

EXHIBIT 1045

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

ADB Safegate Sweden AB,
ADB Safegate BV, and
ADB Safegate Americas, LLC,

Petitioner,

v.

Case PGR2023-00053

U.S. Patent No.

Honeywell International Inc.,

11,538,349

Patent Owner.

EXPERT DEPOSITION OF CHRISTOPHER K. WILSON

July 25, 2024

8:53 a.m.

3 Embarcadero Center, 26th Floor

San Francisco, California

REPORTED BY:

Siew G. Ung

CSR No. 13994, RPR, CSR



<p style="text-align: right;">2</p> <p>1 APPEARANCES:</p> <p>2</p> <p>3 For Petitioner</p> <p>4 XSENSUS LLP</p> <p>5 MARC K. WEINSTEIN, ESQ.</p> <p>6 200 Daingerfield Road, Suite 201</p> <p>7 Alexandria, Virginia 22314</p> <p>8 571.376.6319</p> <p>9 marc.weinstein@xsensus.com</p> <p>10</p> <p>11 For Patent Owner</p> <p>12</p> <p>13 CROWELL & MORING LLP</p> <p>14 JOSHUA P. SMITH, ESQ.</p> <p>15 455 N. Cityfront Plaza Drive, Suite 3600</p> <p>16 Chicago, Illinois 60611</p> <p>17 312.840.3231</p> <p>18 joshsmith@crowell.com</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>	<p style="text-align: right;">4</p> <p>1 EXHIBITS PREVIOUSLY MARKED</p> <p>2 MARKED DESCRIPTION PAGE</p> <p>3</p> <p>4 Exhibit 1001 December 27, 2022, United States 28</p> <p>5 Patent No. US 11,538,349 B2,</p> <p>6 Poojary et al. (17 pages)</p> <p>7</p> <p>8 Exhibit 1003 Declaration of Mark Campbell, 28</p> <p>9 Ph.D. in PGR2023-00053</p> <p>10 (101 pages)</p> <p>11</p> <p>12 Exhibit 1004 March 3, 2022, United States 61</p> <p>13 Patent Application Publication</p> <p>14 No. US 2022/0066025 A1, Berkmo,</p> <p>15 et al. (23 pages)</p> <p>16</p> <p>17 Exhibit 2002 Declaration of Christopher K. 7</p> <p>18 Wilson in ADB Safegate et al. v.</p> <p>19 Honeywell, PGR2023-00053</p> <p>20 (65 pages)</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>
<p style="text-align: right;">3</p> <p>1 INDEX TO EXAMINATIONS</p> <p>2</p> <p>3 WITNESS: CHRISTOPHER K. WILSON</p> <p>4 EXAMINATION PAGE</p> <p>5 BY MR. WEINSTEIN 5</p> <p>6</p> <p>7</p> <p>8</p> <p>9</p> <p>10</p> <p>11</p> <p>12</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>	<p style="text-align: right;">5</p> <p>1 THURSDAY, JULY 25, 2024, 8:53 A.M.</p> <p>2 ***</p> <p>3 CHRISTOPHER K. WILSON,</p> <p>4 having been first duly sworn, was examined and</p> <p>5 testified as follows:</p> <p>6 MR. WEINSTEIN: So I'm Marc Weinstein. I'm --</p> <p>7 I'm here on behalf of the petitioners in the matter of</p> <p>8 PGR2023-00053 involving U.S. Patent Number 11538349.</p> <p>9 MR. SMITH: Joshua Smith. From Crowell and</p> <p>10 Moring, C-R-O-W-E-L-L, and Moring on behalf of patent</p> <p>11 owner Honeywell, Inc.</p> <p>12 THE WITNESS: And I'm Christopher Wilson,</p> <p>13 giving this deposition.</p> <p>14 EXAMINATION BY MR. WEINSTEIN</p> <p>15 Q. Good morning, Mr. Wilson.</p> <p>16 A. Good morning.</p> <p>17 Q. My name is Marc Weinstein. Very nice to meet</p> <p>18 you.</p> <p>19 Do you prefer I call you Mr. Wilson?</p> <p>20 A. Chris is usual.</p> <p>21 Q. Cool. Okay. I'm going to call you Chris,</p> <p>22 thank you. Feel free to call me Mark.</p> <p>23 I understand you have taken lots of</p> <p>24 depositions previously, so I'll just kind of briefly go</p> <p>25 over the rules just as a refresher/reminder.</p>



2 (Pages 2 to 5)

<p style="text-align: right;">6</p> <p>1 Please, when I ask you a question, to make</p> <p>2 sure you answer it orally. Shakes of your head or nods</p> <p>3 of the head won't be on the record.</p> <p>4 Just confirming that you do understand that</p> <p>5 you are under oath.</p> <p>6 A. I do.</p> <p>7 Q. And that you have to answer all questions</p> <p>8 truthfully.</p> <p>9 A. I do.</p> <p>10 Q. Are you on medications or have any illness</p> <p>11 this morning that would prevent you in any way from</p> <p>12 answering questions truthfully?</p> <p>13 A. No.</p> <p>14 Q. My typical practice is to take a break about</p> <p>15 every hour or so, but if at any time you need to take a</p> <p>16 break, feel free to ask. I only ask that if I have</p> <p>17 asked a question and you haven't answered yet, if you</p> <p>18 please answer that question first.</p> <p>19 A. No problem.</p> <p>20 Q. You understand you are being deposed in</p> <p>21 connection with your declaration that you submitted in</p> <p>22 PGR2023-0053 [sic] involving U.S. Patent Number</p> <p>23 11,538,349.</p> <p>24 A. Those numbers sound right.</p> <p>25 Q. Okay.</p>	<p style="text-align: right;">8</p> <p>1 correct?</p> <p>2 A. That is correct.</p> <p>3 Q. And according to your CV, you got your</p> <p>4 bachelor's degree in physics in 1981?</p> <p>5 A. That's correct.</p> <p>6 Q. And after you got your bachelor's degree in</p> <p>7 physics you did some graduate work between 1981 and</p> <p>8 1982?</p> <p>9 A. That's correct.</p> <p>10 Q. Did you do any other classroom work after</p> <p>11 that?</p> <p>12 A. I have done other classroom work generally --</p> <p>13 yes.</p> <p>14 Q. For -- for credit or just, you know?</p> <p>15 A. Not for degree.</p> <p>16 Q. Okay. When you were getting your bachelor's</p> <p>17 degree or in your graduate work, did any of your studies</p> <p>18 involve the use of LIDAR?</p> <p>19 THE REPORTER: Did you say "in your graduate</p> <p>20 work" or "in your undergraduate work"?</p> <p>21 MR. WEINSTEIN: In both. In getting your</p> <p>22 bachelor's degree or in your graduate work. That's</p> <p>23 correct.</p> <p>24 THE WITNESS: No.</p> <p>25 ///</p>
<p style="text-align: right;">7</p> <p>1 A. Yes.</p> <p>2 Q. And if I say "PGR," you understand I mean post</p> <p>3 grant review?</p> <p>4 A. Yes, I do.</p> <p>5 Q. And if I say the '349 patent or the '349 you</p> <p>6 understand I'm referring to U.S. Patent Number</p> <p>7 11,538,349?</p> <p>8 A. Again, that number sounds correct. Yes.</p> <p>9 Q. About how many times have you been deposed?</p> <p>10 A. I think a couple. 20 or a couple more than</p> <p>11 that.</p> <p>12 Q. Okay. And how many of those in the last five</p> <p>13 years or so?</p> <p>14 A. Probably half or so -- between -- between 10</p> <p>15 and 15, maybe, in the last 5 years.</p> <p>16 Q. Okay. I'm going to introduce -- the first</p> <p>17 exhibit is going to be Exhibit 2002, which is</p> <p>18 Mr. Wilson's declaration submitted in this matter.</p> <p>19 (Whereupon, previously marked Exhibit 2002</p> <p>20 was presented to the witness.)</p> <p>21 THE WITNESS: Thank you.</p> <p>22 MR. WEINSTEIN: Just in case, I have a copy</p> <p>23 for you as well.</p> <p>24 BY MR. WEINSTEIN:</p> <p>25 Q. Your CV was attached to your declaration,</p>	<p style="text-align: right;">9</p> <p>1 BY MR. WEINSTEIN:</p> <p>2 Q. Same question with respect to Radar.</p> <p>3 MR. SMITH: Objection. Form.</p> <p>4 THE WITNESS: No.</p> <p>5 BY MR. WEINSTEIN:</p> <p>6 Q. And in getting your bachelor's degree or in</p> <p>7 your graduate work, did any of your studies involve the</p> <p>8 use of cameras or camera sensors?</p> <p>9 A. Yes.</p> <p>10 Q. What was that work related to?</p> <p>11 A. At least one example, my thesis was on an</p> <p>12 astronomical project, so I was using an early CCD camera</p> <p>13 for as- -- astronomical research through a telescope.</p> <p>14 Q. In that early CCD camera, do you recall what</p> <p>15 type of data was produced by it?</p> <p>16 A. It was image data.</p> <p>17 Q. What form was the image data?</p> <p>18 A. It was, you know, electronic -- an electronic</p> <p>19 image file of some type.</p> <p>20 Q. Would it have included RGB data?</p> <p>21 A. I believe it was black and white, so it would</p> <p>22 have been just intensity data, not RGB. It was a long</p> <p>23 time ago.</p> <p>24 Q. Okay. Do you recall if that camera produced</p> <p>25 any data with respect to depth?</p>

<p style="text-align: right;">10</p> <p>1 A. It did not.</p> <p>2 Q. And since your -- you completed your graduate</p> <p>3 studies in 1982, in your experience, have -- have there</p> <p>4 been advancements in the use of LIDAR since 1982?</p> <p>5 A. Yes.</p> <p>6 Q. What kind of advancements with respect to</p> <p>7 LIDAR have there been?</p> <p>8 A. I would say the big advancement is that the</p> <p>9 cost has come down a lot. There's been a lot of</p> <p>10 developments in commercializing the technology, making</p> <p>11 it much more available -- mostly around cost, but also</p> <p>12 just implementing it for commercial types of purposes.</p> <p>13 Q. Have there been any technical improvements</p> <p>14 beyond lowering costs?</p> <p>15 A. Yes. I think lasers in general have developed</p> <p>16 a long way. I don't believe we really had solid-state</p> <p>17 lasers back in the 1980s. Obviously, a lot more</p> <p>18 electronics, the sensitivity of the detectors, many</p> <p>19 changes along those lines.</p> <p>20 Q. So has -- has there been an improvement in the</p> <p>21 quality of the data produced by LIDAR with respect to</p> <p>22 how it was in 1982?</p> <p>23 A. Yes. Certainly at a given cost point, yeah.</p> <p>24 Q. And with respect to Radar have there been</p> <p>25 advancements in Radar technology since 1982?</p>	<p style="text-align: right;">12</p> <p>1 between 2015 and 2020, would they be learning different</p> <p>2 things about these types of sensors? LIDAR, Radar, with</p> <p>3 and without cameras, compared to what you learned?</p> <p>4 A. Well, the physics is still the same of all of</p> <p>5 them, but the -- you know, the technologies have</p> <p>6 changed. As with computing in general, there's been a</p> <p>7 lot of advancements in 40 years.</p> <p>8 Q. Have you ever taught any classes?</p> <p>9 A. I have.</p> <p>10 Q. Where have you taught?</p> <p>11 A. I taught when I was in graduate school. I</p> <p>12 taught some undergraduate physics classes. I have done</p> <p>13 a number of docent types of teaching, but not formal</p> <p>14 classroom types of things.</p> <p>15 Q. What do you mean by docent type of teaching?</p> <p>16 A. Mostly at nature preserves, local nature</p> <p>17 preserves, so leading trips and teaching people about</p> <p>18 the flora and fauna of the region.</p> <p>19 Q. Okay. That's interesting. Okay.</p> <p>20 So but at least with respect to teaching</p> <p>21 technological things, you haven't done that since you</p> <p>22 were a graduate student in 1982? Is that correct?</p> <p>23 A. Not formally, that's correct.</p> <p>24 Q. Are you familiar with what the curriculum is</p> <p>25 for a graduate from college from, say, 2020 in</p>
<p style="text-align: right;">11</p> <p>1 A. Yes.</p> <p>2 Q. What kind of advancements in Radar?</p> <p>3 A. Again, advancements in Radar have been largely</p> <p>4 moving to higher frequencies, which allows much better</p> <p>5 resolution. So spatial resolution has improved a lot.</p> <p>6 I would say that would be the main area.</p> <p>7 Obviously, a lot of decrease in cost for</p> <p>8 equivalent functionality.</p> <p>9 Q. And have there been improvements in camera and</p> <p>10 camera sensors since 1982?</p> <p>11 A. Yes.</p> <p>12 Q. What kind of advancements in cameras?</p> <p>13 A. Again, there -- I was working with a CCD</p> <p>14 camera. Now most cameras are CMOS, so a different</p> <p>15 underlying technology. Better performance in a number</p> <p>16 of parameters, I think, since that time, including</p> <p>17 noise -- less noise in the sensors, more sensitivity,</p> <p>18 more dynamic range.</p> <p>19 Q. What -- what do you mean by "more dynamic</p> <p>20 range"?</p> <p>21 A. The ability for a single sensor to record both</p> <p>22 very light and very dark portions of a scene in the same</p> <p>23 frame.</p> <p>24 Q. So if -- compared to your experience as a</p> <p>25 student between the late '70s and 1982 and a student</p>	<p style="text-align: right;">13</p> <p>1 electrical engineering?</p> <p>2 A. My son graduated in computer science in 2022,</p> <p>3 so I have a fairly good idea, from his college, of what</p> <p>4 the curriculum was like. But I haven't -- I haven't</p> <p>5 been in college since -- for a few years.</p> <p>6 Q. Neither have I.</p> <p>7 Did you speak to your son about the classes he</p> <p>8 took in preparation for today's deposition?</p> <p>9 A. No, I did not.</p> <p>10 Q. Did you meet your attorney in preparation for</p> <p>11 this deposition?</p> <p>12 A. Yes.</p> <p>13 Q. For how long?</p> <p>14 A. We met for about eight hours yesterday.</p> <p>15 Q. Did you review any documents in preparation</p> <p>16 for today's deposition?</p> <p>17 A. I did.</p> <p>18 Q. Which documents did you review?</p> <p>19 A. I reviewed my declaration as well as the</p> <p>20 Poojary and the Berkmo and Richmond.</p> <p>21 Q. Any other documents?</p> <p>22 A. I looked at some other documents. I looked at</p> <p>23 the petition, but didn't -- you know, didn't go over it</p> <p>24 in any depth. I looked at Mr. -- Dr. Campbell's report,</p> <p>25 but again, didn't go over through that in depth.</p>

<p style="text-align: right;">14</p> <p>1 Q. Did you review any of the documents cited in 2 Dr. Campbell's report? 3 A. I don't -- let's see. 4 Obviously, he cited to Berkmo and Richmond, so 5 I did look at those. I don't recall looking at -- at 6 other ones yesterday. 7 Q. Did you review -- besides Berkmo and Richmond, 8 did you review any documents cited in Dr. Campbell's 9 declaration in preparing your declaration? 10 A. Yes, I did. 11 Q. Did you review all of the documents that were 12 cited in it? 13 A. I believe so. But again, that was a couple 14 months ago now, so I couldn't be sure, but I know I 15 reviewed -- I believe I at least looked at all of them. 16 Q. Did you review the file history for the '349 17 patent? 18 A. Yes, I did. 19 Q. When did you review that? 20 A. It would have been in preparing my report. I 21 don't recall anything specific or terribly relevant 22 about the file history. 23 Q. Could you turn to Paragraph 31 of your 24 declaration, that's Exhibit 2002. 25 A. Okay.</p>	<p style="text-align: right;">16</p> <p>1 Q. So the standard -- the POSITA standard we say 2 is that: At least a degree in electrical engineering, 3 computer engineering, computer science, or a similar 4 discipline, with at least two years of relevant industry 5 or research experience including experience designing, 6 planning, or implementing sensor networks using LIDAR, 7 Radar, and/or cameras in corresponding data analysis. 8 What is your understanding of what a POSITA 9 would understand about designing, planning, or 10 implementing LIDAR, Radar and/or cameras and 11 corresponding data analysis? 12 A. So my understanding of that is that a POSITA 13 would have had -- 14 (Fire drill.) 15 THE WITNESS: So my understanding is that a 16 POSITA at the time would have an understanding of the 17 basic characteristics of those sensors, their strengths 18 and weaknesses, how the -- what the data from those 19 sensors looks like and how it can be used in a general 20 sense as well as a -- some knowledge of how those 21 sensors are used in the real world. 22 BY MR. WEINSTEIN: 23 Q. Would they have any understanding of how to 24 use those sensors in combination? 25 A. In a broad sense, yes.</p>
<p style="text-align: right;">15</p> <p>1 Q. So you say in this paragraph that you agree on 2 the same standard for a POSITA, that's P-O-S-I-T-A, as 3 the petitioner set forth and as adopted by the board? 4 A. I do. 5 Q. And you understand that the standard for a 6 POSITA -- and just for the record, a POSITA is a person 7 of ordinary skill in the art, but for the purposes of 8 the deposition, I'm just going to say POSITA instead of 9 six words. 10 Do you understand that the agreed-upon 11 standard for a POSITA is someone with a relevant 12 bachelor's degree such as electrical engineering, 13 computer science, and at least two years of relevant 14 industry experience including designing, planning, and 15 implementing sensor networks with LIDAR, Radar, and 16 cameras with corresponding Radar analysis? 17 A. Yes, I do. 18 Q. And that standard for a POSITA is of as of 19 August 2020, correct? 20 A. Yes. 21 Q. With that definition, what is your 22 understanding of what a POSITA would understand about 23 using LIDAR, Radar, and cameras in combination with 24 corresponding data? 25 A. I guess I'm not clear on the question, so....</p>	<p style="text-align: right;">17</p> <p>1 Q. Would they have any understanding of how to 2 use the data from those sensors in combination? 3 A. Yes. 4 Q. So I know you indicated that your thesis 5 related to it. Besides your thesis, do you have any 6 experience working with camera images? 7 A. Yes. 8 Q. What experience was that? 9 A. While I was at GTE, I was doing a lot of work 10 on reconnaissance systems, so that was space-borne 11 cameras, also cameras on aircraft, so mostly for 12 reconnaissance types of applications, and that would 13 have been up till about 1990. 14 (Fire drill.) 15 THE WITNESS: So I was -- I was discussing my 16 experience with camera systems up through 1990, which 17 were mostly on reconnaissance types of satellites and -- 18 and aircraft. 19 I -- from 1990, I started working more in the 20 automotive space. There I was interested in two things. 21 One was automotive cameras, so I did a lot of work, 22 starting in the mid-2000s on automotive cameras, mostly 23 for collision warning, obstacle detection types of 24 applications. 25 I also worked with cameras for mapping</p>

<p style="text-align: right;">18</p> <p>1 applications, so that would have been aerial cameras, 2 again, as well as using automotive cameras for mapping 3 types of applications. 4 I guess in -- starting about 2016 or so, I was 5 working extensively with a company on using stereo 6 cameras for 3D reconstructions. 7 Q. Have you developed and coded any object 8 detectors using camera sensors that use machine learning 9 methods and image data? 10 A. I think -- I have not developed them 11 personally, but I'm familiar with them. 12 Q. Do you know what specific methods have been 13 used in the ones you are familiar with? 14 A. Can you repeat the question again? 15 Q. So you said that you haven't developed object 16 detectors using camera sensors that use machine learning 17 methods and image data, but you are familiar with them. 18 Do you know what specific methods have been 19 used in the ones that you are familiar with? 20 A. We were doing a lot of work on the 21 convolutional neural networks -- 22 THE REPORTER: Convolutional neural networks? 23 THE WITNESS: Neural networks. 24 So that was one of the areas. That was a lot 25 of work prior to that, but I don't know that they would</p>	<p style="text-align: right;">20</p> <p>1 the camera would often be integrated with a Radar, so 2 the -- the system as a whole would be integrated with 3 different sensors. 4 Q. Okay. So did that system include -- is 5 that -- let me strike that. 6 Besides cameras, did that system use sensors 7 other than cameras? 8 A. So while I was at Mercedes, we were working at 9 -- on obstacle detection/obstacle avoidance systems that 10 used cameras and Radars, and in such of the research we 11 were using LIDARS, and I was involved in developing some 12 of the algorithms and specifications for those systems. 13 Q. When was that? 14 A. That would have been the 2000s -- 2000 to 2008 15 or so. 16 Q. Did that tracking system fuse the output data 17 from the camera sensor with the Radar or the LIDAR? 18 MR. SMITH: Objection. Relevancy. 19 THE WITNESS: The -- the systems used the 20 output from cameras and Radar in -- in order to 21 determine if the vehicle needed to take some action. So 22 it -- 23 BY MR. WEINSTEIN: 24 Q. But did it use the camera data and Radar data 25 independent of each other?</p>
<p style="text-align: right;">19</p> <p>1 have been characterized as using artificial 2 intelligence/machine learning techniques. 3 BY MR. WEINSTEIN: 4 Q. So similarly, have you developed and coded any 5 object detectors using cameras that use deep learning 6 methods and image data? 7 A. No. 8 Q. Have you ever developed a dynamic tracking 9 system using camera sensors that track moving objects 10 from a moving vehicle? 11 A. Yes. When you say "developed" what -- 12 Q. Did you design a dynamic tracking system using 13 camera sensors that track moving objects from a moving 14 vehicle? 15 A. I was involved in the design of some of the 16 algorithms for such a system. 17 Q. Did -- what -- what kind of system was that 18 for? 19 A. This would have been for -- mostly for 20 tracking other vehicles, pedestrians from a -- from a 21 car, a camera mounted in a car. 22 Q. Did that tracking system use detections from 23 multiple types of sensors? 24 A. I think you were -- I believe you are 25 referring to a camera system. The camera didn't, but</p>	<p style="text-align: right;">21</p> <p>1 A. There were various systems that fused the data 2 at different points in the process, but they were -- and 3 some of the systems would work independently as well. 4 There was a -- there was a number of systems being 5 developed at the time at different price points and 6 functionalities. 7 Q. So you are saying there were various systems 8 that fused the data at different points. 9 Can you elaborate on that? 10 A. One of the issues in automated vehicles is at 11 what point the data from various sensors gets combined. 12 And, you know, sometimes the -- and that can be done at 13 a very high level where the sensors provide, 14 essentially, the raw data to a single processor that 15 does the kind of combination, or it can be done at a low 16 level where the individual sensors do a lot of the 17 processing. And then, essentially, the results -- it's 18 like an object list, would get combined at a higher 19 level in the system. 20 So those are -- you know, broadly speaking, 21 those are two approaches. And which one you use depends 22 on a number of different factors. 23 Q. Is that type of two different procedures, one 24 where you combine at the raw data level versus combining 25 after some individual or independent processing, is</p>

<p style="text-align: right;">22</p> <p>1 that -- those two different approaches, is that 2 sometimes referred to as early versus late? 3 A. It could be referred to as that, and it's 4 also -- you know, they're not necessarily different 5 approaches. They -- you know, the engineering problem 6 is figuring out how to combine those two and whatever 7 optimal -- you know, with whatever requirements are 8 needed to be met. 9 Q. So just confirming then. In the system that 10 you were implementing when you were working at Mercedes, 11 it did do some form of combining of camera data with 12 Radar data? 13 A. Yes. And -- and I worked on several different 14 systems, but at least some of them did, yes. 15 Q. And you -- you said also that you did do some 16 experimenting with LIDAR. 17 In your experiments with LIDAR, did you also 18 do any combining of camera data with LIDAR data? 19 A. Yes. 20 Q. Do you recall the specific methods you used to 21 do the combining? 22 A. No. 23 Q. Do you recall if, in implementing those 24 systems, you used any type of Kalman filtering? Kalman 25 is K-A-L-M-A-N.</p>	<p style="text-align: right;">24</p> <p>1 algorithms to automatically scan through image data 2 collected from various sources and, you know, try and 3 find these vehicles, try and find places the vehicles 4 could go, characterize: Could one have driven down this 5 road or that road? So there's a fair bit of work in 6 that area, among other places. 7 Q. Interesting. 8 You also indicate in your CV that in 1987 and 9 2017 you did 3D scene reconstruction from imagery and 10 photogrammetry. 11 THE REPORTER: Wait, can you say that again? 12 MR. WEINSTEIN: You did 3D scene 13 reconstruction from imagery and photogrammetry. 14 Photogrammetry is photo, G-R-A-M-M-E-T-R-Y. 15 BY MR. WEINSTEIN: 16 Q. Can you explain what that involved? 17 A. So that was -- what were the years on that? 18 Q. In -- in 1987 and in 2017. 19 A. Okay. So 2017 was mostly working for 20 mapper.ai, which is a start-up company here in 21 San Francisco. They were using stereo cameras or a 22 stereo camera system to do mapping from cop vehicles, so 23 high-accuracy mapping of the roadways and the 24 environment around the roadways. 25 Q. What is a stereo camera?</p>
<p style="text-align: right;">23</p> <p>1 A. We would have used -- we did use Kalman 2 filtering for object tracking. I don't recall that it 3 was used in the combination of -- yeah, so yes, we did 4 use Kalman filters for object tracking or target 5 tracking. 6 Q. And that Kalman filtering would have used data 7 from both the target sensor and the Radar? 8 A. Yes. 9 Q. And then in the experiments you did with 10 LIDAR, it would have used the camera data in combination 11 with both LIDAR [sic]? 12 A. I don't recall using that with the LIDAR. We 13 did not do -- I was not working with LIDAR as much as 14 cameras and Radars. 15 Q. In your opinion, is using Kalman filtering 16 something within the ability of a POSITA as defined in 17 this -- for the '349 patent? 18 A. Yes. 19 Q. In -- in your CV you refer to, in 1986, that 20 you did image recognition and processing algorithms for 21 various reconnaissance assets. 22 Can you elaborate more on what that means? 23 A. One of the problems at the time was locating 24 mobile missile systems in the Soviet Union, I guess, at 25 the time. And so one of the problems I worked on was</p>	<p style="text-align: right;">25</p> <p>1 A. A stereo camera is a set of two cameras that 2 have a known spatial relationship with each other, so 3 that the data from two images collected simultaneously, 4 that the two cameras can be correlated and depth 5 information can be derived from that stereo camera 6 system. 7 Q. What data is produced by a stereo camera? 8 A. Each of the individual cameras would produce a 9 2D image, you know, essentially a photograph, an 10 electronic version of a photograph. Those are then 11 defined through a computation process to create or 12 assign depth to the various features of -- in the 13 images. 14 Q. So to provide that depth information, do you 15 need a separate processor independent of the cameras to 16 perform that function? 17 A. You need a processor to do that. It could 18 presumably be integrated into one of the cameras, but 19 you need to combine the data into the two individual 20 cameras. They need to be brought to a common processor, 21 which then needs to do some -- process the data with 22 some various algorithms. 23 Q. So for example, if I had the two cameras for 24 the stereo camera system, I could have one camera with 25 this processor implementing the algorithm to calculate</p>

<p style="text-align: right;">26</p> <p>1 the depth, and it would -- that -- that camera would 2 then just be connected to the other camera to be able to 3 receive the image data from that other camera? 4 A. Well, you'd need -- I mean, I think there's 5 essentially a processor in each camera for the 6 collecting, and there's a third processor to do the -- 7 the combination of the two. That could be in either of 8 the cameras or colocated or even the same processor, or 9 it could be at some third location. 10 Q. Also from your CV, from 2002 to 2016, you did 11 assist- -- assessment of image-based FCW AEB and lane 12 following systems. 13 Is that correct? 14 A. Yes. 15 Q. What is FCW? 16 A. FCW is forward collision warning. So that is 17 a system looking in front of a vehicle and identifying 18 something that there may be a collision with and warning 19 the driver. 20 Q. And what -- what did you do for those 21 assessments? 22 A. Those assessments -- it was doing two sorts of 23 assessments. One was for Mercedes internally, and that 24 was looking at various prototype systems and evaluating 25 them.</p>	<p style="text-align: right;">28</p> <p>1 essentially, evaluate their risk, you know, their 2 likelihood of a collision in order to determine 3 insurance premiums. 4 Q. Can you turn to Paragraph 37 of your 5 deposition? 6 THE REPORTER: Of your deposition? 7 THE WITNESS: Paragraph 37. 8 BY MR. WEINSTEIN: 9 Q. I'm sorry. Of your declaration -- that's 10 correct. 11 A. Okay. 12 MR. WEINSTEIN: And before I ask a question 13 right now, I'm going to introduce two more exhibits. 14 The first exhibit is Exhibit 1001, which is U.S. patent 15 11,538,349. 16 And the other is Dr. Campbell's declaration. 17 That's Exhibit 1003. 18 (Whereupon, previously marked Exhibits 19 1001 and 1003 were presented to the 20 witness.) 21 BY MR. WEINSTEIN: 22 Q. In Paragraph 37 of your declaration, you say 23 in the first line that you agree with Dr. Campbell's 24 description of cameras, correct? 25 A. I do.</p>
<p style="text-align: right;">27</p> <p>1 The second assessment was I was working in 2 conjunction with other OEMs, so basically all of the 3 major OEMs, trying to determine validation metrics for 4 these types of systems that would be regulated by the 5 government. 6 So it was in the interest of the automotive 7 community to have a set of standards to design these 8 systems against, and so we were working to develop a set 9 of standards that would not bias the results towards any 10 particular technology or car company, but that the 11 government could use to, you know, regulate these 12 devices and set standards for these devices in vehicles. 13 Q. When were you working with these OEMs to do 14 those assessments? 15 A. That would have been from about 2000 to 2008. 16 There was a number of different projects we did during 17 that time. I believe the forward collision warning was 18 more towards the earlier end of that. 19 Q. And between 2010 and 2016, what type of 20 assessments did you do for that technology? 21 A. Between -- in that time frame, that was 22 mostly -- well, somewhat related to insurance 23 processing. 24 So this was, you know, is it possible to use 25 this sort of data to determine how somebody drives and,</p>	<p style="text-align: right;">29</p> <p>1 Q. You also noted that there are techniques to 2 augment camera data with depth information, correct? 3 A. I do say that Dr. Campbell asserts that there 4 are techniques to augment camera data with depth 5 information such as the use of stereo cameras or depth 6 estimation software. However, nowhere in Berkmo or 7 Richmond is there any discussion of 3D image data, 8 stereo cameras, or depth estimation software. 9 Q. Okay. Do you agree that there are techniques 10 to augment camera data with depth information? 11 A. Yes. 12 Q. What techniques are you aware of? 13 A. Certainly, there is the stereo camera 14 technique that I mentioned earlier that requires two 15 cameras and some processing in order to derive through 16 the information associated with the images. 17 THE REPORTER: Derive or drive? 18 THE WITNESS: Derive. 19 BY MR. WEINSTEIN: 20 Q. Are you aware of any other techniques? 21 A. There is the structure through motion 22 techniques of where the camera is moving, and so you can 23 see how objects move relative to each other, and -- and 24 develop some 3D structure from that. 25 Q. Does that require the camera to be moving or</p>

<p style="text-align: right;">30</p> <p>1 does it require the content of what it's imaging to be 2 moving or both? 3 MR. SMITH: Objection to form. 4 MR. WEINSTEIN: Let me break that down. 5 BY MR. WEINSTEIN: 6 Q. Does that require the camera to be moving? 7 A. Typically, it is done with the camera moving. 8 But if there are objects moving in the scene, there may 9 be some level of reconstruction possible. But 10 typically, one needs to know, in order to scale the 11 results, one needs to know how much movement is taking 12 place. And so that is typically known on the camera 13 side, not the target side. 14 Q. But in your opinion, it would be possible with 15 a fixed camera and moving objects to use an algorithm to 16 determine depth information? 17 A. It depends on the context here and what one 18 knows about the scene. The problem is determining 19 scale, primarily, and without something in the scene to 20 provide scale, some known -- known object, it really -- 21 you know, deriving depth information or deriving the 3D 22 component -- I wouldn't say it can't be done, but it 23 would depend on the scenario. It's not trivial. 24 Q. What information is available when you use a 25 moving camera for this depth information determination</p>	<p style="text-align: right;">32</p> <p>1 characterize this as the ability to identify and 2 discriminate objects, that is determining "what" is 3 there as opposed to determining that "something" is 4 there. 5 Do you see that? 6 A. Yes. 7 Q. Can you explain what you mean by the 8 difference between determining what is there versus 9 determining that something is there? 10 A. Yeah. And I think this is what Dr. Campbell 11 was getting to, but one of the main benefits of a -- of 12 a camera is the ability to look at something and -- and 13 run identification algorithms on it and determine that 14 this thing is a Russian missile or a person or a dog. 15 And those, determining what the object is with 16 Radar, LIDAR, is not as easy. The cameras are ideally 17 suited for that problem -- 18 Q. Uh-huh. 19 A. -- of: What is this thing I'm facing? 20 Q. Okay. So in determining what is there is -- 21 is being more specific than just generally that there is 22 something there. Is that correct? 23 A. Yes. 24 Q. So you are describing that basically then as 25 the ability of the camera to detect an object?</p>
<p style="text-align: right;">31</p> <p>1 that is not available if you have a fixed camera but 2 moving objects? 3 A. Essentially you are getting stereo information 4 with a moving camera. You take a picture at one time 5 and from a -- from one position, and then you take a 6 picture at a different time and a different position. 7 So as long as things have not moved in the 8 scene, you essentially have a scenario camera if you 9 know the baseline or at least how much the camera has 10 moved in the -- in the meantime. So -- and it does 11 require that the scene is stationary as well so you 12 don't have movement there. 13 Q. For that technique with a moving camera, is 14 that within the ability of a POSITA? 15 A. Yes. 16 Q. Why is it within the ability of a POSITA? 17 A. It is -- again, it's -- it involves two steps. 18 One is tracking the camera. The other is combining 19 images in a -- a stereo -- combining two images in a 20 stereo manner to derive 3D, both of which are, you know, 21 well understood. 22 Q. Can you refer to Paragraph 38 of your 23 declaration? 24 A. Okay. 25 Q. In the -- the last sentence, you say: I</p>	<p style="text-align: right;">33</p> <p>1 A. To identify. 2 Q. To identify an object? 3 A. To identify an object. 4 Q. How -- how does the camera go about detecting 5 and identifying an object? 6 A. Well, there are two different processes. 7 Detecting is -- you know, a -- a scene is collected in 8 the image. There is generally a process then to segment 9 the image into different portions that may be the same 10 thing -- hopefully they are the same thing. And then 11 those portions are analyzed in some way to determine 12 what that thing is that that bounding box typically 13 would -- is -- is that a car? Is that a motorcycle? Is 14 it a person? Similar to a question like that. 15 Q. Would a POSITA be familiar with that process 16 for detecting and identifying objects -- 17 A. Yes. 18 Q. -- with camera data? 19 THE REPORTER: With camera data? 20 MR. WEINSTEIN: Yes. 21 THE WITNESS: Yes, they would. 22 BY MR. WEINSTEIN: 23 Q. Would a POSITA also be familiar with using 24 machine learning to do that -- detecting and identifying 25 of objects?</p>

<p style="text-align: right;">34</p> <p>1 A. Yes.</p> <p>2 Q. So outside the context of stereo cameras, it</p> <p>3 is correct that a camera produces a 2D image?</p> <p>4 A. An individual camera produces a 2D image, yes.</p> <p>5 Q. In a camera as of August 2020, what kind of</p> <p>6 data is typically within the 2D image provided by a</p> <p>7 camera?</p> <p>8 A. The 2D image would consist of a set of pixels,</p> <p>9 2D dimensions, you know, 2D -- two dimensional set of</p> <p>10 pixels, each pixel typically having three values: One</p> <p>11 corresponding to the amount of red in the pixel, another</p> <p>12 the blue, and then the green. So three intensity values</p> <p>13 per element of the array.</p> <p>14 Q. How is that data produced by the camera?</p> <p>15 A. It is produced by the light essentially</p> <p>16 knocking electrons loose from a semiconductor, and the</p> <p>17 system counting the charge that builds up as -- as a</p> <p>18 measure of the amount of light that entered that pixel</p> <p>19 when the -- when the camera was on or the shutter was</p> <p>20 open.</p> <p>21 Q. Uh-huh. What is your understanding --</p> <p>22 understanding of a point cloud?</p> <p>23 A. A point cloud is typically associated with</p> <p>24 LIDAR data. It is a 3D set of -- of returns, if you</p> <p>25 will, from the LIDAR laser, you know, providing or --</p>	<p style="text-align: right;">36</p> <p>1 would be the type of data that is present in a 3D point</p> <p>2 cloud?</p> <p>3 A. It is generally the 3D locations of -- of</p> <p>4 surfaces.</p> <p>5 Q. And just confirming, you did say before that</p> <p>6 it could possibly be generated by Radar and by stereo</p> <p>7 cameras, correct?</p> <p>8 A. They would generate point cloud data or point</p> <p>9 cloud-like data.</p> <p>10 Q. So -- like for example if I had a stereo</p> <p>11 cameras -- stereo camera and it outputted the RGB data</p> <p>12 in combination with the depth, would that be considered</p> <p>13 3D point cloud data?</p> <p>14 A. I think it would depend on the context here, I</p> <p>15 mean, it could generate data that would be similar --</p> <p>16 you know, again, you'd have to get the 3D component from</p> <p>17 somewhere, but it could be similar to LIDAR point cloud</p> <p>18 data but I think it would depend on the -- I would have</p> <p>19 to understand the context better really to understand</p> <p>20 that question.</p> <p>21 Q. What context would you need to understand it</p> <p>22 better?</p> <p>23 A. I think the camera data tends to have this</p> <p>24 color component, so that is typically not associated</p> <p>25 with a LIDAR, or not associated with a point cloud.</p>
<p style="text-align: right;">35</p> <p>1 or the three dimensions being the azimuth and elevation</p> <p>2 the laser was pointed at the time, and then the distance</p> <p>3 to the object that is reflected.</p> <p>4 And so, typically, a point cloud is that set</p> <p>5 of points that represent target surfaces that the laser</p> <p>6 bounced off of.</p> <p>7 Q. Do other sensors produce 3D point clouds</p> <p>8 besides LIDAR?</p> <p>9 A. The 3D point cloud is typically associated</p> <p>10 with LIDARs, but the return from a Radar is similar, so</p> <p>11 there are other point cloud-like objects, but the</p> <p>12 term -- I don't believe it's limited to LIDAR, but it's</p> <p>13 generally applied in the context of LIDAR.</p> <p>14 Q. So would a POSITA understand then a point</p> <p>15 cloud is referring to data produced by LIDAR but not</p> <p>16 from other sensors?</p> <p>17 A. No, a -- the -- the canonical -- a POSITA</p> <p>18 would understand the canonical example of a point cloud</p> <p>19 comes from a LIDAR type of sensor --</p> <p>20 Q. Uh-huh.</p> <p>21 A. -- but that similar data can be generated by a</p> <p>22 Radar or possibly stereo cameras or -- a 3D model is</p> <p>23 generally the same data format and similar data to a</p> <p>24 LIDAR point cloud and may be considered a point cloud.</p> <p>25 Q. So whether produced by LIDAR or not, what</p>	<p style="text-align: right;">37</p> <p>1 Point clouds also tend to be quite dense.</p> <p>2 But to the extent a point cloud is this 3D --</p> <p>3 set of 3D surfaces -- or points representing 3D surfaces</p> <p>4 that could be derived -- a point cloud-like dataset</p> <p>5 could be derived from a 3D dataset such as one derived</p> <p>6 from stereo cameras.</p> <p>7 Q. So in -- in the LIDAR, you talked about how it</p> <p>8 detects surfaces, correct?</p> <p>9 A. Correct.</p> <p>10 Q. So the -- the data comes back. You have an</p> <p>11 elevation and azimuth and a depth; is that correct?</p> <p>12 A. From the LIDAR, yes.</p> <p>13 Q. And is it just an indication that there's a</p> <p>14 surface present, meaning that if I have, at this</p> <p>15 elevation, azimuth and depth, and I get a return, is</p> <p>16 the -- the value that is coming back in the LIDAR or is</p> <p>17 the data -- let me strike that.</p> <p>18 The LIDAR has information at a particular</p> <p>19 azimuth, elevation, and depth, correct?</p> <p>20 A. The LIDAR is essentially firing the laser beam</p> <p>21 into an azimuth and elevation space, and it gets a one</p> <p>22 or multiple returns from something reflecting that data</p> <p>23 back as well as noise and -- and other stuff.</p> <p>24 So what the LIDAR is recording is the -- well,</p> <p>25 it's recording that it got a -- a signal at a certain</p>

<p style="text-align: right;">38</p> <p>1 time corresponding to a certain distance. Those</p> <p>2 distances hopefully are surfaces of things reflecting,</p> <p>3 but can also be just noise or -- well, mostly they are</p> <p>4 representative of there's some object they are</p> <p>5 reflecting the -- the laser beam.</p> <p>6 Q. So is it effectively a binary value saying:</p> <p>7 Something was reflected at this depth or nothing was?</p> <p>8 A. No. It -- I mean, it can be. A sort of not</p> <p>9 very sophisticated LIDAR might only see one return. But</p> <p>10 more sophisticated ones will see, like glass, they would</p> <p>11 see a partial return from glass, but they would also see</p> <p>12 return from something behind that glass.</p> <p>13 Also, certain surfaces are dark surfaces, so a</p> <p>14 black surface reflects a lot less than a mirrored</p> <p>15 surface, so there's some information there. Black</p> <p>16 surfaces may not be detectable at all, so it's more</p> <p>17 complicated than just a binary.</p> <p>18 Q. So does it provide some level of intensity of</p> <p>19 the return at that depth?</p> <p>20 A. It often does. But, again, the intensity has</p> <p>21 some correlation with brightness or something like that,</p> <p>22 so it's not terribly useful.</p> <p>23 Q. So in -- an example, if LIDAR was going</p> <p>24 through a window and hit a building on the other side of</p> <p>25 the window, it would potentially get two returns, one</p>	<p style="text-align: right;">40</p> <p>1 reflected the light?</p> <p>2 A. Yes.</p> <p>3 Q. If I have a camera that is in a known position</p> <p>4 and it produces two or more 2D images of an object</p> <p>5 moving over time, is it possible to generate depth</p> <p>6 information that correlates to a 3D point cloud?</p> <p>7 A. You would have to -- as I talked about</p> <p>8 earlier, you would need to get some scale on this</p> <p>9 object. So you -- you could not generate -- no.</p> <p>10 THE REPORTER: No?</p> <p>11 THE WITNESS: No.</p> <p>12 BY MR. WEINSTEIN:</p> <p>13 Q. A camera can detect and identify objects,</p> <p>14 correct?</p> <p>15 A. Yes.</p> <p>16 Q. So if it identified an object and you knew the</p> <p>17 scale of that object, in that case, could a camera in a</p> <p>18 known position that produces two or more 2D images of a</p> <p>19 moving object over time, can that be used to generate</p> <p>20 depth information that correlates to a 3D point cloud?</p> <p>21 A. To the extent there is something in that</p> <p>22 object that has a known scale and orientation and there</p> <p>23 can be a sort of a measurement made on that object, one</p> <p>24 can start to generate that 3D information.</p> <p>25 MR. WEINSTEIN: We have been going about an</p>
<p style="text-align: right;">39</p> <p>1 for the window and one for the side of the building?</p> <p>2 A. Yes.</p> <p>3 Q. And I'm just trying to understand: What</p> <p>4 exactly, when they get that return, what information is</p> <p>5 actually imparted?</p> <p>6 A. What is imparted is the -- the sensor in the</p> <p>7 LIDAR is looking for the photons from the LIDAR, the</p> <p>8 correct frequency to arrive back at the sensor. So it</p> <p>9 could arrive, just randomly from sunlight, so the -- or</p> <p>10 the beam could be bouncing off a dust particle. But in</p> <p>11 general -- you know, so it's basically timing how long</p> <p>12 it took from the time the pulse was sent out till the</p> <p>13 time it returns, which corresponds to a distance.</p> <p>14 And so the complete LIDAR return would include</p> <p>15 the information on the timing of all the various photons</p> <p>16 that came back of the right frequency and their</p> <p>17 corresponding distance. But again, there's processing</p> <p>18 to throw a lot of those away that are noise --</p> <p>19 Q. Right.</p> <p>20 A. -- and clean that data up.</p> <p>21 Q. Right. And other than noise and reflected</p> <p>22 sunlight --</p> <p>23 A. Yeah.</p> <p>24 Q. -- and reflected dust particles, in general</p> <p>25 the return is: At this depth, there was a surface that</p>	<p style="text-align: right;">41</p> <p>1 hour. Would you like to take a break or do you want to</p> <p>2 keep going?</p> <p>3 THE WITNESS: Sure. I'm ready for a break, I</p> <p>4 think.</p> <p>5 (Recess taken.)</p> <p>6 BY MR. WEINSTEIN:</p> <p>7 Q. Can you turn to Paragraph 39 of your</p> <p>8 declaration, please.</p> <p>9 A. Okay.</p> <p>10 Q. And you see, in the first line of that</p> <p>11 paragraph like you did with cameras, you agree with</p> <p>12 Dr. Campbell's description of Radar in Paragraph 44 of</p> <p>13 his declaration?</p> <p>14 A. Yes, I do.</p> <p>15 Q. So it -- it's your understanding that a Radar</p> <p>16 sensor can provide location and speed. Is that correct?</p> <p>17 A. Yes.</p> <p>18 Q. What is the raw data that a Radar sensor</p> <p>19 produces?</p> <p>20 A. So are you talking about the sort of internal</p> <p>21 sensor level or -- so there's a fair bit of processing</p> <p>22 done in a Radar. So do you mean sort of before or after</p> <p>23 that core processing?</p> <p>24 Q. Yes. So I guess -- so we can talk about both.</p> <p>25 So first, what -- what is the raw data before that</p>

<p style="text-align: right;">42</p> <p>1 internal processing is implemented? What is the raw 2 data? What is the signal that is actually produced by 3 the sensor? 4 A. So the Radar produces a waveform of some form, 5 sends that out into space. Unlike the laser, it's 6 generally sort of sent out over a broad region as 7 opposed to the LIDAR systems which send it out in a very 8 particular azimuth and elevation. 9 The Radar then receives reflected versions of 10 that transmitted signal, and then the Radar processes 11 those -- compares those reflected versions to the 12 transmitted versions to derive the distance and some 13 information about the azimuth and elevation of the 14 target. 15 Q. And -- and so the -- the distance, azimuth, 16 and elevation, would you classify that together as the 17 location? 18 A. Yes. 19 Q. And you also indicated that it determines 20 speed? 21 A. Yes. As a part of the process to determine 22 distance, depending on the type of Radar, it can also 23 determine speed. Radars have a fundamental sort of 24 tradeoff between accuracy and speed and accuracy and 25 location, and so some Radars only tell you speed, some</p>	<p style="text-align: right;">44</p> <p>1 with Radar is the beams are generally not very narrow. 2 So unlike a LIDAR -- LIDAR, which is returning data from 3 a very specific azimuth/elevation location, the Radar, 4 the energy is going into a large range of azimuths and 5 elevations, or a large variation in azimuth and 6 elevation. And so the returns -- it's difficult to 7 determine where, in azimuth and elevation, a return 8 is -- is coming from. Radars are not very good at that. 9 And so what you get is a -- sort of a general 10 sense of the azimuth and elevation for an object. 11 And -- and so you will get a location for -- for that, 12 but the location is not as precise in azimuth and 13 elevation as it is for the LIDAR, you know. 14 Con- -- conversely, you get a very accurate 15 speed on the object, rate of speed, if that is what you 16 are interested in getting. 17 Q. Okay. So then how does the Radar find 18 specific datapoints associate with an object? 19 A. So one of the things I talk about -- you know, 20 somewhere here, I can't -- it's not here. One of the 21 issues Radars have is that they -- the return -- the 22 amplitude of the return tends to be very sensitive to, 23 you know, metallic structures and the exact angle of the 24 reflection. 25 Q. Uh-huh.</p>
<p style="text-align: right;">43</p> <p>1 only tell you location. Most sort of give you some of 2 both. 3 Q. Did you say accuracy and speed or accuracy in 4 speed? 5 A. Accuracy -- the tradeoff -- I don't know what 6 I said. It -- 7 Q. So I -- 8 You said a tradeoff between accuracy and speed 9 and accuracy and location? 10 A. I meant between location and speed. 11 Q. Right. 12 A. Not -- accuracy is -- yeah. 13 Q. So the more accurate the location, the less 14 accurate the speed. The more accurate the speed -- 15 A. Correct, correct. 16 Q. -- and vice versa? 17 A. Yes. 18 Q. Do you see in Paragraph 39 where it says that 19 the spatial profile on an object is difficult to 20 discern, but the general location and speed can be 21 reliable? 22 A. Yes. 23 Q. When you use that term "object," does the 24 Radar return datapoints from objects? 25 A. So the Radar return -- one of the problems</p>	<p style="text-align: right;">45</p> <p>1 A. So if you are looking at a mirror, it's 2 obviously different than if you are looking at it 3 directly on as opposed to off at an angle. 4 And so typically in Radars, the return, one 5 pulse to the next, is substantially different, and so 6 there's some averaging to go on to put together these 7 pulses collected over half a second or a tenth of a 8 second, and determine, you know, the center of mass, if 9 you will, of this return, which is an object that's 10 maybe reported as that -- an object to other systems. 11 Did I answer the question? 12 Q. Yes. 13 So the -- would the azimuth and elevation 14 information improve over time if it's detecting the same 15 object? 16 A. Typically, the returns from the object are not 17 coming from the same spot in subsequent shots, if you 18 will, and so the azimuth and elevation, you may get 19 improvement in where the center of mass is, but you 20 really don't get much more information on the extent of 21 the -- you know, if it's a -- you know, a soccer ball or 22 a beach ball, assuming they were reflective. Radars are 23 not very good at differentiating size in that way is my 24 point. 25 Q. But with respect to azimuth and elevation over</p>

<p style="text-align: right;">46</p> <p>1 time, would that improve, even if it can't distinguish a 2 volleyball from a soccer ball? 3 A. I think the way I look at that is -- you know, 4 the azimuth and elevation of what? Because if you can't 5 tell the difference between a soccer ball and a -- a 6 beach ball. You know there's something out there, but 7 you are not really sure where it is, so I guess I would 8 have to think about this a little more as to what that 9 would mean. 10 Q. Okay. So I mean if a Radar -- let me ask it 11 differently. 12 If an object is fixed, it's not moving? 13 A. Uh-huh. 14 Q. The Radar can still detect it, yes? 15 A. Some types of Radar. Some -- some Radars 16 can't detect objects that aren't moving. 17 Q. If for a Radar that can detect an object that 18 is not moving, would the elevation and azimuth 19 information produced by the Radar improve over time as 20 it's continuing to detect that same object? 21 A. I don't think you would see a significant 22 improvement. And part of the reason is that there's a 23 lot out in the world that is not moving, and all of 24 those returns get sort of lumped together. The Radar 25 has a hard time distinguishing between any not --</p>	<p style="text-align: right;">48</p> <p>1 and so forth. But in general most people don't want to 2 deal with Radar data, so the more that is done in the 3 Radar itself the happier everybody else is downstream. 4 Q. In your experience, do Radars typically have 5 integrated software to filter the data to return only 6 one measurement per object? 7 A. In -- in many of the applications I have been 8 developing where the goal is to identify, you know, 9 targets, things it might hit, there is an effort made to 10 consolidate returns from a particular object to one -- 11 to one return or one set of parameters. And this gets 12 back to the question you asked earlier about combining 13 data. 14 It is possible to send the raw data to 15 something that integrates it, combines it with the LIDAR 16 and puts it all together in one big soup and stirs it. 17 More commonly and traditionally, there's an 18 object list that is generated from a Radar saying: You 19 know, I see this thing. It is, you know, at this 20 location. It's about this big. Maybe it's in this 21 bounding box, and it's moving at this speed. And 22 there's another thing over here. 23 And it -- so it will track a set of objects 24 and provide rough object positions along with velocity 25 and other parameters that it can detect.</p>
<p style="text-align: right;">47</p> <p>1 anything that is at the same speed, so any not moving 2 things at a particular range. 3 So especially with not-moving targets, it can 4 be very hard to discriminate them from the background. 5 Basically everything in the scene that is not moving, 6 which is most stuff. 7 Q. So we talked a little bit about the raw data 8 before it -- it gets detected by the data sensor, and 9 then it does a bunch of processing so you can, for 10 example, get location and speed. 11 Is that processing to produce a location and 12 speed, is that typically built into the Radar? 13 A. At least some of that is built in. It depends 14 on the characteristics of the Radar. And so whether 15 it's done in the same chip or not is -- may or may not 16 be, but it is -- it is done with the -- the -- in view 17 of the characteristics of the Radar. It's not a 18 general-purpose processing that needs to be associated 19 with a particular Radar. 20 Q. So typically the Radar device then would have 21 some specific algorithms knowing its characteristics 22 about the data that's sent -- the signals it's sending 23 out and the data it's getting back to be able to do this 24 processing to determine location and speed? 25 A. Yes. I mean it again depends on the use case</p>	<p style="text-align: right;">49</p> <p>1 Q. So then it is fair to say that typically the 2 Radar would be configured to have software to filter the 3 data to produce only one measurement per object? 4 A. I wouldn't say that's typical, but that's 5 not -- it's not uncommon by any means. 6 Q. What is typical then? 7 A. I think it depends on the application, what 8 you are trying to do. Again, there's some where you 9 need more information. You lose a lot of information in 10 that process, and if you need that information, you 11 know, it -- the -- sending an object list is not going 12 to be sufficient. 13 Q. Okay. Again, referring to Paragraph 39, I 14 mentioned the sentence where you say that elevation and 15 azimuth is rather poor so that the spatial profile of an 16 object is difficult to discern, but the general location 17 and speed can be reliable. 18 If you had -- so -- just to summarize, you are 19 saying that in general, elevation and azimuth data from 20 the Radar is poor, correct? 21 A. The location of an object in elevation and 22 azimuth is -- is poor, certainly, compared to a LIDAR. 23 Q. If you had another azimuth measurement that 24 could be combined with the Radar's azimuth measurement, 25 would that combination be more accurate?</p>

<p style="text-align: right;">50</p> <p>1 A. It very much depends on the circumstances. I 2 mean, certainly in -- the -- the key problem there is, 3 you know, determining what's the same object. So if you 4 are measuring -- what is it you are measuring? And are 5 you looking at the same thing with the, say, LIDAR and 6 the Radar? 7 Q. So it -- 8 A. And, you know, it's fairly easy, if you are 9 looking into the sky and there's only one thing to sort 10 of say: Okay. We are looking at the same thing. 11 But in a complex environment such as an 12 airport, there's stuff all over the place. And so the 13 problem of knowing: You know, is my LIDAR looking at 14 the same thing that my Radar is sending a return from or 15 that this camera image is showing, especially with the 16 -- matching that to the Radar -- matching the Radar to 17 the camera and the LIDAR can be quite complex in a 18 complex environment like that. 19 Q. So let's say then in a simplified environment, 20 would the azimuth data from a different sensor that is 21 looking at the same thing as the Radar, would that, in 22 combination, provide an improvement to the accuracy of 23 the azimuth measurement? 24 A. I think as a general rule, the more data one 25 has, assuming the data is characterized correctly and</p>	<p style="text-align: right;">52</p> <p>1 Q. Okay. And so if you found an object from the 2 camera image and you had the azimuth and elevation 3 information, is it possible to match that object 4 detected in the camera image with an object detected by 5 the Radar? 6 A. Again, assuming everything is calibrated, 7 it -- it might be, but it's going to depend on, you 8 know, as I mentioned before, the -- the Radar is going 9 to be vague as to exactly where -- 10 Q. Uh-huh. 11 A. -- there's something out there in this area 12 saying "the pixels" is a very specific area. 13 So being able to say that, you know, this 14 distance return is -- from the Radar is from this 15 particular pixel, that is not a trivial -- it would 16 depend on the context and the scene and those sorts of 17 things. 18 Q. But even if it's not as accurate, the Radar 19 can produce elevation and azimuth information, correct? 20 A. It does produce some -- a very -- a fairly 21 coarse, a relatively coarse azimuth and elevation 22 returns from a Radar. 23 Q. And you referred to a calibrated camera. What 24 do you mean by a calibrated camera? 25 A. By that, I mean that specifically there, the</p>
<p style="text-align: right;">51</p> <p>1 calibrated, the better the results are, again, if the 2 analysis is done properly. But it's a bunch of 3 assumptions that's based on. 4 Q. Okay. If you had a camera with a 2D image 5 of -- a 2D image plane of pixels and you had a detection 6 algorithm using the camera to find objects in those 7 pixels, would the return from that data include azimuth 8 and elevation? 9 A. Can you ask the question again? 10 Q. So if I had a camera that is producing a 2D 11 image plane of pixels -- 12 A. Uh-huh. 13 Q. -- and I -- it had a detection algorithm to 14 find objects in those pixels -- 15 A. Uh-huh. 16 Q. -- would the return from that analysis include 17 azimuth and elevation? 18 A. So the azimuth and el- -- assuming you have a 19 calibrated camera and all that -- 20 Q. Uh-huh. 21 A. -- there is an azimuth and elevation that 22 would be associated with each pixel. So to the extent 23 there is something in the image that is in certain 24 pixels, each of those pixels could be associated with an 25 azimuth and elevation.</p>	<p style="text-align: right;">53</p> <p>1 calibration of azimuth and elevation of a particular 2 pixel, in relation to, say, the -- the bore sight, if 3 you will -- 4 THE REPORTER: Bore sight? 5 THE WITNESS: Bore sight, the camera. 6 So understanding where, you know, each of the 7 pixels is in space relative to all the other pixels in 8 the camera as a whole. 9 BY MR. WEINSTEIN: 10 Q. All right. So based on -- if you knew the 11 specific model of the camera and you actually, based on 12 its specs, you actually did an analysis with the camera 13 to make sure the specs match up, with that information 14 you would be able to get accurate information about the 15 elevation and azimuth of each pixel? 16 A. Assuming you know where the camera is pointed. 17 Q. Uh-huh. 18 A. Yes. 19 So if you had the calibrated camera, you -- 20 and you knew something was in a particular pixel, you 21 could theoretically go into the space and draw a line 22 from the camera to somewhere and say: This object is 23 somewhere along this line. 24 Q. Okay. 25 So in this example of a camera having -- you</p>

<p style="text-align: right;">54</p> <p>1 know, producing a 2D image plane of pixels and a 2 detection algorithm that finds objects within those 3 pixels, would it be within the ability of a POSITA to 4 determine the elevation and azimuth of the detected 5 object? 6 A. A POSITA could -- could calibrate a camera, 7 would understand how to calibrate a camera so that a 8 particular pixel was associated with a particular ray, 9 if you will, in real space. 10 Q. Okay. And so just to confirm, a POSITA would 11 be able to understand in that context how to determine 12 the elevation and azimuth? 13 A. Yes. A POSITA could determine the elevation 14 and the azimuth associated with a particular pixel of a 15 calibrated camera. 16 Q. And so with that elevation and azimuth 17 information -- strike that. 18 So we talked a little bit about the -- the 19 complexities of that combination between -- if I have 20 the elevation and azimuth data from the camera and the 21 relatively imprecise information and azimuth data of the 22 Radar, what are the complexities involved that would 23 make that combination difficult? 24 A. Can you explain the combination again? 25 Q. So I -- we have been talking about Radar and</p>	<p style="text-align: right;">56</p> <p>1 A. There might be some information about the -- 2 those -- that, especially if the vehicle is moving 3 still. 4 Q. Uh-huh. 5 A. Once it's stopped it gets harder. But again, 6 it's -- it's going to be -- you know, there's something 7 out there at 30 meters. There's something else at 35, 8 and something at 37, and something -- you know, really 9 reflective at 40. 10 Q. Uh-huh. 11 A. You get information along those lines, but -- 12 but not the ability to associate that with the nose of 13 the aircraft or the engine or something you would -- 14 that would be obvious in a camera image. 15 Q. Uh-huh. Can you explain a bit more about what 16 are the difficulties with the elevation and azimuth 17 information produced by the Radar? Is it just that it's 18 inaccurate -- let me strike that. 19 What are -- what makes the elevation and 20 azimuth information produced by the Radar not as 21 accurate? 22 A. The -- the basic issue there is that the 23 energy from the Radar is not going out in a particular 24 direction. You know, a laser is very focused. The 25 Radar tends to throw the energy sort of out everywhere,</p>
<p style="text-align: right;">55</p> <p>1 one of the issues with Radar is that it does not produce 2 highly accurate elevation and azimuth information -- 3 A. Uh-huh. 4 Q. -- and we were just talking about how with 5 cameras, with a calibrated camera, that you could 6 determine the elevation and azimuth. 7 A. Uh-huh. 8 Q. You had also talked about how there was some 9 difficulties in combining those two elevations and 10 azimuths. Can you explain those complexities or 11 difficulties? 12 A. Yeah, I think, you know, as proposed to 13 this -- related to this patent, I mean, if I have a 14 camera image and there's a plane in it, I could 15 presumably see in the plane -- let's assume we are 16 looking at the front of the plane -- we see the nose and 17 we see the wings. The Radar would tell us, you know, 18 there's something out there 30 meters away, but it's not 19 going to tell us that that's the nose or the wings or 20 the -- the front wheel or whatever. We can't get that 21 information. And so -- yeah. 22 Q. Would the Radar -- in that example of a Radar 23 detecting the -- the aircraft, would it have different 24 information about the distance to the nose versus the 25 distance to the wing?</p>	<p style="text-align: right;">57</p> <p>1 and so anything in that beam is going to reflect that 2 energy back. And so it makes it difficult to, you know, 3 basically be able to tell where something was in that 4 space because the -- the energy is going over a broad 5 area rather than to specific areas like a laser would. 6 Q. Does the Radar do a scan? Like, for example, 7 does it do a horizontal scan? 8 A. It might. This, again, depends on the type of 9 Radar. There's all different sorts of Radars. Some 10 Radars would scan, other Radars don't. But in general, 11 it's -- it's got to do with the fact that the 12 wavelengths from Radar is much longer -- 13 Q. Uh-huh. 14 A. -- and so it can't be focused as well as LIDAR 15 or as light. 16 Q. Right. What's the difference then between a 17 scanning Radar and one that does not scan? 18 A. One would be whether the antenna is physically 19 moved or the -- the beam is physically moved throughout 20 space. You know, the scanned horizontally and/or 21 vertically. 22 Q. If it is being physically moved with scanning, 23 does that provide better information about elevation and 24 azimuth? 25 A. Well, the -- the elevation and azimuth</p>

<p style="text-align: right;">58</p> <p>1 resolution, if you will, corresponds roughly to the size</p> <p>2 of that beam --</p> <p>3 Q. Uh-huh.</p> <p>4 A. -- and so a small beam scanned is going to</p> <p>5 provide more resolution than a large beam that covers</p> <p>6 the same area all at once.</p> <p>7 Q. Uh-huh.</p> <p>8 A. But again, with Radar, you just can't get the</p> <p>9 beams to be on the scale of -- of a laser or the scale</p> <p>10 of a camera.</p> <p>11 Q. Right. But it still -- if I did have a</p> <p>12 smaller Radar beam that is scanning, that would provide</p> <p>13 better information about elevation and azimuth than one</p> <p>14 with a larger beam that is not scanning?</p> <p>15 A. Yes.</p> <p>16 Q. Can you look at Paragraph 41 of your</p> <p>17 declaration.</p> <p>18 A. Okay.</p> <p>19 Q. In the middle of the paragraph you say: This</p> <p>20 data can easily be translated into a 3D Cartesian</p> <p>21 coordinate system relative to the sensor.</p> <p>22 Is that translation done by an algorithm that</p> <p>23 is in the LIDAR?</p> <p>24 A. That algorithm could be in the LIDAR or -- or</p> <p>25 not. It could be done either way.</p>	<p style="text-align: right;">60</p> <p>1 association of identifying an object. That would be</p> <p>2 done at a later step in the process. The LIDAR just</p> <p>3 returns these point clouds -- returns a point cloud</p> <p>4 where everything is of equal interest -- or equal</p> <p>5 objectivity within the point cloud.</p> <p>6 Q. So you would then have to do some type of</p> <p>7 detection algorithm from the point cloud to find an</p> <p>8 object?</p> <p>9 A. Again, there's typically a segmentation step</p> <p>10 where you look at a point cloud data cloud and you say:</p> <p>11 I think these surfaces belong to the same thing, so that</p> <p>12 might be something that's done. And there's -- at least</p> <p>13 with camera data, there's typically a third step or</p> <p>14 another step which would be: What is this object?</p> <p>15 Typically not done with LIDAR, just because they don't</p> <p>16 have sufficient information for that.</p> <p>17 Q. So is that type of detection typically done</p> <p>18 within the LIDAR or independent of the LIDAR?</p> <p>19 A. Again, it could be either, but, you know, the</p> <p>20 point cloud is the sort of basic LIDAR output. The</p> <p>21 object segmentation could be done in the next step.</p> <p>22 Obviously, that could be integrated into the LIDAR, but</p> <p>23 that doesn't need to be.</p> <p>24 Q. Is that detection of an object using the 3D</p> <p>25 point cloud data from a LIDAR, is that detection</p>
<p style="text-align: right;">59</p> <p>1 Q. Is it fair to say generally that a lot of the</p> <p>2 processing of the raw data, whether from a camera, from</p> <p>3 a LIDAR, or a Radar, can be done within a particular</p> <p>4 sensor or it can be done independent of the sensor?</p> <p>5 A. That's generally true. I mean, up to a</p> <p>6 certain point. I mean, with a Radar certain -- some of</p> <p>7 the processing needs to be done in the sensor itself.</p> <p>8 Q. Uh-huh.</p> <p>9 A. But at a certain point, the -- the data is</p> <p>10 generic enough, if you will, that it can be processed</p> <p>11 somewhere else.</p> <p>12 Q. In the last sentence, you say that multiple</p> <p>13 scans, each corresponding to a point cloud, can be</p> <p>14 combined to derive speed information from various</p> <p>15 objects.</p> <p>16 Do you see that?</p> <p>17 A. Yes, I do.</p> <p>18 Q. Here again, you used the term "object."</p> <p>19 Does the LIDAR return datapoints from objects?</p> <p>20 A. It returns datapoints from surfaces typically,</p> <p>21 and those surfaces usually are associated with an</p> <p>22 object.</p> <p>23 Q. How does the LIDAR find the datapoints that</p> <p>24 are associated with the object?</p> <p>25 A. The LIDAR -- the LIDAR itself does not do the</p>	<p style="text-align: right;">61</p> <p>1 something that is within the ability of a POSITA?</p> <p>2 A. Yes.</p> <p>3 Q. How does the -- how do the multiple scans get</p> <p>4 combined to derive speed information?</p> <p>5 A. This is basically just a distance over time</p> <p>6 calculation. If I have two scans and I can correlate</p> <p>7 some point between the two scans, I can -- and I know</p> <p>8 the time difference, I can compute a speed.</p> <p>9 Q. Do you need to determine which points in the</p> <p>10 3D point cloud correspond to objects and which do not?</p> <p>11 A. For what purpose? I don't understand the</p> <p>12 question.</p> <p>13 Q. Well, let me strike that then.</p> <p>14 Let me ask it differently: Is everything in</p> <p>15 the 3D point cloud produced by a LIDAR representative of</p> <p>16 an object?</p> <p>17 A. Other than the noise, it's all representative</p> <p>18 of something, yes.</p> <p>19 Q. Okay.</p> <p>20 MR. WEINSTEIN: I'm going to introduce the</p> <p>21 Exhibit 1004. The Berkmo reference.</p> <p>22 (Whereupon, previously marked Exhibit 1004</p> <p>23 was presented to the witness.)</p> <p>24 BY MR. WEINSTEIN:</p> <p>25 Q. You understand that when I'm referring to</p>

<p style="text-align: right;">62</p> <p>1 Berkmo, that I'm referring to Exhibit 1004?</p> <p>2 A. I do.</p> <p>3 Q. And do you agree that the sensors in Berkmo --</p> <p>4 let me ask that again.</p> <p>5 Do the -- do you agree that the sensors in</p> <p>6 Berkmo need not be colocated?</p> <p>7 A. I agree. In Berkmo, he indicates that the --</p> <p>8 (Fire drill.)</p> <p>9 THE WITNESS: Can you repeat the question?</p> <p>10 BY MR. WEINSTEIN:</p> <p>11 Q. Do you agree that the sensors in Berkmo need</p> <p>12 not be colocated?</p> <p>13 A. I agree that Berkmo shows examples, certainly,</p> <p>14 where the camera sensor is located at a different</p> <p>15 location than the LIDAR/Radar.</p> <p>16 I did disagree with Dr. Campbell's assertion</p> <p>17 that the -- one example showed the -- the Radar and</p> <p>18 LIDAR being located at different locations, but in</p> <p>19 general, Berkmo does disclose that the sensors can be at</p> <p>20 different locations.</p> <p>21 Q. Sorry, I didn't quite follow.</p> <p>22 Are you saying that Berkmo requires the LIDAR</p> <p>23 and Radar to be at the same location?</p> <p>24 A. No, I do not understand that from Berkmo.</p> <p>25 Q. Okay. So Berkmo itself teaches that the</p>	<p style="text-align: right;">64</p> <p>1 locations, but they aren't necessarily.</p> <p>2 Q. Do you have two sensors with overlapping</p> <p>3 coverage?</p> <p>4 Strike that.</p> <p>5 To have two sensors with the same coverage,</p> <p>6 would they have to be colocated?</p> <p>7 A. It would -- they don't have to be, no.</p> <p>8 Q. Can you go to Paragraph 45 of your</p> <p>9 declaration.</p> <p>10 A. Okay.</p> <p>11 Q. In your opinion, how far apart do sensors have</p> <p>12 to be so that they are no longer colocated?</p> <p>13 A. I think that definitely depends on the</p> <p>14 scenario, but here, in this example, I believe a POSITA</p> <p>15 would understand that these -- the sensors here shown in</p> <p>16 Figure 1, I think it is -- let's see -- in Figure 3, the</p> <p>17 LIDAR 110R and 110L [sic], I understand them to be</p> <p>18 located in the same box, if you Will. So within, say, a</p> <p>19 meter of each other.</p> <p>20 Q. And when you say that Berkmo does not disclose</p> <p>21 a configuration where the Radar and LIDAR sensors are</p> <p>22 displaced from each other, how far apart do they need to</p> <p>23 be before they are displaced?</p> <p>24 A. I don't think there's a hard limit there, but</p> <p>25 it would be based on them having different perspectives</p>
<p style="text-align: right;">63</p> <p>1 sensors need not be colocated, correct?</p> <p>2 A. I don't recall specifically commenting on that</p> <p>3 in my report with respect to the Radar and LIDAR. But</p> <p>4 certainly with respect to the camera system, it can be</p> <p>5 displaced from the Radar/LIDAR.</p> <p>6 Q. In your -- in Paragraph 43 you referred to</p> <p>7 Paragraph 20 of Berkmo.</p> <p>8 Exhibit 1004 is Berkmo and you referred --</p> <p>9 A. Correct.</p> <p>10 Q. -- to Paragraph 20.</p> <p>11 Can you take a look at Paragraph 20 of Berkmo?</p> <p>12 A. Okay.</p> <p>13 Q. In this paragraph it does teach that the --</p> <p>14 the respective coverages of the systems can be</p> <p>15 nonoverlapping, correct?</p> <p>16 A. Yes.</p> <p>17 Q. Would you agree that if two sensors do not</p> <p>18 have overlapping coverage that they need not be</p> <p>19 colocated?</p> <p>20 A. Can you rephrase that? That went sideways.</p> <p>21 Q. Yeah, that -- that has quite a few negatives</p> <p>22 in there.</p> <p>23 To have two sensors without overlapping</p> <p>24 coverage, can they be located at different locations?</p> <p>25 A. They certainly could be located at different</p>	<p style="text-align: right;">65</p> <p>1 on the scene. So, you know, for a situation like this</p> <p>2 where they are looking out to, say, 30 meters, I would</p> <p>3 say it would be something on the order of five to</p> <p>4 10 meters off the top of my head. Basically just enough</p> <p>5 so there would be a different perspective or</p> <p>6 significantly different perspective on the scene. But</p> <p>7 it -- that depends on the -- the use and the sensor.</p> <p>8 THE REPORTER: And the sensor?</p> <p>9 THE WITNESS: And the sensor, yes.</p> <p>10 BY MR. WEINSTEIN:</p> <p>11 Q. Excuse me. I didn't mean to cough during his</p> <p>12 answer and disturb your ability to transcribe.</p> <p>13 Could you go to Paragraph 44 of your</p> <p>14 declaration?</p> <p>15 A. Yes.</p> <p>16 Q. In the first sentence you say that Berkmo</p> <p>17 discloses providing the pilot of the aircraft with</p> <p>18 guidance information "to approach" or "to stop" based</p> <p>19 on, among other things, the ability to properly identify</p> <p>20 the aircraft, the presence of obstacles in the aircraft</p> <p>21 path, and/or system failure.</p> <p>22 A. That's correct.</p> <p>23 Q. Would having lead-in lines also provide the</p> <p>24 pilot with guidance information?</p> <p>25 MR. SMITH: Objection to form.</p>

<p style="text-align: right;">66</p> <p>1 THE WITNESS: The standard way today or -- of 2 not automated systems, the standard manner of providing 3 guidance to a pilot would be through a lead-in line. 4 That is, a line painted on the surface of the ground for 5 the pilot to follow. 6 BY MR. WEINSTEIN: 7 Q. Can you go to Paragraph 38 of Berkmo? 8 A. Okay. All right. 9 Q. Actually, could you just review Paragraph 37 10 and Paragraph 38, please? 11 A. Okay. 12 Q. Based on what you just reviewed in 13 Paragraph 37 and 38, would you agree that what's 14 described there, including the use of lead-in lines 15 helps to guide the pilot? 16 A. I agree that this discloses a lead-in line 17 that is there for helping to guide the pilot into the -- 18 or helping to guide the pilot, yeah. 19 Q. Okay. If I were to ask you to maneuver your 20 car into a parking space, what would you understand a 21 POSITA to understand about maneuvering? 22 MR. SMITH: Objection. Form. 23 THE WITNESS: So the moving into the parking 24 space would be -- if someone were to direct me to move 25 into a parking space.</p>	<p style="text-align: right;">68</p> <p>1 Q. If after turning right I told you to continue 2 to the next traffic light, would that be directional 3 guidance outside of the context of the '349 patent as 4 you have construed it? 5 Strike the question. 6 You -- you have a specific construction for 7 directional guidance in the context of the '349 patent, 8 correct? 9 A. That is correct. 10 Q. Do you agree that there is a dispute between 11 the parties over what the construction is of 12 "directional guidance"? 13 A. I was not -- I did not understand it, but I'm 14 not surprised. 15 Q. So you would understand that Petitioners do 16 not agree with the construction you propose for 17 directional guidance? 18 A. I have not been informed of that, but I would 19 take your word for it if you want to tell me that. 20 Q. So you said before: Outside of the -- because 21 I want to be specific about not -- outside the context 22 of the '349 patent, but I mean outside of the definition 23 that you have for directional guidance in the context of 24 the '349 patent. 25 When I say "outside of your definition," I</p>
<p style="text-align: right;">67</p> <p>1 BY MR. WEINSTEIN: 2 Q. To maneuver -- 3 A. -- to maneuver in any parking space, I would 4 interpret that to be direction to maneuver my car into 5 that particular location corresponding to the parking 6 space. 7 Q. If I told you to -- if you are in a vehicle, 8 and I told you to turn right at an intersection, is my 9 statement to you to turn right directional guidance? 10 A. I think in the context of, you know: Turn 11 right at the intersection, you know, given a particular 12 intersection, I would -- that could be considered 13 directional guidance, but not in the sense of this -- 14 the patent -- the -- the Poojary patent has, as I 15 understand it, you know, construed -- or I construed the 16 directional guidance in the Poojary patent as -- would 17 not be consistent with that definition -- or that 18 example. 19 Q. Okay. So it's directional guidance outside of 20 the context of the '349 patent? 21 A. Again, I didn't consider that. But, you know, 22 sitting here today, I would say that, you know, turn 23 right at that corner up ahead to get to the 7-Eleven, 24 you know, that would be construed as directional 25 guidance by a POSITA, I believe. Yes.</p>	<p style="text-align: right;">69</p> <p>1 mean the definition, the way you are construing 2 directional guidance in the '349 patent. 3 Is that clear? 4 A. It is, but I would characterize it as 5 Poojary's definition, not my definition, but it is, as I 6 understand, his definition, yes. 7 Q. So going back, outside of the definition that 8 Poojary has for directional guidance, you do agree that 9 telling someone to turn right at an intersection in a 10 vehicle is directional guidance? 11 A. You know, sitting here today -- again, I 12 didn't consider this outside of the patent, I -- I would 13 say that is directional guidance as part of directions 14 to a particular location. 15 Q. And similarly, after you turn right, if I told 16 you to continue to the next traffic light, outside of 17 the definition by Poojary for directional guidance, 18 would you consider that directional guidance? 19 A. I don't know that I would consider that next 20 step directional guidance. It's essentially a -- the 21 directional guidance would be: Turn right at the next 22 light, or -- or whatever. But just the -- you know, 23 don't do anything -- I'm not sure I would consider that 24 directional guidance, again, sitting here today. 25 Q. Can you turn to Paragraph 127 of Berkmo?</p>

<p style="text-align: right;">70</p> <p>1 You are there?</p> <p>2 A. Yes, I am.</p> <p>3 Q. You see, on the third line down it says ...to</p> <p>4 provide pilot maneuvering guidance information for</p> <p>5 aiding the pilot of an approaching aircraft in</p> <p>6 maneuvering aircraft towards the parking position.</p> <p>7 Do you see that?</p> <p>8 A. I do.</p> <p>9 Q. What guidance information aids the pilot to a</p> <p>10 parking position?</p> <p>11 A. I think there's many things that can aid -- I</p> <p>12 mean, this could be referring to -- this Paragraph 127</p> <p>13 could be referring to, you know, many different examples</p> <p>14 on its own. But looking at Berkmo in its entirety, you</p> <p>15 know, we have the examples of stopping or going as</p> <p>16 maneuvering guidance.</p> <p>17 Q. But this doesn't say: Maneuvering guidance</p> <p>18 information is limited to stopping and continuing, does</p> <p>19 it?</p> <p>20 A. This Paragraph 127 of Berkmo is fairly open in</p> <p>21 terms of what it would consider maneuvering guidance</p> <p>22 information. But there are other portions of Berkmo</p> <p>23 that are much more limited than this.</p> <p>24 Q. So instructing the pilot to stop or continue</p> <p>25 does aid the pilot to a parking position, correct?</p>	<p style="text-align: right;">72</p> <p>1 A. I'm trying to think of an example here, but --</p> <p>2 I mean, a simple example I'm thinking of is if you told</p> <p>3 me to approach the -- the pier outside the window here.</p> <p>4 I would go -- I would walk back behind myself</p> <p>5 to go find the elevator and to go down the elevator.</p> <p>6 And so, I mean, there is directional information there,</p> <p>7 but it is not according to -- I mean, it doesn't</p> <p>8 apply -- imply a particular direction to start the</p> <p>9 process. So that would be one example.</p> <p>10 Q. So if I am -- if my vehicle is moving in a</p> <p>11 specific direction and I tell you to continue, that's</p> <p>12 not telling you to stay in that direction?</p> <p>13 A. The example is to continue to approach the</p> <p>14 stand here. The -- if the stand -- it depends on where</p> <p>15 the stand is.</p> <p>16 First of all, if the stand is behind you, it</p> <p>17 could mean go in the other direction, you know, turn --</p> <p>18 turn around. I would also note that the stand is a</p> <p>19 broad area, and in fact the directional guidance needs</p> <p>20 to be to a particular spot on the stand, a parking spot,</p> <p>21 not the stand in general.</p> <p>22 Berkmo is just sort of saying: Approach this</p> <p>23 general area within which there is a specific spot you</p> <p>24 need to get to, but Berkmo does not mention that</p> <p>25 specific spot at all. He's just talking about, you</p>
<p style="text-align: right;">71</p> <p>1 A. The pilot's goal is to get to the parking</p> <p>2 position. The pilot wants to do that safely, so to the</p> <p>3 extent that the -- you know, it's safe or not safe,</p> <p>4 informing the pilot of it's safe to proceed or it's not</p> <p>5 safe to proceed, that's useful guidance information,</p> <p>6 certainly, to a pilot.</p> <p>7 Q. Okay. And beyond instructing the pilot to</p> <p>8 stop or continue, there are other ways to provide</p> <p>9 guidance to the pilot to aid him getting into the</p> <p>10 parking position, correct?</p> <p>11 A. Yes, there certainly are. And Poojary talks</p> <p>12 about several. And that's the speed guidance and</p> <p>13 directional guidance that Poojary talks about among</p> <p>14 others.</p> <p>15 Q. In your opinion, is instructing a pilot to</p> <p>16 continue approaching the stand providing directional</p> <p>17 guidance to the pilot?</p> <p>18 A. Not according to the Poojary patent.</p> <p>19 Q. According to the definition that you ascribed</p> <p>20 to directional guidance?</p> <p>21 A. Correct. Not according to how I understand</p> <p>22 Poojary to define guidance.</p> <p>23 Q. Can you explain to me how a pilot can continue</p> <p>24 approaching the stand without understanding what</p> <p>25 direction to go?</p>	<p style="text-align: right;">73</p> <p>1 know, getting into this stand area.</p> <p>2 But I don't -- I don't believe that "continue</p> <p>3 to approach the stand" necessarily implies a direction,</p> <p>4 certainly not according to the Poojary -- or what I</p> <p>5 understand Poojary to be -- to say.</p> <p>6 Q. So if I -- I fly in and out of Dallas airport</p> <p>7 a lot. Dallas airport has a bunch of parallel gates.</p> <p>8 A. Okay.</p> <p>9 Q. Long, 30, 40 gates that go across. And so</p> <p>10 there are these, effectively, driveways where you would</p> <p>11 have gates to your left and gates to your right.</p> <p>12 It's going up that driveway, and he knows he's</p> <p>13 approaching a particular stand because he knows he's</p> <p>14 going to, say, Gate 50, and I tell you -- and I tell the</p> <p>15 pilot: Continue approaching the stand.</p> <p>16 Now, he could -- and -- and let's say the</p> <p>17 stand forward and to the left.</p> <p>18 If I tell him to continue to approach the</p> <p>19 stand, he's not going to turn around, is he?</p> <p>20 A. Presumably not. You know, I would not expect</p> <p>21 him to do that.</p> <p>22 Q. So he's going to go -- he's going to continue</p> <p>23 in the direction of where the gate is?</p> <p>24 A. Yes, in this example, I mean, he will</p> <p>25 generally -- and that's -- yes, that's what pilots are</p>

<p style="text-align: right;">74</p> <p>1 doing at that stage in the process.</p> <p>2 MR. WEINSTEIN: Okay. This is actually a good</p> <p>3 point for a break. It's about time.</p> <p>4 THE WITNESS: Okay. Yeah.</p> <p>5 (Recess taken.)</p> <p>6 BY MR. WEINSTEIN:</p> <p>7 Q. Can you explain to me what your understanding</p> <p>8 is of orientation?</p> <p>9 MR. SMITH: Objection. Vague.</p> <p>10 THE WITNESS: So orientation --</p> <p>11 BY MR. WEINSTEIN:</p> <p>12 Q. Let me strike the question, just to make it</p> <p>13 better.</p> <p>14 What is orientation?</p> <p>15 A. Orientation as used in Berkmo and the Poojary</p> <p>16 patent describes the orientation of an aircraft or</p> <p>17 potentially other object with respect to the sensors,</p> <p>18 that is, essentially, the yaw. So I understand that to</p> <p>19 be the direction the vehicle is facing and, you know,</p> <p>20 the straightforward direction, if you will, of the</p> <p>21 vehicle.</p> <p>22 Q. So how is the orientation of an aircraft that</p> <p>23 is on the ground different from its direction?</p> <p>24 A. The -- the direction could be -- you know, if</p> <p>25 the wheels were turned, the direction it's going could</p>	<p style="text-align: right;">76</p> <p>1 A. So I think the -- as we discussed, the</p> <p>2 position and velocity are possibly not related or not</p> <p>3 sufficient for the orientation because the velocity</p> <p>4 could be -- either reverse simply, or, you know,</p> <p>5 rotational off to one side.</p> <p>6 The dimensions -- with the dimensions, one</p> <p>7 would need, in addition, some measurements of where</p> <p>8 certain parts were, so the dimensions alone aren't</p> <p>9 enough. You need to measure something there, so it --</p> <p>10 it seems like the case is incomplete. So I'm missing</p> <p>11 something.</p> <p>12 Q. If I had the position, velocity, and</p> <p>13 dimensions over time, would I be able to determine the</p> <p>14 orientation? Would a POSITA be able to determine the</p> <p>15 orientation?</p> <p>16 A. I guess I'm confused here by how the</p> <p>17 dimensions are sort of relevant to this question because</p> <p>18 the -- it's throwing me off. I'm not sure I understand</p> <p>19 the question.</p> <p>20 Q. So if -- what -- what is it that you don't</p> <p>21 understand?</p> <p>22 A. Why the dimensions are relevant to this?</p> <p>23 Because just knowing the dimensions without measuring</p> <p>24 something --</p> <p>25 Q. I mean, if I know --</p>
<p style="text-align: right;">75</p> <p>1 be to the right or to the left, whereas the orientation</p> <p>2 is always going to be sort of straight ahead, if you</p> <p>3 will.</p> <p>4 Whereas, you know, obviously, direction could</p> <p>5 also be presumably back -- going backwards if it's being</p> <p>6 towed or in reverse. But the orientation -- the</p> <p>7 orientation is relative to the body frame of the vehicle</p> <p>8 and is that straight -- straight-ahead direction.</p> <p>9 Q. And if the wheels are going straight and it's</p> <p>10 moving forward, the direction is the same as the</p> <p>11 orientation?</p> <p>12 A. It would be moving in the same direction as</p> <p>13 the orientation, yes, if the wheels are straight ahead</p> <p>14 and moving forward.</p> <p>15 Q. If a POSITA had the position, velocity, and</p> <p>16 dimensions of an -- of an aircraft, could the POSITA</p> <p>17 determine the orientation of the aircraft?</p> <p>18 A. It would depend on the -- they need some</p> <p>19 sensor data. The --</p> <p>20 Q. If it was based on a combination of sensors of</p> <p>21 Radar, LIDAR, and camera data.</p> <p>22 A. Let me -- pose the question again.</p> <p>23 Q. If the POSITA had the position, velocity, and</p> <p>24 dimensions of an aircraft, could the POSITA determine</p> <p>25 the orientation of the aircraft?</p>	<p style="text-align: right;">77</p> <p>1 A. -- seems.</p> <p>2 Q. -- the position of the aircraft, then I know</p> <p>3 the dimensions of the aircraft. They are -- can't you</p> <p>4 determine something about how the aircraft is oriented?</p> <p>5 A. You mean with a LIDAR sensor or a camera</p> <p>6 sensor or a -- what, I mean --</p> <p>7 Q. With -- with one of those sensors or with a</p> <p>8 combination of those sensors.</p> <p>9 A. I mean, with a -- say a LIDAR sensor, one can,</p> <p>10 you know, in -- in certain situations, yes, one can</p> <p>11 determine the orientation of -- you know, I'm not sure I</p> <p>12 have -- I'm missing the question somehow.</p> <p>13 Q. So what -- what information do you need to</p> <p>14 determine orientation?</p> <p>15 A. So the orientation is the axis of the</p> <p>16 aircraft, so the orientation of an -- of an aircraft is</p> <p>17 determined by measuring that -- that -- that axis, which</p> <p>18 would be done with -- a number of sensors could do that.</p> <p>19 Q. Which sensors could do that?</p> <p>20 A. This depends partly on the locations of the</p> <p>21 sensors. But if we are looking essentially</p> <p>22 horizontally, you know, I think the one I would want to</p> <p>23 use would be a LIDAR sensor for something like that.</p> <p>24 Looking at the aircraft from the side would be a fairly</p> <p>25 good way of determining orientation to essentially look</p>

<p style="text-align: right;">78</p> <p>1 at the fuselage and the -- comparing the front and the</p> <p>2 back end of the fuselage, the locations of those points</p> <p>3 would describe the -- a line between the two of those</p> <p>4 would define the orientation of the aircraft.</p> <p>5 Q. So you could determine orientation just from</p> <p>6 the LIDAR data?</p> <p>7 A. If the LIDAR was in the proper spot and the --</p> <p>8 and I knew what I was looking at -- and there's always</p> <p>9 this problem of I have to go and figure out where the</p> <p>10 fuselage is and make sure I'm looking at the fuselage.</p> <p>11 But if I had a clear datapoint on the front of the</p> <p>12 fuselage and the back of the fuselage, I could determine</p> <p>13 orientation.</p> <p>14 Q. So if I had LIDAR data and I used it, say, in</p> <p>15 combination with camera data that could detect the nose</p> <p>16 from a wing, would that make it easier to determine the</p> <p>17 orientation?</p> <p>18 A. Yeah. I think the multiple sensors always</p> <p>19 helps. But again, it depends very much on the</p> <p>20 orientation of the sensors, the relationship of the</p> <p>21 sensors to each other.</p> <p>22 You know, it's fairly easy to determine the</p> <p>23 orientation of an aircraft from an overhead camera, but</p> <p>24 that's not what we have.</p> <p>25 Q. Yeah. Okay. So but if -- if you know, you</p>	<p style="text-align: right;">80</p> <p>1 Q. Would that be within the ability of a POSITA?</p> <p>2 A. You know, it -- in -- under good conditions,</p> <p>3 yes. I mean, these are all things that are fairly</p> <p>4 standard in good conditions.</p> <p>5 It's -- the problem is when it's foggy, or you</p> <p>6 don't have a good view, or the -- there's always the</p> <p>7 cases too where, you know, somebody painted a pilot</p> <p>8 window on the plane in the wrong spot and so you -- it</p> <p>9 messes the system up, you know? That's -- there's</p> <p>10 always those edge cases.</p> <p>11 Q. Yeah. Right.</p> <p>12 A. But in general, that would be, you know,</p> <p>13 within the skill set of a POSITA.</p> <p>14 Q. You can go to Paragraph 46 of your</p> <p>15 declaration.</p> <p>16 A. Okay.</p> <p>17 Q. In Paragraph 46, addressing data for</p> <p>18 determining position, orientation, speed, and direction</p> <p>19 of the aircraft, do you cite to Paragraph 110 of</p> <p>20 Dr. Campbell's declaration? Do you see that?</p> <p>21 A. I do.</p> <p>22 Q. Are you aware of other paragraphs in</p> <p>23 Dr. Campbell's declaration that discuss determining</p> <p>24 orientation?</p> <p>25 A. Off the top of my head, I believe it comes up</p>
<p style="text-align: right;">79</p> <p>1 know, if we are talking about a LIDAR/camera</p> <p>2 combination, and you know the position of the LIDAR and</p> <p>3 you know the position of the camera, and you know the</p> <p>4 positions of each relative to each other, and they are</p> <p>5 producing the information they produce, you could</p> <p>6 combine them together and be able to determine</p> <p>7 orientation?</p> <p>8 A. It's, again, going to depend on the specifics</p> <p>9 of the situation. The core problem in that case being</p> <p>10 identifying spots in the camera image and correlating</p> <p>11 those with spots in the LIDAR image, and -- and getting</p> <p>12 that all correct, assuming the proper spots are visible,</p> <p>13 of course.</p> <p>14 Q. So it's a matter of correlating like the</p> <p>15 object detection from the camera with the data in the</p> <p>16 LIDAR?</p> <p>17 A. That, but also identifying specific spots.</p> <p>18 You know, if you are going to do this orientation, I'm</p> <p>19 going to want to find the spot, say, under the pilot's</p> <p>20 window on the maximum width on the aircraft and a spot</p> <p>21 back by the rear passenger window and, you know, sort of</p> <p>22 know I'm looking at those, and get their distances to</p> <p>23 whatever the accuracy is. And a line connecting those</p> <p>24 would presumably be the orientation of the aircraft or</p> <p>25 approximately so.</p>	<p style="text-align: right;">81</p> <p>1 a few times in his document, but I couldn't cite to any</p> <p>2 at this point. I'm not aware of any specifically, no.</p> <p>3 Q. Okay. Can you turn to Paragraph 120 of the</p> <p>4 Campbell declaration? And then also Paragraphs 121,</p> <p>5 122, and 123.</p> <p>6 A. Okay. I'm at them. Do you want me to read</p> <p>7 them?</p> <p>8 Q. Yeah. Just take a little time to read those</p> <p>9 paragraphs, please.</p> <p>10 A. And this is with respect to orientation?</p> <p>11 Q. Yes.</p> <p>12 A. Is that where we are going?</p> <p>13 Q. Yes.</p> <p>14 Just to give you context, this is in relation</p> <p>15 to orientation and the language in Claim 1, and</p> <p>16 Paragraph 119 addresses determining position and then</p> <p>17 Paragraphs 120 to 123 address determining orientation.</p> <p>18 A. Okay. And you want me to read 120 to 123?</p> <p>19 Q. That's correct. Right.</p> <p>20 A. Okay.</p> <p>21 Q. Okay. So this describes using data from a</p> <p>22 combination of the laser system, Radar system, and</p> <p>23 camera system to determine position, speed, and</p> <p>24 direction, correct?</p> <p>25 A. This section is Dr. Campbell's opinions on</p>

<p style="text-align: right;">82</p> <p>1 what can be determined using those -- the -- the laser</p> <p>2 system, imaging system, and Radar system.</p> <p>3 Q. But Berkmo does describe that the data from</p> <p>4 that combined system can be used to determine speed,</p> <p>5 direction, and position, correct?</p> <p>6 A. Yes. Berkmo discloses that his system can be</p> <p>7 used to determine position, speed, and direction.</p> <p>8 Q. And we discussed before and you agreed that</p> <p>9 with a LIDAR and a camera, that under normal conditions,</p> <p>10 it is within the skill of a POSITA to determine the</p> <p>11 orientation of an aircraft, correct?</p> <p>12 MR. SMITH: Objection. Mischaracterizes the</p> <p>13 testimony.</p> <p>14 THE WITNESS: What I meant to say was that</p> <p>15 those sensors can be used in certain situations to</p> <p>16 determine the orientation. And it certainly can be used</p> <p>17 in that -- that manner. Yeah.</p> <p>18 BY MR. WEINSTEIN:</p> <p>19 Q. Can you turn to Paragraph 45 of Dr. Campbell's</p> <p>20 declaration?</p> <p>21 A. Paragraph 45?</p> <p>22 Q. Yes.</p> <p>23 A. Okay.</p> <p>24 Q. Okay. And do you see where it says -- about</p> <p>25 four lines down it says: whereas the main drawbacks?</p>	<p style="text-align: right;">84</p> <p>1 Q. So you would agree that in foggy conditions or</p> <p>2 at night, that it would degrade the ability of the</p> <p>3 system in the '349 patent to work, correct?</p> <p>4 A. The -- certainly the camera systems are going</p> <p>5 to degrade in the presence of fog, and LIDARs to a</p> <p>6 lesser extent.</p> <p>7 Q. Uh-huh.</p> <p>8 A. Not -- not so much for Radars and very little</p> <p>9 --</p> <p>10 THE REPORTER: Not so much for Radars and --</p> <p>11 THE WITNESS: Yes. Little degradation for</p> <p>12 Radar or no degradation for Radar.</p> <p>13 BY MR. WEINSTEIN:</p> <p>14 Q. In really foggy conditions, does the camera</p> <p>15 data degrade or does it become unusable?</p> <p>16 A. In, you know, extremely foggy conditions,</p> <p>17 camera data is unusable.</p> <p>18 Q. If the camera data is unusable, then would the</p> <p>19 system in the '349 patent be able to determine the</p> <p>20 applicable 3D model of the aircraft?</p> <p>21 A. The applicable 3D model is determined using a</p> <p>22 number of inputs, including the ADS-B input.</p> <p>23 THE REPORTER: Using the what input? ASP?</p> <p>24 THE WITNESS: ADS-B.</p> <p>25 THE REPORTER: B or P?</p>
<p style="text-align: right;">83</p> <p>1 A. Yes, I see that.</p> <p>2 Q. And among those main drawbacks at the -- just</p> <p>3 at the end of the page, it says: It is poor performance</p> <p>4 in poor lighting or environmental conditions such as at</p> <p>5 night or when the weather is poor, such as in rain or</p> <p>6 fog, distorting the image from the camera.</p> <p>7 A. I see that.</p> <p>8 Q. And do you agree with this characterization</p> <p>9 from Dr. Campbell's declaration?</p> <p>10 A. Yes, I do.</p> <p>11 Q. Can you turn to Paragraph 54 of your</p> <p>12 declaration?</p> <p>13 A. Okay.</p> <p>14 Q. And you say at the -- the last sentence: The</p> <p>15 invention is beneficial at all times, day and night, and</p> <p>16 in all weather and lighting conditions, and works on all</p> <p>17 aircraft types and colors, unlike prior systems.</p> <p>18 A. That's correct. And this is mostly a</p> <p>19 recitation of what the patent claims here.</p> <p>20 Q. Do you agree with what the patent claims?</p> <p>21 A. I'm not sure I would agree off -- just off the</p> <p>22 top of my head sitting here today that it would work in</p> <p>23 all weather and all lighting conditions or with all</p> <p>24 aircraft types and colors, but it certainly is an</p> <p>25 improvement over the prior art.</p>	<p style="text-align: right;">85</p> <p>1 THE WITNESS: B, boy.</p> <p>2 THE REPORTER: Sorry.</p> <p>3 THE WITNESS: So it could determine a -- an</p> <p>4 input. It also uses the laser system, so -- or the</p> <p>5 LIDAR system, so it could use that.</p> <p>6 The validation of that model would be not as</p> <p>7 robust, I would say, without the camera. But it</p> <p>8 could -- given the other information, it could choose a</p> <p>9 model.</p> <p>10 BY MR. WEINSTEIN:</p> <p>11 Q. What is the ADS-B system?</p> <p>12 A. Something dependent -- it is a -- I can't</p> <p>13 remember the -- the initials right now, but it is a</p> <p>14 system commonly used by aircraft in the United States</p> <p>15 where the aircraft records their position from GPS or</p> <p>16 some other source, and then broadcasts that data through</p> <p>17 a network. It's broadcast to other aircraft and</p> <p>18 airports -- anybody who cares to listen, so it would be</p> <p>19 a set of -- in this case, it is data saying, you know,</p> <p>20 this aircraft is here and it's of this particular type.</p> <p>21 Q. Okay. So the ADS-B information also provides</p> <p>22 information about the type of aircraft, correct?</p> <p>23 A. That is my understanding.</p> <p>24 Q. I have good familiarity with marine</p> <p>25 navigation, and I think -- so it's probably similar to</p>

<p style="text-align: right;">86</p> <p>1 AIS?</p> <p>2 A. AIS?</p> <p>3 Q. It's an automatic identifier that says: I'm</p> <p>4 at this position, and I'm in this type of boat.</p> <p>5 A. Yeah. I see, yeah. I don't -- yeah.</p> <p>6 Q. Sorry, that's really no -- neither here nor</p> <p>7 there, but -- just reminded me of that.</p> <p>8 So if -- if the camera data is unusable, then</p> <p>9 there's no data to merge with the Radar or LIDAR data,</p> <p>10 correct? And this is in the context of very foggy</p> <p>11 conditions.</p> <p>12 A. If the camera data was not available, there</p> <p>13 might still be some value in merging the model because</p> <p>14 the model is being introduced sort of through the</p> <p>15 camera-data side.</p> <p>16 So I -- I would say no, but -- because again,</p> <p>17 the model, based on the ADS-B data or some other source,</p> <p>18 would be useful.</p> <p>19 Q. Does the '349 patent describe using the ADS-B</p> <p>20 information to determine the 3D model?</p> <p>21 A. I believe it does describe using it to</p> <p>22 identify which model to choose. So by the 3D model</p> <p>23 here, I mean which aircraft type, not the -- not the</p> <p>24 orientation. But it does describe using ADS-B to say:</p> <p>25 This is a 737 or whatever.</p>	<p style="text-align: right;">88</p> <p>1 3D model, and it would be reasonable to expect to run</p> <p>2 through the rest of the process based on that.</p> <p>3 Q. Okay. So even if the '349 patent doesn't say</p> <p>4 that you could use the ADS-B information to generate the</p> <p>5 3D point cloud, it would have been within the ability of</p> <p>6 a POSITA to do that?</p> <p>7 A. Yes.</p> <p>8 Q. In the -- in the camera system in the '349</p> <p>9 patent, B [sic], is the output data a 2D image?</p> <p>10 A. The -- looking at the '349 patent, the -- the</p> <p>11 output of the camera system is a 2D image, yes.</p> <p>12 Camera system, I'm thinking of Figure 3.</p> <p>13 There's a box that's -- can't remember the number on it.</p> <p>14 Let me just be clear here.</p> <p>15 Q. It's 346 maybe, the imaging sensor?</p> <p>16 A. Yeah. It's something like that. Yes.</p> <p>17 The output of the imaging sensor 346 would be</p> <p>18 a 2D image.</p> <p>19 Q. Can you go to Paragraph 56 of your</p> <p>20 declaration?</p> <p>21 A. I've just clarified. That's Item 346 on</p> <p>22 Figure 3.</p> <p>23 What is the paragraph?</p> <p>24 Q. Paragraph 56.</p> <p>25 A. Okay. Okay.</p>
<p style="text-align: right;">87</p> <p>1 Q. And so does the '349 patent describe, in the</p> <p>2 absence of camera image data, using the ADS-B to</p> <p>3 identify the 3D model and then determining the 6D pose?</p> <p>4 THE REPORTER: And then determining --</p> <p>5 MR. WEINSTEIN: The 6D pose.</p> <p>6 THE REPORTER: Okay.</p> <p>7 THE WITNESS: No, it does not.</p> <p>8 BY MR. WEINSTEIN:</p> <p>9 Q. Does it describe using the ADS-B only to</p> <p>10 determine a 3D point cloud of any kind?</p> <p>11 A. It does describe using the ADS-B to identify</p> <p>12 an aircraft type corresponding to an aircraft model, and</p> <p>13 as I say somewhere in my report, the aircraft models can</p> <p>14 be used to -- as the basis for a 3D point cloud.</p> <p>15 Q. But the '349 patent doesn't say that?</p> <p>16 A. I believe it describes all of the steps there.</p> <p>17 The '349 doesn't say what?</p> <p>18 Q. It doesn't say that you could use the ADS-B</p> <p>19 model or information alone to identify the 3D model and</p> <p>20 generate a 3D point cloud?</p> <p>21 A. It does not address the situation where the</p> <p>22 camera data is not available. But, you know, in my</p> <p>23 opinion a POSITA looking at this would understand:</p> <p>24 Okay, we go ahead and do what we can without the camera</p> <p>25 data. That would include generating a -- or selecting a</p>	<p style="text-align: right;">89</p> <p>1 Q. And in the first sentence, it talks about</p> <p>2 the -- the characteristics of aircraft that can be</p> <p>3 ascertained from the data captured by the camera image</p> <p>4 sensor 222.</p> <p>5 At the -- at the end of that sentence it says:</p> <p>6 "As well as positioning of wheels 234 to stop point 233</p> <p>7 can be ascertained from data captured by the camera</p> <p>8 image sensor 222."</p> <p>9 Do you see that?</p> <p>10 A. I do.</p> <p>11 Q. With -- with two dimensional camera data, how</p> <p>12 is the position of the wheels to the stop point</p> <p>13 determined?</p> <p>14 A. So in this case, the wheels and the stop point</p> <p>15 are known to be on the ground, so a -- a calibrated</p> <p>16 camera, as we talked before, would understand that the</p> <p>17 distance between two points on a known plane, in this</p> <p>18 case the ground plane, so if it can determine where the</p> <p>19 wheels are during an image recognition process --</p> <p>20 Q. Uh-huh --</p> <p>21 A. -- it knows which pixel that is in, so it</p> <p>22 knows where on the ground the -- those wheels are</p> <p>23 located.</p> <p>24 It also, either in advance or at the time, can</p> <p>25 calculate the position of the stop point. And so</p>

<p style="text-align: right;">90</p> <p>1 knowing those in -- on the -- in the ground plane, it 2 can determine a distance.</p> <p>3 Q. Okay. Can you go on to the next paragraph, 4 57?</p> <p>5 A. Okay.</p> <p>6 Q. And in the second sentence it says: A 7 proposed aircraft 3D model is also selected and 8 validated based on data for the expected aircraft such 9 as ADS-B Rx, (344), camera data, and LIDAR/Radar data, 10 including point cloud analytics (350) and comparison to 11 known aircraft configurations.</p> <p>12 Do you see that.</p> <p>13 A. I do.</p> <p>14 Q. So is -- as described in the '349 patent is 15 the 3D model determined from the camera data alone, or 16 is it also determined using camera and LIDAR and Radar 17 data?</p> <p>18 A. The '349 patent, as I think this paragraph 19 describes, leaves open the possibility of all of those 20 sources in determining the -- the model.</p> <p>21 Q. So when you say "the model," I mean there's an 22 aircraft model and then there's a 3D model. And so 23 let's just look, for example, at --</p> <p>24 A. So I understand the citation you read to be 25 selecting a model from a set of 3D templates.</p>	<p style="text-align: right;">92</p> <p>1 describes selecting the 3D model using the camera data, 2 but then the validation uses combinations.</p> <p>3 A. My recollection is that the -- there's 4 disclosure that the selection uses the LIDAR data or can 5 use elements of the LIDAR data. And I believe it can 6 also use the ADS-B. Is that what -- the point here or 7 are we...?</p> <p>8 Q. So the -- so the -- if you look at Figure 3 of 9 the '349 patent --</p> <p>10 A. Yes.</p> <p>11 Q. -- and you see -- in Element 356 is aircraft 12 3D model configuration.</p> <p>13 A. Yes.</p> <p>14 Q. And you can see that you have data outcome 15 from the imaging sensor (346) goes to the image 16 processing/machine learning/deep learning box (354), and 17 that is connected to the aircraft 3D model configuration 18 (356).</p> <p>19 So based on that, it does -- you have the 20 image data. It does some type of detection algorithm 21 using image processing/machine learning/deep learning to 22 determine what type of aircraft it is. And then based 23 on that, it can then refer to the database of aircraft 24 3D model configurations to identify the applicable 3D 25 model.</p>
<p style="text-align: right;">91</p> <p>1 Q. Yes.</p> <p>2 A. So un- -- unoriented, un- --</p> <p>3 Q. Yeah.</p> <p>4 A. -- unlocated in space.</p> <p>5 Q. Right.</p> <p>6 A. It's just a 3D CAD model, if you will, of the 7 aircraft.</p> <p>8 Q. Okay.</p> <p>9 So you have a -- several citations there.</p> <p>10 So can you maybe just take a look at those and 11 maybe point to where that describes identifying a 3D 12 model using something other than camera data?</p> <p>13 THE REPORTER: He's writing on the exhibit. 14 Is that okay?</p> <p>15 THE WITNESS: Is that a problem?</p> <p>16 MR. WEINSTEIN: No, that's not a problem, 17 particularly if it helps to facilitate your ability to 18 answer the questions, so....</p> <p>19 BY MR. WEINSTEIN:</p> <p>20 Q. If I may interrupt, the -- that sentence I 21 identified in Paragraph 57 talks about the proposed 22 aircraft 3D model was also selected and validated based 23 on the data, and then it lists the different sources of 24 where the data is coming from.</p> <p>25 I would contend to you that the '349 patent</p>	<p style="text-align: right;">93</p> <p>1 Would you agree with that?</p> <p>2 A. I agree with that, but I also remember 3 distinctly in my analysis of this that there is a line, 4 if you will, connecting (342) the LIDAR/Radar data to 5 that aircraft 3D model selection. And also I believe 6 the ADS-B (344) being an input to selecting that model.</p> <p>7 Q. So that --</p> <p>8 A. So I'm looking for those references now.</p> <p>9 Q. But I --</p> <p>10 A. But I remember that distinctly.</p> <p>11 Q. Okay. But also in Figure 3 you see that the 12 optional ADS-B is coupled directly to the data fusion 13 model, correct?</p> <p>14 A. I do.</p> <p>15 Q. And it's not coupled in any way to (356). 16 There is, independently of the database (356) of 3D 17 Model Configurations an element or database (348) of 18 aircraft configurations that apparently is based on 19 LIDAR or Radar data.</p> <p>20 A. Yes. My understanding -- and I didn't get 21 into this in detail in my report, so this is my 22 recollection from reading --</p> <p>23 Q. Okay.</p> <p>24 A. -- the patent, is that the LIDAR or Radar data 25 (342) can be used to validate an aircraft based on the</p>

<p style="text-align: right;">94</p> <p>1 aircraft configurations data in (348)--</p> <p>2 Q. Uh-huh.</p> <p>3 A. -- but also that that data from (342) is used</p> <p>4 in selecting the model chosen out of (356).</p> <p>5 Q. Okay. I don't think we need to spend more</p> <p>6 time on that line.</p> <p>7 We understand that there's a possibility there</p> <p>8 is something in (349) that makes you believe that that</p> <p>9 is the case. But at least based on what you have</p> <p>10 reviewed so far, you haven't found anything that says</p> <p>11 that at least selecting a 3D model from database (356)</p> <p>12 is done with anything other than the camera image data,</p> <p>13 correct?</p> <p>14 A. Give me another minute or two --</p> <p>15 Q. Okay.</p> <p>16 A. -- just to review something in there.</p> <p>17 So I think in answering your question, I</p> <p>18 recall from reading through the '349 patent, that there</p> <p>19 is input from the LIDAR sensor (342) in determining the</p> <p>20 model to be used at (356.) But sitting here right now,</p> <p>21 I can't find that -- that reference.</p> <p>22 I remember that clearly. I also believe</p> <p>23 there's use of the ADS-B data in determining that model,</p> <p>24 but I don't -- I'm not as certain of that.</p> <p>25 Q. So in determining the 3D model using the</p>	<p style="text-align: right;">96</p> <p>1 A. Okay.</p> <p>2 Q. -- but for the purposes of merging data</p> <p>3 together and using the 3D model as a basis for merging</p> <p>4 with the LIDAR/Radar data, it's not actually selecting</p> <p>5 the 3D model from the database.</p> <p>6 A. I -- it has selected a 3D model from the</p> <p>7 database. That's one step in the process. It then goes</p> <p>8 and fits that 3D model to the camera data in order to</p> <p>9 get the -- establish the pose for the 3D model.</p> <p>10 Q. It says in the beginning of the paragraph: In</p> <p>11 some embodiments, the docking system does not need to</p> <p>12 find --</p> <p>13 A. Excuse me. What -- what paragraph are you --</p> <p>14 Q. At -- at -- in Column 7, line 43. In the</p> <p>15 beginning of the paragraph we just pointed to.</p> <p>16 A. Okay.</p> <p>17 Q. The docking system does not need to find an</p> <p>18 exact match to a reference model, but can use a</p> <p>19 statistical probability algorithm to consider how</p> <p>20 closely the approaching aircraft matches the reference</p> <p>21 aircraft based on the data's closeness to matching a</p> <p>22 characteristic of an aircraft.</p> <p>23 A. I see that.</p> <p>24 Q. So again, I -- I don't understand how this</p> <p>25 relates to the -- the aircraft 3D model that is</p>
<p style="text-align: right;">95</p> <p>1 camera data, how does the '349 patent describe the</p> <p>2 camera detecting the aircraft type?</p> <p>3 A. So the patent at least discloses using data</p> <p>4 from the airport's systems.</p> <p>5 So at Column 7, about line 50, the docking</p> <p>6 system can receive aircraft type data from the airport's</p> <p>7 computing system. The docking system can then compare</p> <p>8 the determined aircraft type with an aircraft type</p> <p>9 provided in gate arrival information.</p> <p>10 So that's at least one way in which it</p> <p>11 determines the expected type of aircraft.</p> <p>12 Q. Right. But that -- that's not selecting the</p> <p>13 3D model from the database.</p> <p>14 A. I believe that is -- that information would be</p> <p>15 used to select the corresponding model out of the</p> <p>16 database.</p> <p>17 Could -- can you rephrase the question or</p> <p>18 repeat the question?</p> <p>19 Q. So I -- it says the docking system can then</p> <p>20 compare the determined aircraft type with an aircraft</p> <p>21 type provided in the gate arrival information to</p> <p>22 determine that the aircraft type that is approaching or</p> <p>23 in the ramp area is the correct aircraft type.</p> <p>24 So that's determining if the aircraft is</p> <p>25 correct or not --</p>	<p style="text-align: right;">97</p> <p>1 determined from database (356).</p> <p>2 And just based on Figure 3, which shows no --</p> <p>3 nothing else being connected or coupled to the database,</p> <p>4 is also just consistent with nothing but camera image</p> <p>5 data.</p> <p>6 MR. SMITH: Objection. Form.</p> <p>7 THE WITNESS: So I -- I understand, and I am</p> <p>8 not sure I understood your question. But an aircraft is</p> <p>9 selected from database (356), an aircraft model --</p> <p>10 BY MR. WEINSTEIN:</p> <p>11 Q. Yes.</p> <p>12 A. -- based on airport data. I also believe it's</p> <p>13 based on LIDAR sensor data, possibly ADS-B data that is</p> <p>14 available for that selection process.</p> <p>15 Q. Uh-huh.</p> <p>16 A. Once the model is selected somehow, that model</p> <p>17 is fit to the image processing -- to the image collected</p> <p>18 from the imaging sensor at step (354).</p> <p>19 Q. Uh-huh.</p> <p>20 So how -- how is the camera image data used to</p> <p>21 select the 3D model from the database (356)?</p> <p>22 A. The camera data would be used to -- so are you</p> <p>23 referring to something specifically that in my report --</p> <p>24 I'm just getting confused.</p> <p>25 Q. So we -- we had begun all this by that</p>

<p style="text-align: right;">98</p> <p>1 sentence in Paragraph 57 of your report. And one of the</p> <p>2 things it says is about selecting the 3D model in that</p> <p>3 sentence.</p> <p>4 A. Okay.</p> <p>5 Q. With respect to camera image data, regardless</p> <p>6 of any other data, with respect to the camera image</p> <p>7 data, how does the '349 patent describe, using the</p> <p>8 camera image data, to identify or select the 3D model</p> <p>9 from the database 356?</p> <p>10 A. So in the citation we were looking at before,</p> <p>11 columns -- '349 patent, Column 7, lines 43 to 55 or</p> <p>12 so --</p> <p>13 Q. Uh-huh.</p> <p>14 A. -- this is -- here a model has been selected.</p> <p>15 It is compared to the -- the data available, you know,</p> <p>16 specifically the -- yeah, to the -- to the data</p> <p>17 available, and then based on the goodness of fit, that</p> <p>18 model is either allowed or rejected. And if it's</p> <p>19 rejected, another model presumably is chosen until it</p> <p>20 finds one that is acceptable, or it may find none that</p> <p>21 is acceptable, in which case the process stops.</p> <p>22 Q. And is that specifically based on the camera</p> <p>23 image data?</p> <p>24 A. So looking at Column 7, line 31.</p> <p>25 Q. Uh-huh.</p>	<p style="text-align: right;">100</p> <p>1 there's -- it's -- it's a somewhat different problem</p> <p>2 sort of figuring out what something is rather than</p> <p>3 otherwise figuring out: Is this what I think it is?</p> <p>4 THE REPORTER: Other than -- other --</p> <p>5 THE WITNESS: I don't remember what I said.</p> <p>6 THE REPORTER: You said -- it sounded like</p> <p>7 "vice", but I don't know what it is.</p> <p>8 THE WITNESS: Oh, in place of, place.</p> <p>9 BY MR. WEINSTEIN:</p> <p>10 Q. Whether it's a detection algorithm or a</p> <p>11 validation algorithm, would that have been within the</p> <p>12 ability of a POSITA to do?</p> <p>13 A. These sorts of algorithms, like so many</p> <p>14 others, they are fairly straightforward for a POSITA to</p> <p>15 do poorly. To do really well and robustly would require</p> <p>16 a little more skill.</p> <p>17 Q. Uh-huh.</p> <p>18 A. But the -- the basics are -- would be within</p> <p>19 the capability of a POSITA.</p> <p>20 Q. What is an ICP algorithm?</p> <p>21 A. The ICP algorithm is a well-known algorithm</p> <p>22 used for aligning point clouds of data. So it takes two</p> <p>23 different point clouds and overlaps them, if you will,</p> <p>24 or aligns them -- determines the offset between the two</p> <p>25 and -- and removes the offset.</p>
<p style="text-align: right;">99</p> <p>1 A. In some embodiments, in order to identify a</p> <p>2 probable aircraft type, the docking system can use</p> <p>3 LIDAR/Radar data and machine learning and image data (at</p> <p>4 354 of Figure 3) to determine aircraft 3D model, then</p> <p>5 merging the data together using data fusion model (358),</p> <p>6 So this is actually the citation I recall to</p> <p>7 using the LIDAR data.</p> <p>8 So my understanding of this -- and I believe</p> <p>9 this would be a POSITA's understanding -- is that this</p> <p>10 is using the LIDAR data and the image data to validate</p> <p>11 the -- that the -- the correct model has been selected</p> <p>12 from this database of models.</p> <p>13 Q. Does the '349 patent describe a way for</p> <p>14 selecting the 3D model based just on the camera image</p> <p>15 data?</p> <p>16 And I would suggest maybe looking at</p> <p>17 paragraph -- or excuse me, Column 5?</p> <p>18 A. Anywhere in particular in Column 5.</p> <p>19 Q. Starting at 29.</p> <p>20 A. Yes, so Column 5, 29, it identifies that the</p> <p>21 camera can be used to identify the aircraft type --</p> <p>22 determine the aircraft type.</p> <p>23 Q. Okay. And so to determine aircraft type, it</p> <p>24 uses some type of detection algorithm?</p> <p>25 A. Detection or a validation algorithm. I mean,</p>	<p style="text-align: right;">101</p> <p>1 Q. So it transforms one to be in the same</p> <p>2 effectively --</p> <p>3 A. Translates --</p> <p>4 Q. Translates --</p> <p>5 A. Translates.</p> <p>6 THE REPORTER: Sorry. "So it transforms one</p> <p>7 to be in the same effectively" -- something?</p> <p>8 MR. WEINSTEIN: Sorry, I -- let me finish</p> <p>9 before I --</p> <p>10 THE WITNESS: Sorry.</p> <p>11 MR. WEINSTEIN: That's fine.</p> <p>12 BY MR. WEINSTEIN:</p> <p>13 Q. So it translates the coordinate system of one</p> <p>14 into the coordinate system of the other.</p> <p>15 Is that correct?</p> <p>16 A. I would say it translates the data from --</p> <p>17 into a common coordinate system.</p> <p>18 Q. Okay. So it's maybe into -- one coordinate</p> <p>19 system into the other, or it could be into a third</p> <p>20 coordinate system that both get transformed into?</p> <p>21 A. Yes.</p> <p>22 Q. Does the ICP algorithm itself fuse the data</p> <p>23 between the two point clouds?</p> <p>24 A. It does, because it takes the entirety of</p> <p>25 these two point clouds and merges them, fuses them</p>

<p style="text-align: right;">102</p> <p>1 together into a single frame, if you will -- frame of</p> <p>2 reference.</p> <p>3 Q. Is -- is the data from one point cloud changed</p> <p>4 in any way?</p> <p>5 A. It is translated, but the -- translated into a</p> <p>6 common --</p> <p>7 Q. Coordinate --</p> <p>8 A. -- coordinate system. Yeah.</p> <p>9 Q. Other than translation, is the data merged or</p> <p>10 fused in any way?</p> <p>11 A. Obviously, could be rotation as well, scaling.</p> <p>12 Setting those aside, it is fused -- according</p> <p>13 to Poojary, I think it is, it is definitionally a</p> <p>14 fusion -- a point -- a fusion algorithm. So -- and I</p> <p>15 would consider it fusion because it has this global</p> <p>16 process of taking these two datasets and making them</p> <p>17 consistent with each other, I would characterize as a</p> <p>18 fusion process. And -- and I think that's consistent</p> <p>19 with the meaning of Poojary.</p> <p>20 (Discussion held off the record.)</p> <p>21 Q. Okay. Can you turn to Paragraph 58.</p> <p>22 A. Of?</p> <p>23 Q. Of your declaration.</p> <p>24 A. Okay.</p> <p>25 Q. In the second line, you refer to a hor- --</p>	<p style="text-align: right;">104</p> <p>1 Q. And by -- in the absence of -- if -- if the</p> <p>2 pilot didn't know if he was to the left or to the right</p> <p>3 and I just told him he was 5 meters -- 5 meters deviated</p> <p>4 from the center line, he wouldn't know which way to go,</p> <p>5 correct?</p> <p>6 A. He probably would if it was 5 meters because</p> <p>7 he could have some sense of that. But if it was some</p> <p>8 smaller amount, it might not be easily perceptible to</p> <p>9 the pilot, so the horizontal deviation would include a</p> <p>10 direction.</p> <p>11 Q. But if I only provided the horizontal</p> <p>12 deviation, say it was 1 meter, that of itself is not</p> <p>13 enough to tell which direction for the pilot to go?</p> <p>14 A. Might or might not be depending on if that</p> <p>15 was, you know, perceptible to the pilot.</p> <p>16 Q. In -- in the same paragraph, you say the pilot</p> <p>17 unit display (364) provides at least remaining distance,</p> <p>18 horizontal guidance and speed guidance to the pilot.</p> <p>19 Can you point to me where in the '349 patent</p> <p>20 it refers to horizontal guidance?</p> <p>21 And I'll just say the citation you give for</p> <p>22 support for that is Column 10, lines 8 to 19.</p> <p>23 A. Well, I know there's a citation in the claim</p> <p>24 construction section.</p> <p>25 So looking at Column 10, line 8 --</p>
<p style="text-align: right;">103</p> <p>1 horizontal deviation with respect to the center line of</p> <p>2 the path, e.g., median line.</p> <p>3 Is the horizontal deviation with respect to</p> <p>4 the center line, is that a measure of length?</p> <p>5 A. Yes.</p> <p>6 Q. If I inform the pilot that his horizontal</p> <p>7 deviation from the center line is 5 meters, how is that</p> <p>8 guiding the aircraft?</p> <p>9 A. The deviation would also include a direction,</p> <p>10 and so that would imply that he was 5 meters, say, to</p> <p>11 the left and that he should be -- move the aircraft five</p> <p>12 meters to the right.</p> <p>13 Q. But it's -- horizontal deviation, you just</p> <p>14 said, is a measure of length?</p> <p>15 A. And -- and with a magnitude associated with</p> <p>16 it, I would say. So it's length, in this case, to the</p> <p>17 left side or right side of -- of the line.</p> <p>18 Q. So it's your position that the horizontal</p> <p>19 deviation says not only that it's 5 meters away, but</p> <p>20 it's to the left or to the right?</p> <p>21 A. Yes.</p> <p>22 Q. Okay. What if I say: You are five meters to</p> <p>23 the left. What am I directing you to do?</p> <p>24 A. You are directing me to move five meters to</p> <p>25 the right.</p>	<p style="text-align: right;">105</p> <p>1 Q. Uh-huh.</p> <p>2 A. -- the guidance module of the central docking</p> <p>3 system can, for example, provide the remaining distance</p> <p>4 and the horizontal deviation with respect to the center</p> <p>5 line of the path that the aircraft is supposed to</p> <p>6 follow.</p> <p>7 Q. So that refers to horizontal deviation. It</p> <p>8 doesn't refer to horizontal guidance though, does it?</p> <p>9 A. That -- the deviation, I would understand to</p> <p>10 be an -- an error, if you will, or deviation from some</p> <p>11 intended or idealized -- ideal preferred path.</p> <p>12 So the guidance is the -- the deviation is, in</p> <p>13 my opinion, guidance to reduce the deviation or minimize</p> <p>14 the deviation.</p> <p>15 Q. So it says: Provide the remaining distance.</p> <p>16 Is that the distance to, for example, the stop point?</p> <p>17 A. Yes.</p> <p>18 Q. Okay. So you could say you are 20 meters to</p> <p>19 your stop point, and you are one meter horizontally</p> <p>20 deviated from the center line, correct?</p> <p>21 A. It would say 20 meters away and one meter to</p> <p>22 the left.</p> <p>23 Q. Okay. But just to be specific, while it does</p> <p>24 say horizontal deviation, it's your -- you're construing</p> <p>25 horizontal deviation to require not just a length but</p>

<p style="text-align: right;">106</p> <p>1 also a direction.</p> <p>2 A. Yes. I am construing it to be the -- the</p> <p>3 horizontal deviation with respect to the center line.</p> <p>4 Q. Okay. But the '349 patent itself doesn't say</p> <p>5 "horizontal deviation." It says to which side of the</p> <p>6 center line.</p> <p>7 A. That is correct. But in my opinion, a POSITA</p> <p>8 would understand that -- that the magnitude -- the</p> <p>9 direction is also critical.</p> <p>10 Q. Does the '349 patent describe a way to provide</p> <p>11 directional guidance without using horizontal deviation?</p> <p>12 A. I mean, in my construction of this, I relied</p> <p>13 on this citation to horizontal deviation. I'm not aware</p> <p>14 of another place off the top of my head. But if you</p> <p>15 want to point me to something, I can certainly look at</p> <p>16 it.</p> <p>17 Q. Would a POSITA know how to provide directional</p> <p>18 guidance without using horizontal deviation from a</p> <p>19 center line of a path?</p> <p>20 MR. SMITH: Objection. Vague.</p> <p>21 THE WITNESS: The point of the guidance is to</p> <p>22 keep the pilot on this path, so it could be provided in</p> <p>23 other ways such as, you know, one way is you're 3 meters</p> <p>24 to the left. Another way would be, you know, turn a</p> <p>25 little bit to the right, or turn a lot to the right. I</p>	<p style="text-align: right;">108</p> <p>1 A. That's correct.</p> <p>2 Q. When it says that it can provide the</p> <p>3 horizontal deviation, does that mean it must be</p> <p>4 provided?</p> <p>5 A. I don't believe that "can" is required in --</p> <p>6 in this example...</p> <p>7 THE REPORTER: Wait. I don't believe a can is</p> <p>8 required?</p> <p>9 THE WITNESS: I don't believe that "can" means</p> <p>10 required --</p> <p>11 THE REPORTER: Okay.</p> <p>12 THE WITNESS: -- in this example. But given</p> <p>13 the -- you know, the claims and the entire disclosure of</p> <p>14 Poojary, I think that this is the example that is</p> <p>15 provided, and this is the type of guidance that a POSITA</p> <p>16 would understand Poojary is specifying.</p> <p>17 BY MR. WEINSTEIN:</p> <p>18 Q. So is it your understanding then if a claim</p> <p>19 limitation has a single example in a specification and</p> <p>20 the single example is described as something that can be</p> <p>21 done, that the limitation in the claim requires it to be</p> <p>22 done in the same way?</p> <p>23 MR. SMITH: Objection. Calls for a legal</p> <p>24 conclusion.</p> <p>25 THE WITNESS: It's my understanding that the</p>
<p style="text-align: right;">107</p> <p>1 think those are equivalent, but they are not identical.</p> <p>2 And a POSITA would understand there's a number</p> <p>3 of ways that guidance could be provided along those</p> <p>4 lines.</p> <p>5 BY MR. WEINSTEIN:</p> <p>6 Q. Uh-huh. Okay.</p> <p>7 So it -- it is possible to provide directional</p> <p>8 guidance to a pilot without telling the pilot of a</p> <p>9 horizontal deviation from the center line of a path?</p> <p>10 A. It would be possible in general, but I don't</p> <p>11 believe that is the case given in the -- you know, in</p> <p>12 Poojary. I think the way Poojary defines it is with</p> <p>13 horizontal deviation here. But one could envision</p> <p>14 different ways, you know, independent of Poojary that</p> <p>15 would be the guidance to a pilot.</p> <p>16 Q. Are you aware -- other than this portion of</p> <p>17 Column 10 that makes the -- the mention at line 10 of</p> <p>18 horizontal deviation, are you aware of any other part of</p> <p>19 the '349 patent that mentions horizontal deviation?</p> <p>20 A. I don't recall anything sitting here today,</p> <p>21 right now.</p> <p>22 Q. And in that -- starting at line 8, it says:</p> <p>23 The guidance module of the central docking system can,</p> <p>24 for example, provide the remaining distance and the</p> <p>25 horizontal deviation with respect to the center line.</p>	<p style="text-align: right;">109</p> <p>1 interpretation of the claim needs to be consistent with</p> <p>2 the disclosure of the specification. And while details</p> <p>3 may be different, the overall goal or result should be</p> <p>4 similar. And, you know, that's my understanding of</p> <p>5 where the deviation or horizontal deviation and the</p> <p>6 directional guidance is coming from.</p> <p>7 BY MR. WEINSTEIN:</p> <p>8 Q. Is horizontal deviation used in any of the</p> <p>9 claims of the '349 patent?</p> <p>10 A. Not that I recall sitting here now.</p> <p>11 Q. Is the center line of a path used in any of</p> <p>12 the claims of the '349 patent?</p> <p>13 A. I believe it is not.</p> <p>14 Q. Can you go to Paragraph 66 through 68 of your</p> <p>15 declaration.</p> <p>16 A. Okay.</p> <p>17 Q. And in Paragraph 67, you cite to that same</p> <p>18 column in the '349 patent at lines 16 to 19 that the</p> <p>19 docking system can also provide and monitor maximum</p> <p>20 speeds for approaching a gate. The speed thresholds can</p> <p>21 be set and monitored and instructions can be passed to</p> <p>22 the pilot to slow down.</p> <p>23 Is your understanding of "can," as we</p> <p>24 described before, as not being a requirement?</p> <p>25 A. My understanding of this, based on the claims</p>

<p style="text-align: right;">110</p> <p>1 in combination with this, is that this is what the</p> <p>2 claims require. The specification itself here, you</p> <p>3 know, "can" is one example here. But between -- you</p> <p>4 know, in reading the specification and the claims, I</p> <p>5 understand this -- and I believe a POSITA would</p> <p>6 understand this -- to mean that this is the speed</p> <p>7 guidance that the claims are talking about is this speed</p> <p>8 threshold.</p> <p>9 Q. But you agree that "can" is a permissive term,</p> <p>10 correct?</p> <p>11 A. It can be a permissive term. But in the</p> <p>12 context of this patent and these claims, I believe it is</p> <p>13 a requirement of the claims.</p> <p>14 Q. So instead of saying it must or necessarily be</p> <p>15 required, by saying "can" you are -- strike that.</p> <p>16 You do agree, outside of the context of the</p> <p>17 '349 patent, that the word "can" is a permissive term,</p> <p>18 correct?</p> <p>19 A. The term "can" means that it is capable of</p> <p>20 doing something. So, yes.</p> <p>21 Q. So if I say: You can do something, it means</p> <p>22 you can choose to do it or you can choose not to do it,</p> <p>23 correct?</p> <p>24 A. Yes.</p> <p>25 Q. So in this case, the specification doesn't say</p>	<p style="text-align: right;">112</p> <p>1 Q. And you can go to, in Claim 1, the display</p> <p>2 limitation.</p> <p>3 A. All right.</p> <p>4 Q. Do you see there it says: Display messages to</p> <p>5 provide directional and speed guidance to a pilot with</p> <p>6 the merged dataset? Do you see that?</p> <p>7 A. That's correct, yes.</p> <p>8 Q. Is it correct that you are interpreting</p> <p>9 "displaying messages with the merged dataset" to mean</p> <p>10 that what is displayed is a merged dataset?</p> <p>11 Okay. And I can refer you to Paragraph 95 of</p> <p>12 your declaration.</p> <p>13 A. Yeah. So my interpretation is that "with," as</p> <p>14 used here, means at least some of the merged dataset is</p> <p>15 displayed to the pilot.</p> <p>16 Q. What is displayed when you display at least</p> <p>17 some of the merged dataset?</p> <p>18 A. It would be an indicator of some -- some -- a</p> <p>19 merged dataset being data of some of the data elements</p> <p>20 of that merged dataset.</p> <p>21 Q. Can you give me an example of what would be</p> <p>22 displayed?</p> <p>23 A. Yeah. I mean one of the -- an example, I</p> <p>24 think, not limiting, would be the speed information</p> <p>25 derived from the Radar, say. I mean, that would be in</p>
<p style="text-align: right;">111</p> <p>1 that you must provide and monitor the maximum speed --</p> <p>2 so it doesn't say you are required to monitor -- to</p> <p>3 provide and monitor maximum speed. It doesn't say you</p> <p>4 must provide -- sorry, I just said -- necessarily</p> <p>5 provide and monitor maximum speeds, correct?</p> <p>6 A. The -- the cited paragraph does not, but the</p> <p>7 claims require speed guidance, and this is the example</p> <p>8 of speed guidance that's provided in the specification</p> <p>9 which I -- you know, my opinion would be what a POSITA</p> <p>10 would look to.</p> <p>11 Q. And the term "maximum speed" doesn't -- is not</p> <p>12 recited in any of the claims, correct?</p> <p>13 A. That is correct.</p> <p>14 THE REPORTER: "Any other" or "any of the"?</p> <p>15 MR. WEINSTEIN: Any of the.</p> <p>16 BY MR. WEINSTEIN:</p> <p>17 Q. And the term "speed thresholds" is not recited</p> <p>18 in any of the claims, correct?</p> <p>19 A. I believe that is correct, yes.</p> <p>20 MR. WEINSTEIN: This is a good time to take a</p> <p>21 break.</p> <p>22 (Lunch recess.)</p> <p>23 BY MR. WEINSTEIN:</p> <p>24 Q. Can you turn to Claim 1 of the '349 patent?</p> <p>25 A. Okay.</p>	<p style="text-align: right;">113</p> <p>1 the dataset, and so that could be one thing that would</p> <p>2 be displayed.</p> <p>3 Q. So if you had speed information from the Radar</p> <p>4 and displayed that, that would be consistent with</p> <p>5 displaying with the merged dataset?</p> <p>6 A. I mean, it would be incorporated into the --</p> <p>7 the assumption being that it has been incorporated into</p> <p>8 the merged dataset in the merging process. But, yes.</p> <p>9 Q. So would that one single piece of data be</p> <p>10 sufficient to meet "displaying with the merged dataset"?</p> <p>11 A. Yes, I -- my understanding is it requires one</p> <p>12 or more elements from the merged dataset.</p> <p>13 Q. And referring again, to Claim 1, the "wherein"</p> <p>14 clause recites what the merged dataset includes,</p> <p>15 correct?</p> <p>16 A. It includes at least one of the listed things,</p> <p>17 yes.</p> <p>18 Q. Is it your understanding that "at least one</p> <p>19 of" means that if you had just the data for determining</p> <p>20 direction of the aircraft, that is enough to meet the</p> <p>21 merged dataset?</p> <p>22 A. That is enough to meet this limitation of the</p> <p>23 merged dataset, yes. I think one of those seven or</p> <p>24 eight elements would suffice.</p> <p>25 Q. I think it's five elements that are listed.</p>

<p style="text-align: right;">114</p> <p>1 THE REPORTER: Wait. I think one of the --</p> <p>2 MR. WEINSTEIN: Six, seven or eight elements.</p> <p>3 THE REPORTER: Eight elements would -- was it</p> <p>4 suffice or?</p> <p>5 THE WITNESS: Would suffice, yeah.</p> <p>6 THE REPORTER: And then your question?</p> <p>7 MR. WEINSTEIN: I said it think it's five</p> <p>8 elements that were listed.</p> <p>9 BY MR. WEINSTEIN:</p> <p>10 Q. So to just ask the converse then. So to meet</p> <p>11 the merged dataset does not require having each of the</p> <p>12 five data types listed, correct?</p> <p>13 A. That is my opinion, yes.</p> <p>14 Q. So the first type of data is data for</p> <p>15 determining position and orientation of the aircraft</p> <p>16 relative to the position and orientation of the ramp</p> <p>17 area.</p> <p>18 Do you see that?</p> <p>19 A. Yes.</p> <p>20 Q. Is the data for determining position and</p> <p>21 orientation different than the actual determined</p> <p>22 position and orientation?</p> <p>23 A. Yeah. I didn't really opine on this because</p> <p>24 this was not something that I -- I argued. I don't</p> <p>25 recall arguing this with respect to Berkmo here.</p>	<p style="text-align: right;">116</p> <p>1 Q. Let me ask a follow-up question.</p> <p>2 A. Okay.</p> <p>3 Q. We talked a bit about how you determined</p> <p>4 orientation, and we [sic] gave an example of using LIDAR</p> <p>5 in combination with cameras under proper conditions --</p> <p>6 A. Uh-huh.</p> <p>7 Q. -- and knowing information using a calibrated</p> <p>8 camera and so on.</p> <p>9 The data provided by the LIDAR -- LIDAR and</p> <p>10 camera, even when combined, is not itself orientation,</p> <p>11 correct?</p> <p>12 A. The orientation would be an angle in this</p> <p>13 case, so the -- the merged data process could either</p> <p>14 produce an angle directly, or it might not -- I think</p> <p>15 either of those possibilities is a -- envisioned by the</p> <p>16 patent.</p> <p>17 It -- so it would depend on the merging</p> <p>18 process and what the -- what that dataset entails</p> <p>19 or composed -- is composed of at the end of the day.</p> <p>20 Q. But the merging could be where -- after the</p> <p>21 merging, the data is sufficient to make the</p> <p>22 determination for orientation, but the orientation has</p> <p>23 yet to be determined?</p> <p>24 A. Yes, so the -- it is possible that there are</p> <p>25 scenarios in which the -- the specific elements listed</p>
<p style="text-align: right;">115</p> <p>1 Q. Uh-huh.</p> <p>2 A. I remembered thinking about some of these</p> <p>3 issues and thinking they were complex problems, and I</p> <p>4 was glad I didn't have to delve too deeply into the fine</p> <p>5 parsing of these things.</p> <p>6 Q. Okay. So to ask the question again: Is</p> <p>7 there -- is there a difference between data for</p> <p>8 determining position and orientation and the determined</p> <p>9 position and orientation.</p> <p>10 THE REPORTER: Wait, than "v" determined</p> <p>11 position and orientation?</p> <p>12 MR. WEINSTEIN: Than the -- let me ask the</p> <p>13 question again.</p> <p>14 THE REPORTER: Okay.</p> <p>15 BY MR. WEINSTEIN:</p> <p>16 Q. Is the data for determining position and</p> <p>17 orientation different from the determined position and</p> <p>18 orientation?</p> <p>19 A. And the -- I think I would need to get</p> <p>20 specific on this. There is some of the data -- as I</p> <p>21 suggested, such as speed, that comes directly out of</p> <p>22 the -- the raw data, if you will -- the merged and</p> <p>23 presumably maintained through the merged dataset. And</p> <p>24 that -- well, that's not position or orientation, but</p> <p>25 some of those elements are the same.</p>	<p style="text-align: right;">117</p> <p>1 here are not contained in the merged dataset, but they</p> <p>2 could be derived by known -- well-known methods from the</p> <p>3 merged dataset, and that would meet the limitations of</p> <p>4 this claim -- or this claim element.</p> <p>5 Q. Yeah, yeah. And just to give a different</p> <p>6 example, if I had data that showed three dimensionally</p> <p>7 where the aircraft was over time --</p> <p>8 A. Uh-huh.</p> <p>9 Q. -- I could -- that could be the merged data,</p> <p>10 and then from that data I could determine speed because</p> <p>11 I can compare its position and divide it by time.</p> <p>12 A. Assuming you had time and had position with</p> <p>13 sufficient accuracy.</p> <p>14 Q. Yes. Okay.</p> <p>15 In Paragraph 95 you refer to --</p> <p>16 A. Is this of my report?</p> <p>17 Q. Yes.</p> <p>18 Sorry that I'm not always specific in saying</p> <p>19 that. But typically, if I say "paragraph" and I don't</p> <p>20 delineate, it's going to be your declaration.</p> <p>21 A. I'm learning that, but --</p> <p>22 Q. It's better to clarify. I appreciate that.</p> <p>23 A. Yeah. Okay.</p> <p>24 Q. And about five lines above the end of that</p> <p>25 paragraph it says: ...the specifications specifically</p>

<p style="text-align: right;">118</p> <p>1 discloses displaying at least some of these elements to 2 the pilot. And you cite to -- 3 A. I'm sorry where? 4 Q. It's on 95. 5 A. Yeah. 6 Q. Towards the -- well, it's about five lines 7 from the bottom of the paragraph. 8 A. Okay. 9 Q. The end of the paragraph. 10 A. I was on the wrong page. Okay. Go ahead. 11 Q. You see where it says: In the specification, 12 it specifically discloses displaying at least some of 13 these elements to the pilot? 14 A. I do. 15 Q. And you cite to Column 10, lines 19 to 23 of 16 the Berkmo -- excuse me, of the '349 patent? 17 A. Correct. 18 Q. And in that paragraph, again, quote, in some 19 embodiments, the determined speed, position, 20 orientation, and/or direction can be sent to a ramp 21 docking system controller device in the ramp docking 22 system and then passed to the pilot unit computing 23 device. 24 Do you see that? 25 A. Correct. Yes, I do.</p>	<p style="text-align: right;">120</p> <p>1 Q. Would it be possible to provide the merged 2 dataset to the aircraft and then have the aircraft use 3 that data to determine directional and speed guidance? 4 A. So you are suggesting that instead of the 5 calculation being done off board, the -- I guess this is 6 the merged dataset -- is passed to the aircraft, and the 7 aircraft would then provide the guidance directly as 8 opposed through this pilot display? 9 Q. Right. 10 A. I think that would be possible. I don't think 11 that's what is disclosed at all, but that would be 12 technically possible. 13 Q. And returning again to Claim 1 of the '349 14 patent -- 15 A. Okay. 16 Q. -- the -- the first step is receiving camera 17 image data of the aircraft while the aircraft is 18 approaching the ramp area for parking the aircraft on an 19 airside of an airport. Do you see that? 20 A. I do. 21 Q. What is the camera image data as recited 22 there? 23 A. Camera image data would be this 2D array of 24 pixel values from a camera located proximate to this 25 ramp area.</p>
<p style="text-align: right;">119</p> <p>1 Q. The -- the language there says that "the 2 determined speed, position, orientation, and/or 3 direction are sent." 4 Do you see that? 5 A. Yes. 6 Q. As we were just discussing, data for 7 determining speed is different from the determined 8 speed, correct? 9 A. It may be. 10 Q. And this language says that the determined 11 speed, position, orientation, direction -- and/or 12 direction are passed to the pilot unit computing device, 13 correct? 14 A. That's correct. 15 Q. So it's passed to the pilot unit computing 16 device, but it doesn't say it's displayed, does it? 17 A. It does not say it's displayed here, but 18 the -- my understanding -- again, I didn't opine on this 19 in my report. As far as I can remember is that the 20 pilot unit display computing device -- where is that? 21 Or the pilot unit computing device is associated with 22 the pilot unit display of 364 of -- of Figure 3. And 23 so, essentially, the purpose of that device is to 24 display information to the pilot, but that is not 25 clearly disclosed in this citation.</p>	<p style="text-align: right;">121</p> <p>1 Q. So the -- the camera image data is 2 two-dimensional pixel values representing the aircraft 3 while it's approaching the ramp area for parking, 4 correct? 5 A. Representing a scene around the ramp area 6 which may have the aircraft approaching or not -- but 7 presumably some of the time there is an aircraft 8 approaching in that image. 9 Q. Can you turn to Paragraph 71 of your 10 declaration? 11 A. Okay. 12 Q. And in the last two sentences you say: A 13 POSITA would have understood that the method steps 14 recited in independent claims 1 and 10 utilize sensors 15 to be able to receive the identified types of data and 16 that they do this while the aircraft is moving toward 17 the ramp. That is, the claims require specific sensors 18 at a specific location and time; thus the POSITA 19 understands these to be required elements of the method 20 claims 1 and 10. 21 A. That's correct. 22 Q. So returning again to the receiving camera 23 image data language in Claim 1, what is received is 24 camera image data, and the camera image data is two 25 dimensional pixel data that is data showing the aircraft</p>

<p style="text-align: right;">122</p> <p>1 while the aircraft is approaching the ramp area for</p> <p>2 parking the aircraft on an airside in an airport,</p> <p>3 correct?</p> <p>4 A. That is correct. But that data is generated</p> <p>5 by a camera located at -- in the ramp area at the time</p> <p>6 the aircraft is approaching --</p> <p>7 Q. Okay.</p> <p>8 A. -- so....</p> <p>9 Q. If I had a text file that was formatted in the</p> <p>10 same format as what a camera would produce as the output</p> <p>11 of a camera and had the same pixel values that was</p> <p>12 reproduced by the camera, would that text file be</p> <p>13 considered camera image data according to Claim 1?</p> <p>14 A. I would say that would be camera image data</p> <p>15 according to this element of Claim 1. But, you know,</p> <p>16 claim 1 also requires merging of the data --</p> <p>17 Q. Hmm.</p> <p>18 A. -- and it's not in a form for merging there,</p> <p>19 so it's -- would need to be digitized, put into a</p> <p>20 processor, so -- one -- one theoretically could take the</p> <p>21 camera data, print it out, suck it back in --</p> <p>22 Q. Okay. So --</p> <p>23 A. -- and that printout would come -- would meet</p> <p>24 this limitation -- this first limitation of the claim.</p> <p>25 Q. And obviously, if I had a computer simulator</p>	<p style="text-align: right;">124</p> <p>1 as well as format?</p> <p>2 Q. Yeah. So the -- the claim requires receiving</p> <p>3 camera image data.</p> <p>4 A. Yeah.</p> <p>5 Q. And then everything else after that is a</p> <p>6 modification of what the camera image data has to be.</p> <p>7 A. Right.</p> <p>8 Q. So just to receive the camera image data, if I</p> <p>9 had a computer simulator or simply a text file that</p> <p>10 reproduced the exact same thing, data-wise, as what the</p> <p>11 camera did, wouldn't that still be the same camera image</p> <p>12 data?</p> <p>13 A. I think that would not be because it's not a</p> <p>14 camera image. It's a synthesized image or something.</p> <p>15 A camera is that -- you know, in my opinion, a</p> <p>16 camera is a device that takes photos and converts them</p> <p>17 into bits, basically. And a simulator doesn't do that.</p> <p>18 So the -- the camera image requires that there</p> <p>19 have been photons recently in its past.</p> <p>20 Q. So you are reading by using -- if they had</p> <p>21 used "image data," it might be something different. But</p> <p>22 because it says "camera image data," it then requires</p> <p>23 the use of a camera?</p> <p>24 A. Yes. I think that's a fair characterization.</p> <p>25 Q. Can you go to Paragraph 73 of your</p>
<p style="text-align: right;">123</p> <p>1 that could create image data and output it without</p> <p>2 actually using a camera, could that computer simulator</p> <p>3 produce the camera image data that would moot that</p> <p>4 preceding that receiving camera image data step?</p> <p>5 A. It would have to be of the aircraft at that</p> <p>6 time, so I don't see -- a simulator? I don't see a</p> <p>7 simulator doing that.</p> <p>8 If you are talking about a, essentially,</p> <p>9 virtual reality type of system where it's -- it's</p> <p>10 creating an image that would be identical to that that</p> <p>11 the camera would have taken, I don't know. That's</p> <p>12 getting fairly hypothetical.</p> <p>13 Q. Okay. I guess I'm just trying to understand</p> <p>14 the difference -- or nail down what's actually being</p> <p>15 received.</p> <p>16 I understand what you are saying is that:</p> <p>17 Based on the context, that it would have to be from a</p> <p>18 camera that is actually watching the -- the aircraft</p> <p>19 approach the -- the ramp area. But what's actually</p> <p>20 being received is just the camera image data.</p> <p>21 And what I want to understand is: Is it</p> <p>22 possible for a computer simulator or a text file to</p> <p>23 produce what would be the same thing as what the camera</p> <p>24 produces?</p> <p>25 A. The same thing in terms of identical content</p>	<p style="text-align: right;">125</p> <p>1 declaration?</p> <p>2 A. Okay.</p> <p>3 Q. And in this first sentence you say: A POSITA</p> <p>4 understands that "merging" data -- and I assume by</p> <p>5 quotes there, that you're referring to merging as</p> <p>6 recited in Claim 1 -- particularly when applied to</p> <p>7 specific data with a specific outcome, as recited in the</p> <p>8 '349 Patent claims, requires certain concrete methods</p> <p>9 and procedures to be applied as part of the process that</p> <p>10 require a processor to perform.</p> <p>11 What is the specific data and specific outcome</p> <p>12 in the claims that require a processor to perform?</p> <p>13 A. Well, I think here the -- well, one example of</p> <p>14 the merging that the patent provides is this ICP</p> <p>15 algorithm.</p> <p>16 Q. What is the specific data and specific outcome</p> <p>17 recited in the claims that's required of a processor to</p> <p>18 perform?</p> <p>19 A. So the -- the specific data in the claim here</p> <p>20 is camera data as well as LIDAR or Radar data. The, you</p> <p>21 know, process of aligning those, you know, a POSITA</p> <p>22 would certainly understand there are certainly --</p> <p>23 certainly some alignment steps in there of -- of -- you</p> <p>24 know, aligning those data types to the extent that's</p> <p>25 done. I mean, I think it's implied in this claim.</p>

<p style="text-align: right;">126</p> <p>1 The merging step involves the -- one example 2 of the merging step is this ICP algorithm. It's not 3 identified in the claim, but it's certainly identified 4 in the spec as an example of the merging, which is a 5 specific process.</p> <p>6 Q. Besides ICP, what other processes would a 7 POSITA understand could be used to merge LIDAR or Radar 8 data with camera image data?</p> <p>9 A. I would think the other process that is 10 described in this patent is aligning the 3D model based 11 on the camera image. That -- there's that process, as 12 described in the spec. And then fusing that 3D data 13 with the 3D data from the LIDAR/Radar.</p> <p>14 You know, each of those require some 15 coordinate transformation -- or potentially requires 16 some coordinate transformations depending on the form of 17 the data.</p> <p>18 Q. Are there other methods beyond those described 19 in the specification of the '349 patent that could be 20 used to merge camera image data with LIDAR or Radar 21 data?</p> <p>22 A. Yes. There are other methods in -- in general 23 in different contexts. The methods available really 24 depend on the context, but this is not the only context 25 there is for merging camera and Radar data or LIDAR</p>	<p style="text-align: right;">128</p> <p>1 A. At some point the -- to the extent the 2 datasets are aligned, a 2D point in the image can 3 correspond to many points in the 3D dataset, right?</p> <p>4 Q. Uh-huh.</p> <p>5 A. But looking in the depth direction.</p> <p>6 THE REPORTER: But looking at the -- 7 THE WITNESS: In the depth direction. 8 So, no, you can't -- I -- based on that data 9 alone, you cannot correlate the -- a 2D pixel from the 10 image dataset with the 3D pixels from the Radar or 11 LIDAR.</p> <p>12 BY MR. WEINSTEIN:</p> <p>13 Q. If -- if the camera image data included depth 14 data, whether it was with a stereo camera or some other 15 process to estimate depth, could that data be correlated 16 to the 3D point cloud of the LIDAR or Radar data?</p> <p>17 A. So if you have two 3D datasets and know the 18 coordinate transforms between them and so forth, then 19 the data can be correlated to the extent the data is 20 accurate and all of those things. But they need to be 21 both in 3Ds -- three dimensions.</p> <p>22 Q. Okay. So -- but if you did have that for the 23 camera image data, then you would not need a 3D model, 24 correct?</p> <p>25 A. Well, if you had -- you would have a 3D model</p>
<p style="text-align: right;">127</p> <p>1 data.</p> <p>2 Q. You also say that it requires certain concrete 3 methods and procedures to be applied.</p> <p>4 What is in the claims that requires certain 5 concrete methods and procedures to be applied?</p> <p>6 A. The -- the idea of even fusing this camera 7 image data and -- and this 2D data with 3D data, you 8 know, there are certain steps that have to be taken in 9 order to make that possible.</p> <p>10 So those -- such as what I just talked about, 11 about building the 3D model from the -- or posing the 3D 12 model based on the image data, et cetera.</p> <p>13 Q. Is there a claim that requires fitting a 3D 14 model to a point cloud?</p> <p>15 A. I think it's implicit, at least in claim 19, 16 whether -- and, you know, it's described clearly in the 17 specification.</p> <p>18 Q. Claim 19 doesn't actually recite a 3D model, 19 does it?</p> <p>20 A. It does not, but the elements it's referring 21 to involve that create -- posing the 3D model so that 22 the point cloud dataset can be formed from it and then 23 merged. And the merging is identified in claim 19.</p> <p>24 Q. Could you correlate points in LIDAR/Radar 25 sensor data to camera image data without a 3D model?</p>	<p style="text-align: right;">129</p> <p>1 of -- to some extent, if you had the camera image data 2 in 3D, you know, because you have got, essentially, the 3 surface outlined in -- in three dimensions.</p> <p>4 You would still probably use the 3D model of 5 Figure 3 just for alignment and refinement, but you 6 would be farther along in doing that process if you had 7 3D data to start with rather than 2D.</p> <p>8 Q. Going back to Paragraph 73 of your 9 declaration.</p> <p>10 In the last sentence, starting with "Further."</p> <p>11 A. Okay.</p> <p>12 Q. Do you see that?</p> <p>13 A. Yes.</p> <p>14 Q. ...determining and displaying directional 15 guidance and/or speed guidance from the merged data 16 requires the use of a processor.</p> <p>17 Let's go to Claim 1 of the '349 patent.</p> <p>18 A. Okay.</p> <p>19 Q. Where does the claim say that the messages to 20 provide directional and speed guidance are determined 21 from the merged dataset?</p> <p>22 MR. SMITH: Objection. Form.</p> <p>23 THE WITNESS: Can you repeat that question? 24 I'm not sure I got it. 25 ///</p>

<p style="text-align: right;">130</p> <p>1 BY MR. WEINSTEIN:</p> <p>2 Q. Where does the claim say that the directional</p> <p>3 or speed guidance in the displaying step is determined</p> <p>4 from the merged data?</p> <p>5 A. In the claim, I don't see the -- it requires</p> <p>6 the speed or the direction to be determined from the</p> <p>7 merged data, but given that's the point of the patent</p> <p>8 and in light of the specification as a whole, that is my</p> <p>9 opinion of where the speed and directional guidance is</p> <p>10 coming from, is from that merged dataset.</p> <p>11 Q. But it's not in the claim itself, correct?</p> <p>12 A. The claim describes how to make a merged</p> <p>13 dataset and displaying messages to provide directional</p> <p>14 and speed information -- guidance. It does not require</p> <p>15 that those messages be based on the merged dataset, but</p> <p>16 that is my understanding of the -- of -- of the</p> <p>17 requirement of this claim, even though it doesn't say</p> <p>18 that in the four corners of the page, at least is the</p> <p>19 term.</p> <p>20 THE REPORTER: Four corners of the page.</p> <p>21 THE WITNESS: Four corners of the page.</p> <p>22 THE REPORTER: And then something about term?</p> <p>23 THE WITNESS: Don't worry about it.</p> <p>24 BY MR. WEINSTEIN:</p> <p>25 Q. Does the displaying step in Claim 1 say what</p>	<p style="text-align: right;">132</p> <p>1 an image in their mind from a stream of data from an</p> <p>2 image sensor any more than they could watch a TV show by</p> <p>3 directly receiving a stream of data from their cable</p> <p>4 provider.</p> <p>5 Where in claims does it recite forming or</p> <p>6 creating an image from the data?</p> <p>7 A. I guess I'm not sure what you are asking. The</p> <p>8 claim requires image data. Are you asking -- you know,</p> <p>9 what --</p> <p>10 Q. So the -- the language you used here is</p> <p>11 that -- and this is all in your discussion of why the</p> <p>12 steps of Claim 1, for example, cannot be done in the</p> <p>13 human mind or by pen and paper.</p> <p>14 A. Right.</p> <p>15 Q. And you wrote: "A human cannot recreate an</p> <p>16 image in their mind from a stream of data from an image</p> <p>17 sensor."</p> <p>18 Where do the claims require an -- formation of</p> <p>19 an image from the image sensor?</p> <p>20 A. The -- the context of this is that I believe</p> <p>21 Dr. Campbell to be saying that this process, this claim,</p> <p>22 can be implicated in someone's mind. The -- the process</p> <p>23 of taking the image data and understanding, you know,</p> <p>24 I'm looking at an aircraft, and it's this type of</p> <p>25 aircraft, and it's located at this position. And the</p>
<p style="text-align: right;">131</p> <p>1 the directional and speed guidance is directed to?</p> <p>2 A. Let me --</p> <p>3 MR. SMITH: Objection. Form.</p> <p>4 BY MR. WEINSTEIN:</p> <p>5 Q. Yeah. Let me strike that.</p> <p>6 The limitation says "displaying messages to</p> <p>7 provide directional and speed guidance to a pilot."</p> <p>8 Does it say to where the pilot is being</p> <p>9 directed?</p> <p>10 A. The claim does not say to where the pilot is</p> <p>11 being directed. But again, looking at the specification</p> <p>12 in its entirety, to me it's clearly to the stop point.</p> <p>13 Q. Of course they could have said that in the</p> <p>14 claim, correct?</p> <p>15 A. They could have said that in the claim, and --</p> <p>16 like all claims, it's missing important elements.</p> <p>17 Q. Uh-huh.</p> <p>18 Can you turn to Paragraph 75.</p> <p>19 A. Okay.</p> <p>20 Q. In the -- the middle of paragraph it says "for</p> <p>21 example."</p> <p>22 Do you see that?</p> <p>23 A. Yes.</p> <p>24 Q. It says, "For example, even if one could</p> <p>25 receive that data -- the data, a human cannot recreate</p>	<p style="text-align: right;">133</p> <p>1 tail height is this high, and it matches that other</p> <p>2 data. That requires a model for the -- translating that</p> <p>3 bit stream, if you will, into a 3D model with</p> <p>4 relationships between the points, which I think is an</p> <p>5 image. I mean I would characterize that as an image.</p> <p>6 And so, you know, implicit in this claim, to</p> <p>7 me, is processing that data as -- as a two-dimensional</p> <p>8 spatial array, which is how I would characterize an</p> <p>9 image. I mean, again, exactly what an image is, I</p> <p>10 didn't opine on this. I'm getting a little bit</p> <p>11 spontaneous, which is dangerous.</p> <p>12 Q. Not that I would ever try to make you do that.</p> <p>13 A. No, you wouldn't, would you?</p> <p>14 Yeah, so I think, you know, to the extent an</p> <p>15 image is this 2D relationship of these points, that's</p> <p>16 required for practicing this -- this claim.</p> <p>17 Q. All right. Can you go to Paragraph 79 of your</p> <p>18 declaration?</p> <p>19 A. Okay.</p> <p>20 Q. And if you go to the -- the next page at the</p> <p>21 top. The first line that says: A human mind is</p> <p>22 incapable.</p> <p>23 A. Yes.</p> <p>24 Q. A human mind is incapable of understanding,</p> <p>25 and thus using the merged dataset to determine any kind</p>

<p style="text-align: right;">134</p> <p>1 of directional guidance or speed guidance to display to</p> <p>2 a pilot.</p> <p>3 As we just discussed before, claim 1 or</p> <p>4 claim 10 or claim 18 actually require that the guidance</p> <p>5 be determined from the merged dataset, correct?</p> <p>6 A. Again, the letter or the -- the words on the</p> <p>7 page do not require that, but I believe the patent</p> <p>8 requires that.</p> <p>9 Q. It -- it would be possible just to display</p> <p>10 messages providing directional and speed guidance</p> <p>11 without using the merged dataset, correct?</p> <p>12 A. You know, other systems, other sensors, other</p> <p>13 processes could provide directional and speed guidance</p> <p>14 in other manners, yes.</p> <p>15 Q. And so could just somebody in the tower typing</p> <p>16 out a message and sending, you know: Turn right. Go</p> <p>17 about 5 knots?</p> <p>18 A. Well, arguably the marshal sitting there on</p> <p>19 the ground --</p> <p>20 Q. Yes.</p> <p>21 A. -- waving the wands around is providing</p> <p>22 directional and -- I guess maybe not speed guidance, but</p> <p>23 at least directional guidance.</p> <p>24 Q. Yeah. Yeah. But that's -- I'm not sure you</p> <p>25 would call it displaying. I guess it is. You're</p>	<p style="text-align: right;">136</p> <p>1 camera data has been used to pose that 3D model in --</p> <p>2 the camera space. That 3D model is essentially a point</p> <p>3 cloud, because it -- it has 3D positions of the scan of</p> <p>4 the aircraft, say. That point cloud is merged with the</p> <p>5 point cloud generated by the LIDAR and/or Radar.</p> <p>6 Q. So if -- going back, we talked a little bit</p> <p>7 just a little while ago about if you had camera image</p> <p>8 data that had depth, regardless of how that depth data</p> <p>9 was provided.</p> <p>10 If I didn't do any type of detection or</p> <p>11 recognition of the object and I didn't use the data from</p> <p>12 the camera image data to then find a 3D model from the</p> <p>13 database that matches the information in my camera image</p> <p>14 data, I would be able to correlate that to the</p> <p>15 LIDAR/Radar data, correct?</p> <p>16 MR. SMITH: Objection. Form.</p> <p>17 THE WITNESS: Yeah, I didn't....</p> <p>18 MR. WEINSTEIN: Sorry.</p> <p>19 THE WITNESS: I don't --</p> <p>20 BY MR. WEINSTEIN:</p> <p>21 Q. If I had -- if I have camera image data with</p> <p>22 depth information --</p> <p>23 A. So this is hypothetically?</p> <p>24 Q. Yes.</p> <p>25 Yes, if I have camera image data with depth</p>
<p style="text-align: right;">135</p> <p>1 displaying it to him.</p> <p>2 A. Yeah, take a picture of him.</p> <p>3 Q. Yes, that's -- that's true.</p> <p>4 Can you go on to Paragraph 83 of your</p> <p>5 declaration, please.</p> <p>6 A. Okay.</p> <p>7 Q. In kind of the middle it says "Claim 19</p> <p>8 requires...."</p> <p>9 A. Yes.</p> <p>10 Q. So it says claim 19 requires that the point</p> <p>11 cloud data from the LIDAR/RADAR be aligned or correlated</p> <p>12 with points in the camera image data. The POSITA, in</p> <p>13 reading the specification, understands that the camera</p> <p>14 image data includes a 3D model of the aircraft in the</p> <p>15 camera's coordinate system, and is processed by aligning</p> <p>16 a 3D model of the aircraft and with the camera image in</p> <p>17 order to generate an initial aircraft 3D model.</p> <p>18 Do you see that?</p> <p>19 A. I do.</p> <p>20 Q. Is it your contention that the correlating of</p> <p>21 LIDAR/Radar sensor datapoints with points in the camera</p> <p>22 image data as recited in claim 19 is a 3D model of the</p> <p>23 aircraft in the camera image data?</p> <p>24 A. The process here is the camera data has been</p> <p>25 used to pose -- a 3D model has been selected. The</p>	<p style="text-align: right;">137</p> <p>1 data --</p> <p>2 A. Okay.</p> <p>3 Q. -- I can correlate that to a 3D point cloud of</p> <p>4 Radar or LIDAR data, correct?</p> <p>5 A. Again, assuming you know the coordinate</p> <p>6 systems and so forth, you can coordinate two 3D -- you</p> <p>7 can correlate two 3D datasets --</p> <p>8 THE REPORTER: Wait, wait, wait. Please,</p> <p>9 sorry. When you say two 3D [phonetic], do you mean T-O</p> <p>10 or T-W-O?</p> <p>11 THE WITNESS: T-W-O.</p> <p>12 THE REPORTER: Okay. Thanks.</p> <p>13 THE WITNESS: So two separate 3D datasets can</p> <p>14 be correlated to each other.</p> <p>15 BY MR. WEINSTEIN:</p> <p>16 Q. So in -- in that quoted paragraph, from -- or</p> <p>17 quoted sentence from Paragraph 83 -- two sentences, you</p> <p>18 refer to the -- that the camera image data includes a 3D</p> <p>19 model of the aircraft.</p> <p>20 So my question is: If I had camera image data</p> <p>21 with depth, would you consider that to be a 3D model of</p> <p>22 the aircraft?</p> <p>23 A. First of all, assuming it's an image of an</p> <p>24 aircraft, I would --</p> <p>25 It's certainly not the same 3D model of an</p>

<p style="text-align: right;">138</p> <p>1 aircraft that is specified in this patent. It is a 3D 2 data structure describing an aircraft, so in that sense 3 I guess it's a 3D model of the aircraft. But it is not 4 the -- but I guess I would say it is a 3- -- what I'm 5 imagining here is an image of an aircraft with 3D data, 6 depth data, associated with each of the pixels. 7 That would, sitting here today, be a model of 8 at least that exposed size -- side or portion of the 9 aircraft that -- yeah.</p> <p>10 Q. Okay. So just to kind of summarize it all 11 then. 12 It is possible to correlate the 3D point cloud 13 data of the LIDAR or Radar with camera image data that 14 includes depth or with camera image data that is used to 15 select a 3D model from a database, correct? 16 MR. SMITH: Objection, form. 17 THE WITNESS: I would say no to that. And 18 focusing on the second part of that, the 3D model needs 19 to be posed based on the camera data. The camera data 20 is used to take this 3D model and orient it in 21 accordance with the real world. That 3D model can then 22 be correlated with the Radar/LIDAR data using a point 23 cloud process, among other ways. 24 BY MR. WEINSTEIN: 25 Q. But if I had camera image data that included</p>	<p style="text-align: right;">140</p> <p>1 Berkmo is doing is essentially saying: Is this space 2 clear? Is this stand area available for an aircraft or 3 is there something there that would be dangerous to the 4 aircraft? 5 I don't see an indication that Berkmo cares 6 exactly where the object is, if it's in the space or 7 going to be in the space when the aircraft gets there, 8 that is sufficient to stop the aircraft. 9 He's not trying -- I don't see that he is 10 trying to, you know, determine the exact relationship 11 between the aircraft and other objects as much as just: 12 Be sure that the space the aircraft is expected to go 13 into is clear. 14 Q. Can you go to Paragraph 79 and 80 of Berkmo? 15 A. Berkmo? 16 Q. Yes. Exhibit 1004. It's right there. 79 and 17 80. 18 A. Okay. 19 Q. So in these paragraphs, Berkmo is describing 20 predicting collisions, correct? 21 A. Yes, he is. 22 Q. What information do you need to predict 23 collisions? 24 A. As I read this, I don't -- I understand that 25 predicting a collision as used by Berkmo here is</p>
<p style="text-align: right;">139</p> <p>1 the aircraft, and I had depth data with it, that could 2 also be correlated with the LIDAR/Radar data? 3 A. Again, if you have 3D -- a 3D dataset, which I 4 think is what you are describing here, camera data with 5 depth information, two 3D datasets can be correlated 6 with each other. The -- the correlation may or may not 7 be good, but the process would be understood by a POSITA 8 of how to combine two different 3D datasets or how to 9 correlate the two. 10 Q. Can you go to Paragraph 90 of your 11 declaration. 12 A. Okay. 13 Q. And about two thirds of the way down it says: 14 If another object is there, its precise position does 15 not matter in Berkmo -- the aircraft is simply told to 16 stop. 17 Do you see that? 18 A. I do. 19 Q. You also indicate that Berkmo is focused on 20 safety, correct? 21 A. That's correct. 22 Q. Don't you need to know positioning in order to 23 assess whether there's going to be a collision and to 24 provide safety? 25 A. Not necessarily. My point here is that what</p>	<p style="text-align: right;">141</p> <p>1 equivalent to predicting if they are both going to be in 2 the stand area at the same time. This doesn't require a 3 physical collision. 4 Again, these are valuable aircraft. People 5 are not -- not going to predict: Okay. They are going 6 to miss by two inches. We are good. You know, Berkmo 7 is basically trying to -- a collision occurs according 8 to Berkmo, in my opinion, when they are both in the 9 stand area at the same time. That would be, 10 essentially, a collision, according to my reading of 11 Berkmo. 12 Q. In Paragraph 80 it says that: ...based on at 13 least a speed and direction of each of said other 14 objects and a speed and direction of the approaching 15 aircraft, determine if said other objects are predicted 16 to leave the stand area before the approaching aircraft 17 is predicted to arrive. 18 Do you see that? 19 A. Yes, I do. 20 Q. So it -- isn't at least some of the 21 information that it uses to predict collisions is the 22 speed and/or direction of the other objects and the 23 aircraft? 24 A. Yes, it is. But it is also here, he's not 25 determining if the two are going to be in the same space</p>

<p style="text-align: right;">142</p> <p>1 or going to physically touch each other. He's just 2 trying to determine if the object is going to be within 3 the stand area. 4 So, you know, that's sufficient for his needs, 5 is he doesn't, based on what you just read, need to know 6 where in the stand area that object is. 7 If it's the stand area, that's not good. 8 Q. If -- if it's looking at the speed and 9 direction, how can it determine if it's going to be in 10 the stand area or not if it doesn't know where it is? 11 A. It does know where it is to some extent. So 12 my understanding is that Berkmo does know approximately 13 where it is. 14 But, you know, as we talked about earlier with 15 Radar, it can be difficult sometimes to tradeoff between 16 speed and -- and location, so -- 17 Q. So -- 18 A. -- you know, Berkmo is not -- Berkmo doesn't 19 care exactly where it is. He does care if it's going to 20 be out of the area or -- or not when the plane arrives. 21 Q. So going back, the sentence you said in 22 Paragraph 90 is: If another object is there, its 23 precise position does not matter in Berkmo. The 24 aircraft is simply told to stop. 25 A. Correct.</p>	<p style="text-align: right;">144</p> <p>1 A. Yes. I did not -- did not mean to imply here 2 that he has no knowledge at all of the position. What I 3 meant to -- my emphasis here is that, you know, 4 approximate position within the stand area is sufficient 5 for his -- implementing his invention. 6 It doesn't, you know -- so -- whether it's on 7 the left or the right side in your example would make a 8 difference whether it's a foot from the left or 2 feet 9 from the left side or 5 feet probably would -- 10 Q. Can you go to Paragraph 97 of your 11 declaration. I'm getting better at that, being very 12 specific. 13 A. Okay. 14 Q. In this paragraph you say Berkmo does not 15 disclose "merging the camera image data and the 16 LIDAR/Radar-sensor data into a merged dataset" -- or as 17 you say in Claim 1: Or "merging the camera image data 18 and the LIDAR/Radar sensor data associated with the 19 aircraft into a merged dataset" as recited in 20 independent claims 10 and 18. 21 Do you see that? 22 A. I do. 23 Q. So you assert that Berkmo does not disclose 24 merging camera image data with LIDAR or with Radar 25 sensor data, correct?</p>
<p style="text-align: right;">143</p> <p>1 Q. All right. Are you putting a significant 2 emphasis on "precise" when it comes to position? 3 A. What I'm saying is that if it's in the stand 4 area, my interpretation of Berkmo is: He's going to say 5 stop. It doesn't matter if it's on the left side of the 6 stand or the right side or anywhere. If it's in that 7 stand area at any position, you know, Berkmo will behave 8 in the same manner. 9 Q. Okay. Let's say the -- the stand area is 10 approximately a square. 11 A. Okay. 12 Q. And an object is on the left side of the 13 square, and it's moving to the right and it has a 14 certain speed. 15 So if the direction is to the right and it has 16 a certain speed, and there's another object that is also 17 on the right side -- that's in the same thing, and it's 18 on the right side, and it has the same speed and same 19 direction. 20 In five seconds, the one that is on the right 21 side is going to be out. But in five seconds, the one 22 that's on the left side will still be on the stand area. 23 So doesn't he need to know with some precision where 24 it's starting from when it's making the calculation if 25 it's going to be in the stand area or not?</p>	<p style="text-align: right;">145</p> <p>1 A. That is correct. 2 Q. Can you go to Paragraph 32 in Berkmo? 3 A. This is Berkmo, yes. 4 Q. Uh-huh. 5 A. Okay. 6 Q. Do you see the second sentence there, it says: 7 For example, the airport stand arrangement may be 8 configured to detect and track the approaching aircraft 9 based on combined output data from a laser-based system 10 and an imaging system. 11 Do you see that? 12 A. Yes, I do. 13 Q. Is combined output data from a laser-based 14 system and an imaging system merged data from a LIDAR or 15 sensor data and camera image data? 16 A. Could you repeat the question, please? 17 Q. Combined output data from a laser-based system 18 and an imaging system as described in Paragraph 32 of 19 Berkmo is merging camera image data with LIDAR sensor 20 data, correct? 21 A. No. 22 Q. Why isn't it? 23 A. Nowhere in Berkmo do I see a -- he is clearly 24 using camera data. He is using LIDAR data. He is using 25 Radar data. But nowhere is he merging the data -- the</p>

<p style="text-align: right;">146</p> <p>1 camera data with either the LIDAR or the image data. 2 He does make conclusions based on the camera 3 data, and -- and he makes conclusions based on the 4 Radar -- Radar data, but he does not, you know, 5 combine -- I don't see any evidence that the data -- the 6 camera data and the other data is combined in Berkmo, 7 nor do I see any instructions on how one would do that 8 given the differences in the 2D/3D formats of the data. 9 Q. So when it says that the airport stand 10 arrangement detects and tracks the approaching aircraft 11 based on combined output data from a laser-based system 12 and an imaging system, you are saying that the combined 13 output data is not actually combined? 14 A. I'm saying that the -- the data is not 15 combined, you know, the -- the two systems may be 16 arguably used independently. But again, I see no 17 evidence that the data is combined or a procedure by 18 which that would be done. 19 Q. Can you go to Paragraph 16 to 18 of Berkmo. 20 A. Okay. 21 Q. And in Paragraph 16 it says: According to 22 some embodiments, said one or more additional systems 23 are selected from laser-based systems only. 24 17, According to some embodiments, said one or 25 more additional systems are selected from imaging</p>	<p style="text-align: right;">148</p> <p>1 elevation information in the Radar, correct? 2 A. That is correct, yes. 3 Q. And you also -- you also discussed earlier 4 today that from the camera image data you can determine 5 azimuth and elevation information, correct? 6 A. Given the proper information, yes. 7 Q. And there are also ways to use camera image 8 data to provide an estimation of the depth in the camera 9 image, correct? 10 A. There are ways, as I mentioned, such as stereo 11 imagery for getting depth, but none of those are 12 disclosed or alluded to in Berkmo, and I see no 13 indication in Berkmo of any 3D component to the image 14 data or a method for producing that. 15 Q. But you did agree before that a POSITA -- 16 THE REPORTER: Wait, can you say that again? 17 BY MR. WEINSTEIN: 18 Q. A POSITA would have been able to determine 19 depth data from camera images using a stereo camera or 20 using other depth estimation processes like having 21 cameras moving over time or, at least in one example, 22 the possibility of a camera that is taking images of 23 moving objects if it has some information about the 24 moving objects. 25 MR. SMITH: Objection to form.</p>
<p style="text-align: right;">147</p> <p>1 systems only. 2 And 18, According to some embodiments, said 3 one or more additional systems comprise and at least one 4 laser-based system and at least one image-based system. 5 Would you agree based on the description of 6 Paragraphs 16 to 18, that said one or more additional 7 systems can be laser-based systems only, image systems 8 only, or both together? 9 A. Yes. And I would agree that Berkmo implies 10 that he is using the camera data as he uses the LIDAR 11 data, but, you know, in all of his specific examples, he 12 never uses the -- the camera data. None of the claims 13 reference the camera data. The -- the processes are not 14 appropriate for combining camera data and 3D data, so 15 while he throws out the idea that this can all be done 16 with the camera data, there's no support for that 17 elsewhere in the document or in the details. 18 Q. We discussed earlier today that one of the 19 issues with Radar data is that the azimuth and elevation 20 information is not that accurate. 21 Do you remember that? 22 A. Yes. 23 Q. And we also talked about how if you had a 24 smaller beam on the Radar that was used to scan, that 25 that would improve the accuracy of the azimuth and</p>	<p style="text-align: right;">149</p> <p>1 BY MR. WEINSTEIN: 2 Q. Do you -- 3 A. I mean, I would say that there's many things 4 that a POSITA could do. But there's no indication of 5 them doing anything along those lines in Berkmo. 6 Q. So there's -- you are saying that there's no 7 description in Berkmo of doing that, correct? 8 A. No description or implication or allusion to 9 something that I think would indicate that, or even an 10 undis- -- undescribed -- you know, something in here 11 that he is not clear how it is done. 12 And sometimes in a patent, there's things that 13 there's no details on how they are done, and one has to 14 make assumptions about that. But there is nothing in 15 Berkmo that would indicate to me that 3D image data is 16 used or contemplated in -- in any way. 17 Q. But you do at least, at this point agree that 18 Berkmo says you do combine image data with Radar data or 19 laser data? 20 MR. SMITH: Objection. Mischaracterization. 21 THE WITNESS: I mean, there was a citation we 22 read a while ago that says they are used for similar 23 purposes, but I don't agree that they are combined. 24 They are both used for tracking, but I believe that was 25 the example we were discussing. But that does not mean,</p>

<p style="text-align: right;">150</p> <p>1 to me, that they are combined. 2 BY MR. WEINSTEIN: 3 Q. Okay. And again, Berkmo Paragraph 32 says: 4 Combined output data from a laser-based system and an 5 imaging system. 6 And you are saying it doesn't teach -- Berkmo 7 does not -- let me strike that. 8 With respect to the sentence in Paragraph 32, 9 that the combined output data from a laser-based system 10 and an imaging system is used to detect and track the 11 approaching aircraft. 12 You are saying that even though it says the 13 data -- the output data from both is combined, it's not 14 used in combination to detect and track. 15 Is that correct? 16 THE REPORTER: Used in combination to detect.. 17 MR. WEINSTEIN: And track. 18 THE WITNESS: In reading Paragraph 32, I do 19 not understand that to mean that the data is combined. 20 I understand that to mean that the results, if you will, 21 of the camera system and the laser-based system, may be 22 combined. 23 But I don't -- I do not understand that to 24 require the data itself be combined. 25 ///</p>	<p style="text-align: right;">152</p> <p>1 example for one and implying it applies to the other 2 sensor. But I don't believe that's -- it doesn't seem 3 to apply, in my opinion, reading these -- these LIDAR 4 examples that Dr. Campbell cites to, are not appropriate 5 for the image systems as Berkmo seems to allude to and 6 Dr. Campbell seems to assert. 7 BY MR. WEINSTEIN: 8 Q. Can you go to Paragraph 23 of Berkmo? 9 A. Okay. 10 Q. And there it says: The airport stand 11 arrangement may be configured to detect and track the 12 approaching aircraft based on a spatially resolved 13 weighted average of the combined output data, wherein 14 the weighted average is determined based on statistical 15 weights for the Radar system and the one or more 16 additional systems, respectively. 17 Do you see that? 18 A. I do. 19 Q. Can the one or more additional systems be the 20 image-based system? 21 A. Again. This is where I see Berkmo as 22 asserting that the one or more additional systems can be 23 either a LIDAR system or a camera system. But all of 24 his examples are with LIDAR systems and the methods 25 would have to be different. The methods are all</p>
<p style="text-align: right;">151</p> <p>1 BY MR. WEINSTEIN: 2 Q. When Berkmo describes that the LIDAR and Radar 3 data are combined, do you describe that data as being 4 combined? 5 A. Yes. He provides some methods by which that 6 data can be combined and some specific examples of that, 7 but he doesn't provide any specific examples for image 8 data nor does he provide a method that would work for 9 image data. 10 Q. So again, I want to understand the distinction 11 because Berkmo repeatedly uses the term "combined output 12 data." And at least in 32, it says the combined output 13 data is laser and image data. 14 So other than your contention that there's no 15 description of how the laser and image data is combined, 16 that is the basis for you saying that they are not 17 actually combined. 18 Is that correct? 19 MR. SMITH: Objection. Form. 20 THE WITNESS: I'm also responding here to 21 Dr. Campbell's opinions on this. And, you know, he drew 22 opinions about the imaging system based on examples that 23 were specifically to the laser system. 24 Berkmo is fairly free in conflating the two 25 or -- you know -- you know, using one when -- giving an</p>	<p style="text-align: right;">153</p> <p>1 appropriate for LIDAR types of systems. 2 So while Berkmo does seem to imply that the 3 image system and LIDAR systems could be treated 4 interchangeably, that's not my opinion, and I think 5 Berkmo has, essentially, just, you know, thrown the 6 image system in there as a catch-all or something that 7 he wants to address in his patent, but doesn't -- you 8 know, there is no meaningful discussion of how the image 9 data is used as relevant the Poojary patent, and there's 10 no mention of the image data in the claims. It doesn't 11 seem to be something that Berkmo was terribly concerned 12 with. 13 Q. Okay. But we are not interpreting the -- the 14 claims of the patent. We are interpreting what the 15 specification says -- 16 A. Yes. 17 Q. -- because, what it -- when it comes to 18 invalidity, based on not just the claims but -- 19 THE REPORTER: Wait, wait, wait. Oh, please. 20 MR. WEINSTEIN: Sorry. 21 BY MR. WEINSTEIN: 22 Q. When we are talking invalidity, we are talking 23 about not just the claims but the specification of the 24 prior art. 25 Do you agree in claim -- in Paragraph 23 of</p>

<p style="text-align: right;">154</p> <p>1 Berkmo, that when it says: The weighted average is 2 determined based on statistical weights from the Radar 3 system and/or one or more additional systems, that even 4 if it doesn't describe how to do it, that it would apply 5 to both the image and the laser-based systems? 6 A. I would agree that Berkmo intends this as a 7 catch-all to include the image-based system, but I do 8 not agree that the system, as described, would actually 9 perform with the image sensor. 10 Q. Why could it not perform with the image 11 sensor? 12 A. As first point, I mean Berkmo never describes 13 that in any specific examples with the image sensor. 14 And secondly, the -- the image sensor is providing 2D 15 data that, in order to fuse that 2D data with 3D data 16 such as the Radar or LIDAR, certain steps need to be 17 taken. They cannot be fused directly. And none of 18 those steps are alluded to or described or obvious how 19 they would be used in Berkmo. 20 Q. So it can be done. You are just contending 21 there's not enough description about how it's done. 22 MR. SMITH: Objection. Mischaracterization. 23 THE WITNESS: I think Poojary has described a 24 way in which it can be done. And as I said before, a 25 POSITA can do a lot of stuff, but there's no indication</p>	<p style="text-align: right;">156</p> <p>1 correct? 2 A. One needs additional information such as the 3 3D component of the camera data or some way to derive 4 additional 3D data. 5 But as a -- one needs to be able to assign a 6 3D coordinate to the 2D data in order to combine it with 7 3D data in any meaningful way. 8 Q. Would a POSITA understand what steps you would 9 need to take to be able to make that combination of -- 10 THE REPORTER: Wait. In order to make that -- 11 MR. WEINSTEIN: To combine the 2D camera -- 12 let me just ask the question again. 13 BY MR. WEINSTEIN: 14 Q. Would a POSITA understand what steps you need 15 to take to be able to combine 2D camera image data with 16 the 3D LIDAR/Radar data? 17 A. As we have discussed, turning the 2D data into 18 3D data through a stereo mechanism or something else 19 would be one way to do it. 20 Depending on the exact circumstances and 21 situation, there may be other ways. But, you know, in 22 general, no. In general, the -- the data needs to be 23 turned into 3D data to combine with the Radar/LIDAR 24 data. Somehow that 3D -- third dimension needs to be 25 derived.</p>
<p style="text-align: right;">155</p> <p>1 that the -- any of that is anticipated here in Berkmo or 2 that the, you know, tools such as the stereo camera are 3 present to perform those additional steps. 4 BY MR. WEINSTEIN: 5 Q. If Berkmo described that the camera could be a 6 stereo camera, would you have any of these objections? 7 A. I would in the sense that it's not that it can 8 be a stereo camera. In order to provide the integration 9 of the -- the image data with the Radar data along the 10 lines of Berkmo's invention, it would be required to be 11 stereo data because the 3D component is required. It's 12 not optional. The fact that he doesn't require that 13 means to me that he is working with 2D data. And again, 14 there is no disclosed way or approach to combining that 15 2D data with the 3D data of the Radar/LIDAR system. 16 Q. If the image data in Berkmo was 3D data, it 17 would be within the skill of a POSITA to combine it with 18 LIDAR/Radar data, correct? 19 A. In that hypothetical case, that would probably 20 be -- yes, it's -- but -- but again, that's a total 21 hypothetical here, and there's no indication at all that 22 the imagery data in Berkmo is three dimensional. 23 Q. And so -- just so I also understand as well 24 that in your opinion, there's no way to combine 2D 25 camera data with 3D Radar and LIDAR data. Is that</p>	<p style="text-align: right;">157</p> <p>1 MR. WEINSTEIN: Do you want to take a break? 2 We have been going about an hour and 15. 3 MR. SMITH: Sounds good. 4 (Recess taken.) 5 BY MR. WEINSTEIN: 6 Q. Okay. Turn to Paragraph 104 of your 7 declaration. 8 A. Okay. 9 Q. And in the second line you say in reference to 10 Paragraphs 22 to 25 of Berkmo: They discuss 11 automatically shifting from one system to another with 12 no indication of a merged output. 13 In Paragraph 23 of Berkmo that talked about 14 the weighted average is the weighted average of the 15 combined output, if it's, say, the Radar and LIDAR, is 16 that weighted average of the combined output merging? 17 A. This is another area where I was really glad I 18 didn't have to parse exactly what "merging" means. I 19 don't -- I didn't form an opinion on whether this is 20 merging or not. 21 Q. What -- what did you mean by "no indication of 22 a merged output" then? 23 A. The -- I sort of think of combining data as a 24 spectrum. On one end there would be no -- no 25 culmination because things are separate. The other end</p>

<p style="text-align: right;">158</p> <p>1 being probably fusion or something like that, where data 2 is -- I think of fusing as putting, you know, the data 3 together in a -- in a sort of global sense. 4 Merging is somewhere in between there, and the 5 combination of image data and Radar/LIDAR data in Berkmo 6 isn't -- it is way over on the not fusing side of that 7 spectrum. 8 There's no cul- -- no cul- -- no evident 9 culmination of exact -- of the datasets together, so 10 that's certainly not merging. Where exactly beyond that 11 merging starts, I don't have a strong opinion on it. 12 Q. Would you agree that with respect to Berkmo 13 that it teaches merging LIDAR and Radar data? 14 A. Again, I don't know that I would characterize 15 the weighted average as merging, but it certainly -- it 16 might be considered merging. It's within the -- the 17 potential scope of merging that a POSITA would 18 understand. 19 Q. You used the term "fusion" or "fusing" 20 repeatedly in your answers. What is your understanding 21 of fusion of data? 22 A. This is another term that I think has somewhat 23 different meanings in different contexts. To me I think 24 of fusion, as I have gone through these patents -- 25 fusion is taking datasets as a whole and somehow</p>	<p style="text-align: right;">160</p> <p>1 claim 2, or claim 18? 2 A. I am construing merging. I -- it requires 3 some level of taking the datasets and, you know, 4 combining them in some way more than just sticking them 5 in the same Excel file perhaps. 6 Since I don't see that Berkmo even discloses 7 that, I do not need to construe the term any more finely 8 than, you know, a general construction of merging. 9 Q. When you say that "Berkmo does not even 10 disclose that" you mean that with respect to combining 11 image data with Radar/laser data? 12 A. Yes. He discloses some -- this weighted 13 average process on combining the laser data and the 14 Radar data. And whether or not that is merging, I'm not 15 taking a hard opinion on. But that is certainly more 16 than is disclosed with the image data. 17 Q. Okay. What -- what is the '349 patent -- so 18 strike that. 19 I want to be able to understand what is 20 sufficient to meet the merging of claim 1. And, you 21 know, we talk about this idea of fusion at one end of 22 the spectrum of being 100 percent merging and then 23 something on the other end, as you described, a phone 24 book. And -- and we have talked about data fusion. I 25 guess I'm trying to understand: Can you give me a</p>
<p style="text-align: right;">159</p> <p>1 combining them as opposed to segments of it -- of the 2 data. So that's, again, sort of how I think of fusion 3 in this context. But that definition is not -- you 4 know, the specifics of that definition or the definition 5 of merge, have not influenced my opinions -- do not 6 influence my opinions here. They are not based on the 7 fine parsing of those terms. 8 THE REPORTER: Did you say "the dictionary 9 definition" or "the specifics of that definition"? 10 THE WITNESS: The specifics of that 11 definition. 12 BY MR. WEINSTEIN: 13 Q. If I have one dataset and another dataset and 14 I combine them into a single dataset, is that merging? 15 A. Again, this is -- depends on how it's done. 16 I -- I could take two -- you know, an address book and 17 an image data and stick them into an Excel file. Have 18 they been merged? I would argue not, but somebody 19 might. 20 Those specific definitions I -- I think it's 21 very hard to draw a hard line between those. And I 22 don't have to for this analysis -- my analysis, which is 23 nice. 24 Q. Okay. So for the purposes of your analysis, 25 you are not actually construing merging in claim 1,</p>	<p style="text-align: right;">161</p> <p>1 specific example that would -- that a POSITA would 2 understand as: This data was fused with that data? 3 A. I think a -- a specific example would be this 4 ICP algorithm where there's two point clouds that are 5 essentially merged into a single point cloud. And I 6 would consider that to be fusion. 7 Q. In that -- in that type of fusion then, is 8 the -- the data from one point cloud -- let me strike 9 that. 10 So each point cloud has a particular 11 coordinate system for its data. Is that accurate? 12 A. They may be the same. But, yes. 13 Q. Let's say, first and second point clouds have 14 first and second coordinate systems that are different 15 from each other, okay? 16 The ICP algorithm would allow me to have both 17 point clouds in the same coordinate system, correct? 18 A. Yes. It does more than that, in that -- 19 consider the example of these two point clouds 20 describing an airplane. Both of the point clouds have 21 errors on points. Some will be, you know, right on the 22 surface, some will be off in one direction or another. 23 The ICP algorithm also resolves those errors between the 24 two datasets, so combine -- so minimizes the error over 25 both the -- the combination of both datasets. So that</p>

<p style="text-align: right;">162</p> <p>1 is -- you know, and -- and results in a third dataset</p> <p>2 that is the best fit, if you will, to the aircraft</p> <p>3 model.</p> <p>4 And that -- that, to me, is a good example</p> <p>5 of -- of fusion.</p> <p>6 Q. When you have done this translation so that</p> <p>7 they are in the same coordinate system, is the</p> <p>8 underlying data in either cloud actually changed other</p> <p>9 than effectively position information?</p> <p>10 A. So in this last example, which is probably a</p> <p>11 better example, yes. Both the -- the -- there's also a</p> <p>12 smoothing component to the algorithm so that, you know,</p> <p>13 the data is pulled together. The outliers are hopefully</p> <p>14 reduced in the -- in the process by -- so, you know,</p> <p>15 presumably we would have these two airplane models.</p> <p>16 They would start out being fairly rough, and after this</p> <p>17 ICP process, we would have a smoother model of the</p> <p>18 airplane if that makes sense.</p> <p>19 Q. So it's kind of like using the best data from</p> <p>20 each set?</p> <p>21 A. Yes, it is a -- it's sort of a 3D</p> <p>22 least-squares type of fitting algorithm of, you know,</p> <p>23 trying to make the best fit possible to this set of data</p> <p>24 in three -- three dimensions. So it -- probably a good</p> <p>25 analogy would be a least squares algorithm for a line.</p>	<p style="text-align: right;">164</p> <p>1 to get late.</p> <p>2 Q. So it -- to ask the question again: Are there</p> <p>3 any point cloud processes that can be used other than</p> <p>4 ICP to do that correlation in claim 19? Is your answer</p> <p>5 "yes" or "no"?</p> <p>6 A. My answer is that there is a specific</p> <p>7 correlation that ICP does and other processes -- I can't</p> <p>8 think of any offhand that do the same type of</p> <p>9 correlation, but there are potentially other</p> <p>10 correlations, and with more time, could probably come up</p> <p>11 with some counterexamples.</p> <p>12 But sitting here right now, I can't.</p> <p>13 Q. Can you go to Paragraph 119 of your</p> <p>14 declaration.</p> <p>15 A. Okay.</p> <p>16 Q. Do you see there in the third line, you make</p> <p>17 reference to pixel-to-pixel matching?</p> <p>18 A. I do.</p> <p>19 Q. What does, pixel-to-pixel matching mean?</p> <p>20 A. To me I think here that one of the things that</p> <p>21 I find confusing is pixels often refer to 2D structures.</p> <p>22 I believe here a better term would be voxels, which are</p> <p>23 3D pixels if you will. And I believe that that is --</p> <p>24 it's my opinion that what Berkmo is referring to is a</p> <p>25 voxel-to-voxel correlation. But pixels can also be</p>
<p style="text-align: right;">163</p> <p>1 The ICP algorithm is for a surface.</p> <p>2 Q. Just to confirm, neither claim 1 nor any other</p> <p>3 claim in the '349 patent actually recites that the data</p> <p>4 has to be fused, correct?</p> <p>5 A. That is correct. Again, claim 19, I think it</p> <p>6 is, requires that there's the point cloud process, the</p> <p>7 ICP being an example provided. But -- but it does not</p> <p>8 say "fused." The word is not used.</p> <p>9 Q. And the -- well, ICP is an example. The</p> <p>10 correlation that's done in -- strike that.</p> <p>11 Claim 19 recites about correlating the</p> <p>12 datapoints of the 3D point cloud of the Radar and LIDAR</p> <p>13 data to the camera image data, correct?</p> <p>14 A. Just -- yes. Claim 19 is the analysis of</p> <p>15 claim 18 where the LIDAR/Radar data is analyzed using a</p> <p>16 point cloud process to correlate points in the</p> <p>17 LIDAR/radar sensor data to points in the camera image</p> <p>18 data.</p> <p>19 Q. Are there point cloud processes that can be</p> <p>20 used other than ICP to do that?</p> <p>21 A. That's a fairly broad question, and I think,</p> <p>22 you know, correlation, can have many different meanings,</p> <p>23 what correlation means. So no other processes come to</p> <p>24 mind offhand, but it's a very broad -- broad question</p> <p>25 depending on what correlation means, and it's starting</p>	<p style="text-align: right;">165</p> <p>1 applied to three-dimensional structures.</p> <p>2 So what this is, is essentially alignment of</p> <p>3 the LIDAR and Radar data, the 3D spaces so that the</p> <p>4 pixels -- voxels are associated between the two</p> <p>5 datasets.</p> <p>6 Q. And also here --</p> <p>7 THE REPORTER: Wait, wait. And also</p> <p>8 something?</p> <p>9 BY MR. WEINSTEIN:</p> <p>10 Q. And also here there are spatial regions of the</p> <p>11 output data.</p> <p>12 Where are the spatial regions of the output</p> <p>13 data?</p> <p>14 A. I understand that to be the 3D space of the</p> <p>15 stand, so the -- the stand area and the space above it,</p> <p>16 with the 3D cells corresponding to that -- that area --</p> <p>17 that region. And possibly more -- probably more, but --</p> <p>18 or -- or a portion thereof. Again, depending on what</p> <p>19 part is being imaged there, but it's 3D volumes</p> <p>20 throughout the stand area.</p> <p>21 Q. So in this process, is -- is the field of view</p> <p>22 split into angular regions and azimuth and elevation to</p> <p>23 create 2D pixels, and then range data is merged and</p> <p>24 combined with it?</p> <p>25 MR. SMITH: Objection. Form.</p>

<p style="text-align: right;">166</p> <p>1 THE WITNESS: I believe what is going on here</p> <p>2 in Berkmo is he is taking, essentially, the data from</p> <p>3 the LIDAR -- the 3D data from the LIDAR, the 3D data</p> <p>4 from the Radar, putting that into a common reference</p> <p>5 frame, if you will, which is these Cartesian voxels, and</p> <p>6 essentially, associating or projecting the data from the</p> <p>7 sensor space of the LIDAR/Radar into this Cartesian</p> <p>8 coordinate system, and then within each of those voxels</p> <p>9 doing this averaging process.</p> <p>10 BY MR. WEINSTEIN:</p> <p>11 Q. Can you look at Figure 2 of Berkmo?</p> <p>12 A. Okay.</p> <p>13 Q. This is a combination that has Radar and</p> <p>14 camera in it, correct?</p> <p>15 A. Yes.</p> <p>16 Q. Looking at this, would you be able to find the</p> <p>17 spatial regions for each of the two sensors?</p> <p>18 A. I would -- so the way I have been thinking</p> <p>19 about this is that the spatial regions Berkmo is</p> <p>20 referring to would be essentially the whole page, if you</p> <p>21 will -- and in three dimensions, and that only the cells</p> <p>22 that the various sensors could provide information for</p> <p>23 would be filled in. There would be unknowns or</p> <p>24 something in the cells that are not within the coverage</p> <p>25 regions of the sensors. But that that -- that is the</p>	<p style="text-align: right;">168</p> <p>1 that space, and there is no way, without that third</p> <p>2 dimension, to assign data values from the camera to</p> <p>3 the -- to the three-dimensional cells.</p> <p>4 Q. Does -- does the Radar produce -- so -- we</p> <p>5 gave the example of LIDAR, that if you had a window</p> <p>6 facing the wall of a building, that at the same azimuth</p> <p>7 and elevation, you would get a return from the window</p> <p>8 and you would get a return from the wall, potentially,</p> <p>9 plus other things.</p> <p>10 A. Yeah.</p> <p>11 Q. But you would get multiple returns from the</p> <p>12 same azimuth and elevation.</p> <p>13 Is there something analogous in Radar that at</p> <p>14 a particular azimuth and elevation you would get more</p> <p>15 than one return?</p> <p>16 A. You can, but I would say in Radar, it's more</p> <p>17 due to the fact that everything is blurred together, and</p> <p>18 so you'll -- you'll see a number of returns in -- in</p> <p>19 depth, but, you know, they are sort of all from the</p> <p>20 same -- they would appear to be from the same azimuth</p> <p>21 and elevation. But in fact, they are -- they are</p> <p>22 different objects that are just within that same space,</p> <p>23 not behind each other. They are displaced.</p> <p>24 In the LIDAR example, they were -- they were</p> <p>25 literally behind each other, and there was some</p>
<p style="text-align: right;">167</p> <p>1 process that Berkmo was going through, is essentially</p> <p>2 filling the sensor data into that Cartesian</p> <p>3 three-dimensional space roughly corresponding to the</p> <p>4 stand area.</p> <p>5 Q. And you refer to "only the cells of the</p> <p>6 various sensors could provide information for what would</p> <p>7 be filled in."</p> <p>8 What -- what do you mean "the cells of the</p> <p>9 various sensors"?</p> <p>10 A. What I was trying to get at there is that</p> <p>11 certain of the cells in the space are not imaged by the</p> <p>12 sensors. They are outside of the field of view, and so</p> <p>13 there would be no data in those -- those cells, again,</p> <p>14 in this Cartesian space.</p> <p>15 Q. So in -- in this space then, could you do, in</p> <p>16 reference to Figure 2, pixel-to-pixel matching with the</p> <p>17 Radar and camera?</p> <p>18 A. You can't because you -- the camera data, you</p> <p>19 do not have depth information in there. And so a given</p> <p>20 pixel in the camera corresponds to many different voxels</p> <p>21 in this Cartesian space. Again, I'm using Cartesian</p> <p>22 space to refer to the -- the created space as opposed to</p> <p>23 the sensor spaces which are pie shaped.</p> <p>24 So again, the specific problem the camera has</p> <p>25 is that its data corresponds to many different cells in</p>	<p style="text-align: right;">169</p> <p>1 transparency. In the Radar example, they are more</p> <p>2 likely to be laterally spaced and just not resolved.</p> <p>3 Q. So overlapped in different depth kind of</p> <p>4 thing. Is that right?</p> <p>5 A. Yeah. It's going to be fun to read in the</p> <p>6 transcript.</p> <p>7 Q. Yeah, somehow they don't see this, right?</p> <p>8 A. No.</p> <p>9 Q. If the Radar had enough resolution that it</p> <p>10 could provide accurate azimuth and elevation of what</p> <p>11 it's getting returns on, would it typically only get one</p> <p>12 return then from that particular azimuth and elevation?</p> <p>13 A. Again, it's sending the energy out into a</p> <p>14 cone, and there's no -- it's not like there's a hard</p> <p>15 edge to that cone. It will get a return of different</p> <p>16 strengths from everything in that cone, so potentially</p> <p>17 it would get multiple returns depending on what's in the</p> <p>18 environment, what it's looking at.</p> <p>19 Q. And if it was detecting a flat surface, say</p> <p>20 a -- a 10 feet by 10 feet flat surface, for a</p> <p>21 significant portion of it then, you would assume that it</p> <p>22 would just get one return back?</p> <p>23 A. Yes. You would expect to see one return sort</p> <p>24 of associated with that azimuth and elevation, and --</p> <p>25 and that distance.</p>

<p style="text-align: right;">170</p> <p>1 Q. In that example, at that azimuth and 2 elevation, if you could map it to 2D camera image data, 3 wouldn't the image at that same azimuth and elevation 4 correspond to that same point in the Radar data? 5 A. Possibly and possibly not. I mean, one of the 6 things that -- one of these patents directs to is 7 that -- and I think it's Berkmo -- talks about certain 8 composite materials being transparent. 9 I believe he says that -- like the nose cone 10 composite materials are transparent to LIDAR. They are 11 actually transparent to Radar, so you could see the 12 front of the aircraft. You are not going to see the 13 nice nose cone in the Radar. 14 Q. Uh-huh. 15 A. You are going to see through that and whatever 16 is behind there. So the pilot's shoes or whatever it 17 is, is what's going to show up, which is obviously not 18 what's going to show up in the imagery. So there are 19 complications. 20 Q. Let me ask it a little differently. 21 If I resolve the Radar data so that I had 22 azimuth and elevation for each detection that the Radar 23 does -- 24 A. Uh-huh. 25 Q. -- could I then match it with the camera image</p>	<p style="text-align: right;">172</p> <p>1 the Radar data. So, you know, all of that stuff needs 2 to be dealt with somehow in these models. 3 Q. Can you go to the '349 patent at Column 8, 4 line 50? 5 A. Line 5-0? 6 Q. Yes. 7 A. Okay. 8 Q. And in the subsequent lines, this describes a 9 60 pose estimation process. 10 Is that correct? 11 A. Yes. 12 Q. And in that process, it talks about that -- 13 starting on line 55, the 6D pose estimation can be 14 accomplished by, for example, orienting the projection 15 of the 3D model within an image plane by using a 16 calibrated camera and then comparing the projection with 17 image contours of the aircraft from the camera image 18 data. 19 Do you see that? 20 A. I do. 21 Q. What are image contours? 22 A. I believe what they are referring to here is 23 edges, you know, fairly common in image processing to 24 bring out the edges in a -- in an image and match up the 25 edges. Edges tend to stand out more than solid colors</p>
<p style="text-align: right;">171</p> <p>1 seeing just azimuth and elevation? 2 A. Again, you define the -- I mean, you first of 3 all have to have them colocated, which Berkmo 4 specifically indicated they don't have to be, so that's 5 not Berkmo's -- 6 Q. But in Figure 2 they are colocated. 7 A. Yes. Then again, my -- with my example 8 before, the ray -- the nose cone of the -- of the 9 aircraft, you are going to see the -- the nose cone with 10 the vid- -- with the camera system. The Radar is going 11 to see something behind there. You know, possibly quite 12 a ways back. You can't -- we don't know -- I don't know 13 what's back there. So they would not align. 14 Q. So there will be portions that would align but 15 then portions that would not align? 16 A. Presumably, depending on how much composite 17 stuff you have. Radar can also -- you know, have this 18 scintillating property. And the whole stealth idea that 19 certain surfaces are just going to reflect the energy 20 away, so something may -- and I think I talked about it 21 in this bouncy house example, which I kind of liked, you 22 know, there may be surfaces, even metallic surfaces, 23 that don't show up in the Radar because the energy is 24 reflected away. There are surfaces like bouncy houses 25 and Radar nose cones that are not going to show up in</p>	<p style="text-align: right;">173</p> <p>1 or surfaces, so I think this is just an edge -- you 2 know, bring -- highlight the edges and then match the 3 edges type of process. 4 Q. Okay. And so -- what you described -- 5 described there is how the camera image data would 6 determine the image contours? 7 A. Yes. The image contours to me would be the -- 8 the edges of -- that appear in the image. 9 Q. Okay. Is this 6D pose estimation process 10 described here a well-known process for doing 6D pose 11 estimation? 12 A. It's pretty standard. I would say, yes. 13 Q. So a POSITA would have understood how to do 14 this? 15 A. It can be, you know, like many of these 16 processes, it's fairly -- would be understood -- 17 understood how to do it poorly, or under -- with good 18 data -- 19 Q. Yeah. 20 A. To make it work well, reliably in fog and 21 these other situations, is not trivial -- 22 Q. Yeah. 23 A. -- but -- but the general concept would be 24 known to a POSITA. 25 Q. Okay.</p>

<p style="text-align: right;">174</p> <p>1 MR. WEINSTEIN: I have no further questions.</p> <p>2 MR. SMITH: Okay. Can I take a few minutes to</p> <p>3 look through here?</p> <p>4 MR. WEINSTEIN: Sure.</p> <p>5 (Recess taken.)</p> <p>6 THE REPORTER: Does anyone need a transcript?</p> <p>7 MR. WEINSTEIN: Can I get a rough?</p> <p>8 THE REPORTER: Oh, not tonight, because I have</p> <p>9 something I need to do tonight. I specifically told</p> <p>10 them I could only take this job if you don't need a</p> <p>11 rough or an expedite, but I can --</p> <p>12 MR. WEINSTEIN: When could you get a rough?</p> <p>13 THE REPORTER: Possibly tomorrow or day after.</p> <p>14 MR. WEINSTEIN: That's fine.</p> <p>15 MR. SMITH: That's fine.</p> <p>16 (Deposition concluded at 3:15 p.m.</p> <p>17 Declaration under penalty of perjury on</p> <p>18 the following page hereof.)</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>	<p style="text-align: right;">176</p> <p>1 DEPOSITION ERRATA SHEET</p> <p>2 Page No. _____ Line No. _____</p> <p>3 Change: _____</p> <p>4 Reason for change: _____</p> <p>5 Page No. _____ Line No. _____</p> <p>6 Change: _____</p> <p>7 Reason for change: _____</p> <p>8 Page No. _____ Line No. _____</p> <p>9 Change: _____</p> <p>10 Reason for change: _____</p> <p>11 Page No. _____ Line No. _____</p> <p>12 Change: _____</p> <p>13 Reason for change: _____</p> <p>14 Page No. _____ Line No. _____</p> <p>15 Change: _____</p> <p>16 Reason for change: _____</p> <p>17 Page No. _____ Line No. _____</p> <p>18 Change: _____</p> <p>19 Reason for change: _____</p> <p>20 Page No. _____ Line No. _____</p> <p>21 Change: _____</p> <p>22 Reason for Change: _____</p> <p>23</p> <p>24</p> <p>25 CHRISTOPHER K. WILSON _____ Dated _____</p>
<p style="text-align: right;">175</p> <p>1 DECLARATION UNDER PENALTY OF PERJURY</p> <p>2 I, CHRISTOPHER K. WILSON, do hereby certify under</p> <p>3 penalty of perjury that I have read the foregoing</p> <p>4 transcript of my deposition taken on July 25, 2024; that</p> <p>5 I have made such corrections as appear noted on the</p> <p>6 Deposition Errata Page, attached hereto, signed by me;</p> <p>7 that my testimony as contained herein, as corrected, is</p> <p>8 true and correct.</p> <p>9</p> <p>10 Dated this _____ day of _____</p> <p>11 _____, at _____</p> <p>12 California.</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17 _____</p> <p>18 CHRISTOPHER K. WILSON</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p>	<p style="text-align: right;">177</p> <p>1 CERTIFICATE OF REPORTER</p> <p>2</p> <p>3 I, Siew Ung, a Certified Shorthand Reporter, do</p> <p>4 hereby certify:</p> <p>5 That prior to being examined, the witness in the</p> <p>6 foregoing proceedings was by me duly sworn to testify to</p> <p>7 the truth, the whole truth, and nothing but the truth;</p> <p>8 That said proceedings were taken before me at the</p> <p>9 time therein set forth and were taken down by me in</p> <p>10 shorthand and thereafter transcribed into typewriting</p> <p>11 under my direction and supervision;</p> <p>12 I further certify that I am neither counsel for,</p> <p>13 nor related to, any party to said proceedings, nor in</p> <p>14 any way interested in the outcome thereof.</p> <p>15 In witness whereof, I have hereunto subscribed my</p> <p>16 name.</p> <p>17</p> <p>18</p> <p>19 8/9/2024</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24 _____</p> <p>25 Siew Ung CSR No. 13994, RPR, CSR</p>

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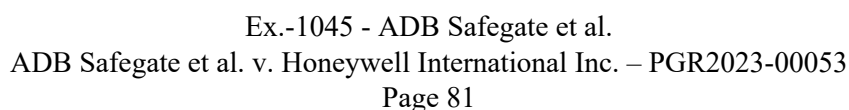
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