 straight at the camera. So now you have to get into
2 different orientations and try to reconcile that, which
3 adds more challenges.

4 Q. Can we use a confidence level or accuracy
5 level to characterize how likely face recognition will
6 be successful?

7 MR. SNADER: Objection; form.

8 A. Again, you have to -- I mean, it depends on
9 the application. I mean, you know, machine learning
10 applications do this all the time. They give you a
11 certain probability that this is Tom, but it could be
12 John, and it could be Frank.

13 So it depends on how the application is
14 constructed, how the approach is designed, whether you
15 get a confidence or a probability or just a binary
16 decision it's Tom or it's not Tom.

17 Q. Let's say -- if a face recognition algorithm
18 on a picture has a 25 percent chance of success, will it
19 identify the right person in 25 percent of the cases?

20 A. Well, you'd have to -- I would have to know
21 more about how you define that 25 percent exactly. We
22 have to see the experiments that you've done, how you've
23 done that. Is it done on -- what kind of pictures?
24 What kind of environment? There's a lot of parameters
25 to this.

1 Q. Can you please go to paragraph 61 of your
2 supplemental declaration.

3 A. 61. Yes, sir.

4 Q. It talks about a 25 percent chance of
5 success, correct?

6 A. So this is obviously trying to provide an
7 example, an illustration here to argue the point, to
8 make the point.

9 Q. Okay. So it talks about a 25 percent chance
10 of success. When it is not successful, what happens?

11 A. I don't know what you mean "when it is not
12 successful." So if it doesn't find a face in an
13 image -- if it doesn't find a face in frame, it could be
14 that there's no face in the frame. It could be that
15 there is a face in the frame, and it just didn't find
16 it. So it depends on how you design your algorithm what
17 to do next.

18 Q. What do you -- if we talk about a chance of
19 success for facial recognition, what does that mean?

20 A. It means you are recognizing Tom with a
21 certain level of accuracy. So I have a face in the
22 image. I have a database of 100 people. And that face
23 in the image I want to match to one of these templates
24 in the database with a certain level of accuracy. I'm
25 not sure I understand your question.

1 Q. Let me rephrase my question.

2 When facial recognition is unsuccessful, will
3 it identify a wrong person?

4 A. It could be that it didn't identify anything,
5 or it could be that it identified a person -- the wrong
6 person in your database. So I only have a hundred
7 people in my company that work for me. I have all their
8 faces. A new face came in that's not one of these 100.
9 It's not going to identify any one of them. That
10 doesn't mean it's not successful. It just said "This
11 face doesn't exist in your database." It depends --
12 you're asking very general questions, and you need more
13 specifics and more details to really answer
14 specifically.

15 Q. So when facial recognition is unsuccessful,
16 it is possible that no face is recognized, or it is
17 possible that a wrong person is identified. Is that
18 correct?

19 A. So assuming you detected the face correctly
20 and now you're trying to recognize it. So it could be
21 that the face doesn't exist in your database. So it's a
22 new face you've never seen, so the algorithm will not be
23 successful in finding the face in the database. That
24 doesn't mean it's not successful. It just says -- it's
25 been successful because it didn't match to anything in

1 the database. So it's actually told you that this face
2 doesn't exist. So that was a successful scenario. If
3 it matches Tom to John, then it's an unsuccessful
4 scenario unless John is a twin of Tom and the two are
5 identical twins. I mean, you're posing scenarios that
6 essentially require more details to answer with
7 specifics.

8 Q. Let's go to paragraph 63 of your supplemental
9 declaration. Please let me know when you're there.

10 A. Yes, I'm there.

11 Q. There you described the approach of Lu-000 of
12 matching face signatures to signatures stored in a
13 database. Is that correct?

14 A. Yes. That is generally correct.

15 Q. The reference Lu-000, which is Exhibit 1008,
16 discuss -- teaches storing multiple signatures
17 corresponding to different poses of the head of the
18 person, correct?

19 A. Can you upload the reference?

20 Q. Sure.

21 MR. SNADER: Counselor, while Dr. Saber
22 downloads that, I'll just note that you've got about
23 15 minutes left.

24 MR. QIU: Yep. Time noted.

25 (Exhibit Number 1008 introduced.)

1 A. I have downloaded your reference, but I do
2 need a two-minute break just to use the facilities.

3 Q. Okay. Can we be back at 4:45 your time?

4 A. Yeah. I just need two or three minutes just
5 to use the facilities. I'll be right back.

6 (Off the record: 1:44 p.m. to 1:46 p.m.)

7 Q. Dr. Saber --

8 A. Yes, sir.

9 Q. -- have you received Exhibit 1008?

10 A. I have, and I have it open.

11 Q. Let's go to paragraph 63 of your
12 declaration -- supplemental declaration.

13 A. Yes, sir.

14 Q. In the middle of that paragraph, there's a
15 sentence stating "Multiple reference signatures are
16 stored for each audience member to account for various
17 head poses." Is that correct?

18 A. You read it correctly.

19 Q. That refers to a teaching of Lu-000, correct?

20 A. That is correct. It's cited there as
21 Column 8, 36 through 40.

22 Q. Is it your opinion that Lu-000 teaches
23 storing signatures corresponding to all possible
24 orientations of a person's head?

25 MR. SNADER: Objection; vague and ambiguous.

1 A. Again, the use of "always," "all," "never" is
2 always problematic.

3 So Lu-000 stores multiple -- you know,
4 various profiles, obviously. As they discuss, "Multiple
5 reference signatures are stored for each audience member
6 to account for various head poses," which, you know, you
7 may have a few angles. You may have every angle. You
8 may have it 1 degrees. It doesn't really state clearly
9 how many. It just says you have multiple profiles -- or
10 multiple reference signatures.

11 Q. When you -- Lu-000 teaches to compare a newly
12 derived face signature with those stored in the
13 database. Is that correct?

14 A. What part of Lu are you referring to? Let's
15 be specific and accurate with the description.

16 Q. The last sentence of your paragraph 63, you
17 state "Thus, when a captured image is compared to the
18 referenced signatures to identify a match." And there
19 you cited to Lu-000, Column 7, lines 52 to 55.

20 A. Yes.

21 Q. So back to my question.

22 Does Lu teach comparing a new face signature
23 with -- to all the face signatures stored for a person
24 in the database?

25 A. So if you go to Lu Column 7, starting at

1 roughly line 49, 50.

2 So you see Lu there is discussing Figure 7,
3 which is a block diagram, essentially, that describes
4 his -- so the description in Lu of Figure 7 states
5 "Figure 7 is a block diagram of a recognition functional
6 portion of the audience recognition subsystem of the
7 image recognition system of Figure 1." So it's
8 essentially the recognition functional portion.

9 And if you look at Figure 7, you can see
10 Figure 7 is targeted for recognition. You can see the
11 switch, like, in between Figure 6 and Figure 7. You can
12 switch between learning and recognition. And then you
13 see a series of blocks that are in the figure starting
14 with zooming and head location to normalization,
15 thresholding, et cetera, et cetera.

16 So now if you go to the text, Column 7, the
17 lines that you just quoted, 52 and 55 or thereabout, you
18 see it says "A feature signature is extracted from the
19 B-sub image at feature signature extraction block 110."
20 So if you look at Figure 7, you see block 110 there, and
21 that block is essentially a feature signature extraction
22 block.

23 Q. Sir, can we go to the next sentence, to the
24 sentence you just talked about. The next sentence
25 states "The extracted B-sub image feature signature is

1 compared with each of the pattern image signatures
2 stored in the individual face library, as illustrated at
3 block 112, to identify a match." Is that correct?

4 A. That is correct.

5 Q. When you compare a face pattern image
6 signature derived from a facial image where the person
7 is looking to the -- let me -- strike that. Let me
8 rephrase the question.

9 When the orientation of the person's head for
10 the newly derived image feature signature is different
11 from the post -- from the orientation of the person's
12 head for a stored signature, is it true that there's a
13 low chance that their comparison will result in
14 identifying a person?

15 MR. SNADER: Objection; form.

16 A. So I think you're conflating and convoluting
17 things here together a bit.

18 So the face that you are -- looking at
19 Figure 7, the -- I mean, we are talking about
20 recognition. So you're going to do the zoom and head
21 location. You're going to do the normalization, the
22 thresholding, the feature extraction.

23 That face has a certain orientation that
24 you've done all this on. Let's say it's 10 degrees for
25 the purpose of discussion. So if you have a face in

1 that -- in your database of Tom and that is at 10
2 degrees or, say, 11 or 9 degrees or thereabout, you're
3 obviously going to correlate that face with the
4 signature with that in the database.

5 So you can see -- if you look at line 55 of
6 that Column 7, you can see "A particular audience member
7 is identified when the compared signatures exceed a
8 predetermined correlation threshold value corresponding
9 to the best matching rate or highest correlation with an
10 individual face pattern image signature in the
11 individual face library identified at the conclusion of
12 block 114."

13 So if that orientation of Tom is existing in
14 your database exactly as you have found, your
15 correlation is going to be very high. If it is -- the
16 angle is slightly off, it's going to drop. If it drops
17 below a certain point, you may say "Well, I think below
18 a certain point this is really not Tom now."

19 So that's essentially what -- in a nutshell,
20 so to speak, what's going on.

21 Q. So comparing two images where the person's
22 head angles are very different will not create a match
23 or a correlation. Is that correct?

24 MR. SNADER: Objection --

25 A. Well, I think you're misrepresenting what's

1 going on here. Because Lu-000 has multiple facial
2 signatures of Tom in the database at various head
3 orientations. So maybe Tom has 20 of those, one at
4 90 degrees, one at 85, one at 80, et cetera.

5 So you acquire an image of Tom where Tom is
6 looking at 20 degrees. You compute that face signature,
7 and you're comparing it to all those ones in the
8 database that you have -- among others, not just Tom.
9 There may be John there and Eli and Robin and Fred.
10 You're making this comparison, and then -- you're then
11 going to select the best match and decide whether that's
12 high enough to say it's Tom.

13 MR. SNADER: Counselor, do you have much
14 more? We're coming up on time.

15 MR. QIU: Yeah. Let me have my last -- very
16 last question.

17 MR. SNADER: Of course.

18 Q. Can you please go to paragraph 146 of your
19 original declaration, which is Exhibit 2001.

20 A. 146 of the original declaration. Yes, I am
21 there.

22 Q. There you -- in the subtitle, you state
23 "Petitioner's Proposed Modification Would Change the
24 Principle of Operations of Nielsen-372's System." Is
25 that correct?

1 A. You read that correctly.

2 Q. What is the principle of operation of
3 Nielsen-372?

4 A. Well --

5 MR. SNADER: Objection; vague and ambiguous.

6 A. And I don't have Nielsen here, so you would
7 have to upload it. And I think we're running out of
8 time. I don't have Nielsen, so you would need to upload
9 it.

10 Q. Could you explain Nielsen's principle of
11 operation in your declaration?

12 A. I don't have it memorized off the top of my
13 head. I would need to look at Nielsen.

14 Q. Okay. That's fine.

15 MR. QIU: Since we are out of time -- yeah.
16 That's the end of my questioning at this deposition.

17 MR. SNADER: Nothing on redirect.

18 THE REPORTER: I just need to confirm
19 transcript orders, and we're good. I don't need the
20 doctor for anything unless Counsel does.

21 THE WITNESS: Thank you very much. I need to
22 sign off, because I have a class to teach.

23 I appreciate it, Mr. Qiu. Thank you very
24 much. It's been a pleasure talking to you today.

25 MR. QIU: Thank you so much, Dr. Saber.

1 Thank you very much for your time.

2 MR. SNADER: Thank you, Dr. Saber.

3 THE WITNESS: The pleasure has been all mine,
4 Mr. Qiu.

5 THE REPORTER: Mr. Qiu, I have you down for a
6 transcript in five business days.

7 MR. QIU: Yep. And that would be -- which
8 day will that be delivered?

9 THE REPORTER: It's next Wednesday with the
10 holiday. Is that okay?

11 MR. QIU: Yes. That's fine.

12 THE TECHNICIAN: And, Counsel, would you like
13 the exhibits attached?

14 MR. QIU: No. All of the exhibits have been
15 filed in this case, so we don't need --

16 THE TECHNICIAN: Okay. Got it.

17 THE REPORTER: Mr. Snader, did you need the
18 transcript?

19 MR. SNADER: Yeah, the same, five business days.

20 (Proceedings concluded at 2:00 p.m.)
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C E R T I F I C A T E

I, Crystal Hereford, Certified Reporter and
Notary Public within and for the State of California,
do hereby certify:

That Dr. Eli Saber, 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,
was represented by counsel at the deposition.

I further certify that the deposition of
Dr. Eli Saber, occurred virtually on Tuesday,
July 2, 2024, commencing at 7:32 a.m. PST to 2:00 pm PST.

I further certify the inspection, reading
and signing of said deposition were not waived by
counsel for the respective parties and by the witness.

I further certify that I am not related to
any of the parties to this action by blood or
marriage, I am not employed by or an attorney to any
of the parties to this action, and that I am in no way
interested, financially or otherwise, in the outcome

1 of this matter.

2 IN WITNESS WHEREOF, I have hereunto set my
3 hand this 10th day of July, 2024.

4
5
6 *Cyrtel Hereford*
7

8 _____
9 NOTARY PUBLIC IN AND FOR THE
10 STATE OF CALIFORNIA
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Re: Deposition of **Dr. Eli Saber**

Date: 7/2/2024

Case: TVision Insights, Inc. -v- The Nielsen Company (US), LLC (PTAB)

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ACKNOWLEDGMENT OF DEPONENT

I, Dr. Eli Saber, do hereby acknowledge that I have read and examined the foregoing testimony, and the same is a true, correct and complete transcription of the testimony given by me and any corrections appear on the attached Errata sheet signed by me.

____ July 13, 2024 ____

(Date)



(Signature)

