

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.

HONEYWELL INTERNATIONAL INC.,

Patent Owner

Case PGR2023-00053
Patent 11,538,349 B2

DECLARATION OF CHRISTOPHER K. WILSON

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I, Christopher Wilson, hereby declare as follows:

1. I am making this declaration at the request of Patent Owner Honeywell International Inc. in the matter of post grant review proceeding number PGR2023-00053 of U.S. Patent No. 11,538,349 to Poojary et al. (“the ’349 Patent” or “Poojary”) (Ex1001) before the United States Patent and Trademark Office (“USPTO”) Patent Trial and Appeal Board (“the Board”).

2. I understand that the Board has instituted post grant review of the ’349 Patent (Ex1001) on the following grounds:

- a. Ground 1: asserting that claims 1-20 are invalid under 35 U.S.C. § 101 for being directed to unpatentable subject matter.
- b. Ground 2: asserting that claims 1, 6-10, and 13-20 are either anticipated under 35 U.S.C. § 102 and/or obvious under 35 U.S.C. § 103 over U.S. Publication No. 2022/0066025 to Berkmo et al. (“Berkmo”) (Ex1004).
- c. Ground 3: asserting that claims 1-20 are obvious under 35 U.S.C. § 103 over Berkmo and U.S. Patent No. 5,675,661 to Richman et al. (“Richman”) (Ex1005).

3. For purposes of this declaration, I have been asked to analyze certain arguments made by Petitioners related to each of these grounds. I have reviewed the petition as well as the declaration of Petitioners’ expert, Mark Campbell, Ph.D.

(Ex1003). In rendering my opinions, I specifically considered the '349 Patent, the prior art references Berkmo and Richman, in addition to the exhibits identified throughout this declaration, as well as my knowledge and experience based upon my 30 years of work and study experience in this area, working with vehicle tracking and safety systems, as described in the next section.

4. I am being compensated for my work in this matter at a rate of \$525/hour. I have no prior financial relationship with Honeywell or ADB Safegate, and my compensation in no way depends on the outcome of this proceeding.

I. QUALIFICATIONS AND PROFESSIONAL EXPERIENCE

5. I am an expert in the field of Advanced Driver Assistance Systems (“ADAS”) and the various technologies supporting these systems, such as vehicle sensors, including radars and cameras, communications, maps and positioning, as well as the processing of vehicle data both in the vehicle and infrastructure. I am currently a vehicle data and technology consultant focused on advanced information and safety systems and sensors, in particular those enabled or supported by telematics systems. I have been working as such a consultant since 2012.

6. I have a Bachelor of Arts degree in Physics from Princeton University, conferred in 1981. I attended the University of California at San Diego

as a graduate student in physics in 1981-1982. There I developed algorithms for processing satellite telemetry data.

7. From 1983 to 1986, I worked for GTE Government Systems Inc. (GTE) as a Systems Engineer on various reconnaissance programs and telemetry analysis. My work included development of communications and radar algorithms, as well as operations of a radar system, as well as analysis of positioning algorithms and assessing the accuracy of various Global Navigation Satellite Systems (e.g. GPS, GLONASS). GTE was a telecommunications company and US defense contractor. It was acquired by General Dynamics Corporation in 1999.

8. In 1986, I started working at TRW Inc. (TRW). TRW was an American corporation involved in the aerospace and automotive industries. I was employed as a Systems Engineer, working on satellite telemetry and control systems and artificial intelligence programs, including the development of various image collection, processing, and object recognition algorithms and systems, and the development of Radar, Synthetic Aperture Radar, and LIDAR systems for various aircraft and space systems.

9. By 1991, my role at TRW changed to Program Manager, and I moved from the aerospace side of TRW to the automotive side of the company to apply aerospace technology to automotive problems and markets. Specifically, I worked

on the interpretation of data from automotive crash sensors (which TRW designed and built) to understand the likely medical outcomes for vehicle occupants during a crash. I also developed telematics systems to relay the summarized data from crash sensors, along with location data, to a remote facility (often a 911 facility) where dispatchers could assign various emergency responders (such as police, fire, or ambulance) to the crash. This data could also be used to inform medical staff at the receiving hospitals of possible or likely injuries to the various vehicle occupants. This system worked similarly to the OnStar system developed at around the same time by Motorola and General Motors. I also worked on the development of a radar system for Forward Collision Warning.

10. In or about 1996, I left TRW and spent a brief time as the Director of Product Development at Information Access Inc., a start-up company attempting to integrate Personal Digital Assistants (PDAs) (such as the IBM Simon, Apple Newton, and the Sony Magic Link) into vehicles for various real-time navigation, traffic, and safety applications. The application, called Fastline, ran on PDA devices, which were wirelessly connected to the traffic feeds of public entities through the cellular network, and provided information, such as routing information, to drivers. This application used the CDPD (Cellular Digital Packet Data) network, which was a data channel used for early cell phones. It also collected vehicle data in order to support traffic monitoring systems.

11. I started working at Mercedes-Benz (Daimler) in 1996 as a Senior Research Scientist. My work focused on developing safety technologies enabled by new sensors, communications, and analysis capabilities, including mapping, positioning and communications for automobiles and trucks. In particular, I worked on systems to make the driving of vehicles safer based on their location, as well as various vehicle, driver, and environmental characteristics generally sensed by radars and cameras in the vehicles. This included techniques for discriminating “targets” of interest (generally moving vehicles) from background features such as parked vehicles and roadside furniture, and techniques for combining data from multiple sensor systems to determine vehicle actions. I worked on the Intelligent Predictive System, which would “tune” the vehicle for the road ahead. The system worked by using information from map databases; location information collected using GPS; and information from the vehicle as to how the vehicle was behaving (collected using vehicle sensors, primarily gyroscopes and accelerometers installed in the vehicle). I worked on systems to reduce false alarms from Forward Collision Warning (FCW) radars based on map data. I also worked on various “pre collision” systems to mitigate crash injuries, generally based on car-to-car communications in combination with radar and camera sensors.

12. I also worked on various telematics systems that could be deployed in combination with the safety systems described above. Those systems included

navigation systems for Mercedes, remote diagnostics systems for Chrysler vehicles, and various fleet management systems for Freightliner.

13. By the end of my tenure with Daimler, I was the Vice President of Intelligent Transportation Systems Programs and Strategy at Mercedes-Benz Research and Development North America.

14. During this time (between about 1999 and 2008), I was also heavily involved in the industry's interaction with state and federal governments on the development of short-range communications technology. I led Mercedes-Benz's participation in this project. I worked with the Collision Avoidance Metrics Partners (CAMP), which included all of the major automotive companies working with the Federal Highway Administration, the National Highway Transportation Safety Administration, and other key players, both domestic and international. One of the uses for this technology was to coordinate activities between vehicles and between vehicles and infrastructure, such as vehicle movements.

15. I left Mercedes-Benz (Daimler) in 2008 and joined Tele Atlas, where I was the Director of Research. Tele Atlas is a digital map supplier for navigation and location-based services, including fleet monitoring systems. After Tele Atlas was acquired by TomTom, I moved to the role of Director of Products and Programs for Advanced Driver Assistance Systems. In this role, I developed various map and map-based products for automotive companies and for

commercial trucking companies. These included systems for managing fleet movements and for managing infrastructure to optimize the efficiency of the systems.

16. In 2012, I left TomTom and began work as an independent consultant. One client was Liberty Mutual Insurance Co, one of the top 5 US automobile insurance companies. I was hired to help them analyze their commercial customers' risk by assessing drivers' behavior using data from vehicles.

17. In 2013, I founded the company Vehicle Data Science Corporation, a Silicon Valley start-up building crowdsourced kinematic maps to support navigation and control systems for automated vehicles. Kinematic maps predict how a vehicle should drive based on how other similar drivers drove on the same roads in similar traffic and road conditions. I was the CEO of this company until 2016.

18. In 2016, and early 2017 I worked part time at ATG Risk Solutions (ATG) as the Vice President for Business Development. ATG provides vehicle data and analytics for the insurance and transportation industries. In this role, I was responsible for developing telematics-based risk assessment for the insurance industry. I worked with many fleet management companies developing solutions that worked across all of their vehicle tracking and data collection technologies. Around 2018, I worked for Mapper.ai developing highly accurate maps to support

automated vehicles utilizing stereo camera systems along with other sensors.

19. I am the inventor named in ten US and several international patents, which all relate to vehicle, data processing and analytics.

20. I have served as an expert witness on several occasions since 2012, mostly related to patents in my area of expertise as described above.

21. In view of my education, experience, and expertise described above, I am an expert in the field of managing vehicle movements to avoid collisions and improve operational efficiency.

22. My curriculum vitae (“CV”), containing a more detailed list of my qualifications, is attached hereto as Appendix A.

II. RELEVANT LEGAL STANDARDS

23. In expressing my opinions and considering the subject matter of the claims of the ’349 Patent, I am relying upon certain basic legal principles that counsel has explained to me.

24. I understand that the term “person of ordinary skill in the art” (“POSITA”) in the context of a patent validity challenge refers to a hypothetical person who is presumed to have knowledge of the relevant prior art at the time of a patented invention. I understand that many factors may influence the level of ordinary skill in the art, including: (1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) prior art solutions to such problems;

(4) the rapidity with which innovations are made in the relevant field; (5) the sophistication of the technology to which the patent is directed; and (6) the educational level of active workers in the field. I understand that a POSITA is considered to be a person of ordinary creativity, not an automaton, meaning that a POSITA may employ inferences and creative steps in his or her work.

25. I understand that the patentability of an invention should be viewed in terms of what a POSITA would know and think based on the prior art at the time of the invention. In this case, I treat August 3, 2020, as the invention date, which is the filing date of the '349 Patent. My opinions and statements below regarding the '349 Patent, the teachings of the asserted prior art, and the patentability of the invention claimed in the '349 Patent are made from the perspective of a POSITA (described below) as of August 3, 2020.

26. I understand that in a post grant review, the claims of a patent, when considered by the Board, are to be construed under the “*Phillips*” standard, provided in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005). I understand that, under this standard, the words of a claim are generally given their ordinary and customary meaning which is the meaning that the term would have to the POSITA at the time of the invention. I also understand that the ordinary meaning of a claim term is its meaning to the POSITA after reading the entire patent, including the specification and file history. I also understand that the

context of the surrounding words of the claim also must be considered. I have applied this standard in connection with my opinions set forth herein.

27. I understand that to anticipate a claim under 35 U.S.C. § 102, a single prior art reference must describe each and every claim limitation, either expressly or inherently, arranged as in the claims. I also understand that a prior art reference must provide sufficient guidance to enable a POSITA to make and use the claimed invention without undue experimentation in order to anticipate a claim.

28. I understand that a claimed invention is unpatentable under 35 U.S.C. § 103 if the differences between the invention and the prior art are such that the subject matter as a whole would have been obvious at the time the alleged invention was made to a person having ordinary skill in the art to which the subject matter pertains. I also understand that an obviousness analysis takes into account factual inquiries including the level of ordinary skill in the art, the scope and content of the prior art, and the differences between the prior art and the claimed subject matter.

29. I understand that, for a patent claim to be found obvious, it must be shown that a POSITA would have had a reason to combine and, if necessary, modify the teaching of the prior art references to achieve the claimed invention, and that the skilled artisan must have had a reasonable expectation of success in doing so. Additionally, I understand that it must be shown how a combination of

prior references would work and read on the claims. Thus, it is my understanding that simply showing that that each of several claimed elements was independently known in the prior art is not enough.

30. I understand that, in determining whether a claimed invention would have been obvious to a POSITA, it is necessary to avoid distortion caused by hindsight bias, which is likely to be present where the asserted motivation to combine does not provide a sufficient reason, supported by rational underpinnings, for combining the references in the claimed manner. I understand that the determination of obviousness cannot be based on the hindsight combination of components selectively culled from the prior art to fit the parameters of the patented invention. Rather, I understand that there must be a teaching or suggestion within the prior art, or within the general knowledge of a POSITA, to look to particular sources of information, to select particular elements, and to combine them in the way they were combined by the inventor.

III. QUALIFICATIONS OF ONE OF ORDINARY SKILL IN THE ART

31. For purposes of my analysis, I have utilized Petitioners' definition of a POSITA, which was adopted by the Board: a person who "would have held at least a degree in electrical engineering, computer engineering, computer science or a similar discipline, with at least two years of relevant industry or research experience, including experience designing, planning, or implementing sensor

networks using LIDAR, radar and/or cameras and corresponding data analysis,” and where “[a]dditional work or research experience can substitute for less or different education, and vice-versa.” Petition at 10. I note that I understand the “degree” reference above would have been at least a *bachelor’s* degree.

32. I understand that this determination is made at the time of the invention, which I treat August 3, 2020, as the invention date, which is the filing date of the ’349 Patent. As I also discussed in my “Qualifications and Professional Experience” above, I am familiar with the level of knowledge and the abilities of a POSITA at the time of the claimed invention based on my education experience in the industry, and qualify currently, and at the time of the claimed invention, as a person of at least ordinary skill in the art relevant to the ’349 Patent.

IV. STATE OF THE ART

33. Aircraft docking is little different than parking any automated vehicle. While the aircraft wings are generally quite high, and it would be possible to have them pass over small objects, this is not done for reasons including 1) determining the height of an object can be fraught and the allowable height for the aircraft to “pass over” is highly dependent on the exact position of the object, e.g. under the fuselage, engines, or winglets; 2) the jet wash may interact with or “suck in” smaller objects damaging the engines. The damage risk to a \$100 million aircraft, and the impact of delays to the specific aircraft and potentially many other

scheduled flights for an inspection after a suspected impact, let alone maintenance and repair is simply not worth saving a few seconds by having objects in the aircraft's movement envelope. The safety of an aircraft and the docking area is of paramount importance during the aircraft docking procedure. While related, ensuring the safety is not the same as providing navigational guidance. The movement of an aircraft traditionally involves projected movement along the 2D space of the ground (i.e., top down view) and any object at any height can be incorporated into the relevant algorithms based on the top view projection onto the ground plane, and the proximity of the projections of the aircraft and other objects to each other and the intended path of the aircraft.

34. One conventional approach to managing movements for automated vehicles, and which is directly applicable to guiding an airplane into the apron area, is the "free space" approach discussed in Petitioner's Exhibit 1031 (e.g. pages 4 and 6). In essence this approach is to classify the 2D region around the aircraft into partitions that are "free," "occupied," or "occluded." If any of the classified space is not free, the vehicle cannot move into that space and the vehicle must stop or find another path. In my opinion, this appears to be the general approach utilized in Berkmo.

35. The applicability of such autonomous vehicle algorithms to aircraft is further supported by Petitioners' and Dr. Campbell's inclusion of several

references addressing autonomous vehicle algorithms. See, for example, Ex1009, Ex1010, Ex1014, Ex1017, Ex1019, Ex1020, Ex1021, Ex1029, and Ex1031.

A. Sensor Data

36. Different sensors produce different types of data. An important aspect of the '349 Patent is the merging or fusing of data from the various sensors. One consideration when merging data sets is the data types of the sources, because the data types include certain restrictions on the types of fusion or merging that are possible.

B. Cameras

37. I agree with Dr. Campbell's description of cameras (Ex1003, ¶45). Cameras produce images. These are 2 dimensional arrays of pixels, each pixel containing information regarding the intensity of the light, and possibly color, for that particular pixel. Dr. Campbell acknowledges that camera data includes 2D data and not 3D data when identifying one of the drawbacks of cameras as "lack of depth information." In this paragraph, as well as others, he goes on to assert that there are techniques to augment camera data with depth information (such as the use of stereo cameras or depth estimation software), however, nowhere in Berkmo or Richman is there any discussion of 3D image data, stereo cameras, or depth estimation software, nor does Dr. Campbell assert that there is. He likewise acknowledged at his deposition that there is no disclosure of capturing depth with

camera data in Berkmo. Ex2003 at 33:22-34:5.

38. I also note that Dr. Campbell identifies a main benefit of a camera as “their ability to capture context of a scene (i.e. understanding that an object is a car as opposed to a cement barrier of the same size and shape).” Ex1003, ¶45. I characterize this as the ability to identify and discriminate objects, that is determining “what” is there, as opposed to determining that “something” is there.

C. Radar

39. I agree with Dr. Campbell’s description of radar (Ex1003, ¶44). A radar produces data consisting of a set of 3D points in azimuth, elevation and range from the sensor, each point generally having a radial velocity, and often with intensity of the reflected signal associated with each point. Resolution in elevation and azimuth is rather poor so that the spatial profile of an object is difficult to discern, but the general location and speed can be reliable. Dr. Campbell discloses in this paragraph that there are recent techniques for radars to provide “multiple returns for larger, 3D objects – similar to lidar sensors though less dense,” however, nowhere in Berkmo or Richman is there any discussion of this newer technology, nor does Dr. Campbell assert that there is.

D. LIDAR

40. Dr. Campbell’s description of LIDAR cites a “high level of accuracy (sub-cm).” (Ex1003, ¶43). While I agree sub-cm accuracy is possible for a

LIDAR, many LIDARs are much less accurate than this, often due to inconsistencies in the scanning mechanisms. In addition, as with all sensors, there are technical trade-offs. For LIDARs, one trades off at least between accuracy, resolution, the number of points scanned, range, revisit rate, eye safety, and, of course, cost.

41. I emphasize that the data produced by a LIDAR consists of a (possibly quite large) set of 3D points in azimuth, elevation and range from the sensor, often with intensity of the reflected signal associated with each point. This data can easily be translated into a 3D Cartesian coordinate system relative to the sensor. As disclosed by Dr. Campbell, the output consists of “point clouds”, which are sets of 3D points. Ex1003, ¶43. Multiple scans (each corresponding to a point cloud) can be combined to derive speed information for various objects.

E. Petitioners’ Asserted Prior Art

a. Berkmo (Ex1004)

42. The first reference that is relied on by Petitioners for Grounds 2 and 3 is U.S. Publication No. 2022/0066025 to Berkmo et al. (“Berkmo”) (Ex1004). For purposes of my analysis, I have been asked to assume that Berkmo is considered prior art because it claims a priority date that is before the earliest priority date of the ’349 Patent.

43. Berkmo discloses a system to detect and track an aircraft approaching

a stand (apron) area of an airport utilizing a radar sensor and one or more additional systems selected from a laser-based system and an imaging system. Ex1004, ABSTRACT. The sensors may be co-located with one another, or distributed around the stand area, preferably having overlapping fields of view. See Ex1004 at Figs. 1-3, ¶20.

44. Berkmo discloses providing the pilot of the aircraft with guidance information “to approach” or to “stop” based on, among other things, the ability to properly identify the aircraft, the presence of obstacles in the aircraft path, and/or system failure. Ex1004, ¶¶58, 136, 143, 145. This is the only disclosure of guidance information to the pilot in Berkmo, and relates to ensuring the safety of the aircraft approaching the docking area. Berkmo does not disclose any directions for maneuvering the aircraft into the docking area beyond this guidance “to approach” or to “stop.”

45. Dr. Campbell’s *Summary of Berkmo*, (Ex1004, VI.B.1) is incorrect in a number of aspects, some of which I discuss herein. In the embodiment shown in Figure 3 of Berkmo, which includes 3 sensors, Dr. Campbell asserts that “[e]ach sensor system is arranged at a different position.” Ex1003, at 107. This is incorrect. The radar (110R) and lidar (110L) are at the same location, their separation is merely for clarity of the art. Fig. 1 shows an identical configuration for 110L and 110R as Fig. 3 and it is disclosed that “in FIG. 1, the combined

system 110 is disposed at the display and arranged so as to emit laser radiation and radar radiation in a direction along the lead-in line 162 towards the approaching aircraft 10.” Ex1004, ¶119. In addition, Berkmo discloses that “[t]he airport stand arrangement 300 [of figure 3] also differs from the airport stand arrangement 100 in that the imaging system 110C is distanced from the radar-based system 110R and the laser based system 110L.” Ex1004, ¶132. Berkmo is clear that, contrary to Dr. Campbell’s assertion, 110R and 110L of figures 1 and 3 are collocated, emitting radiation along the same line, not displaced from each other. Berkmo does not disclose a configuration where the radar and lidar sensors are displaced from each other.

46. Dr. Campbell suggests that Berkmo discloses collecting data about the aircraft “that can be used to determine information about aircraft 10 and objects 11, 12, including data for determining position, orientation, speed, and direction of the aircraft 10.” Ex1003 at ¶110 (referring to Berkmo, Ex1004, ¶¶126 and 136). In fact, Berkmo only discloses that the data collected is “tracking data” and “said tracking data include[es] the position of the aircraft 10, the velocity of the aircraft 10 etc.” and also that “the dimensions of the aircraft” can be determined from the data. Ex1004 at ¶126. Nowhere does Berkmo suggest that orientation of the aircraft is determined from the data collected, nor that the collected data is capable of being used to determine orientation.

47. I discuss additional relevant aspects of Berkmo in my discussion of Grounds 2 and 3 below.

b. Richman (Ex1005)

48. The second reference that is relied on by Petitioners for Ground 3 is U.S. Patent No. 5,675,661 to Richman et al. (“Richman”) (Ex1005). For purposes of my analysis, I have been asked to assume that Richman is considered prior art because it has an issuance date that is before the earliest priority date of the ’349 Patent.

49. Richman discloses the use of a lidar (which he variably calls a “radar,” “laser radar” or a “ladar,” and, in my opinion, refer to the same system) to detect and track an airplane approaching a dock. The lidar image of the aircraft is compared to 3D templates of aircraft (which are rotated and scaled appropriately “in the manner of a computed aided design (CAD) procedure”) in order to determine the type of aircraft and its location and orientation. The lidar is also used to detect obstacles in the region bordering the travel path. Ex1005, 1:65-3:24.

50. I discuss additional relevant aspects of Richman in my discussion of Ground 3 below.

V. The ’349 Patent

51. I have reviewed the specification and drawing figures of the ’349 Patent (Ex1001).

52. The '349 Patent is directed to a method and system for “detection, tracking, and docking aircraft in a taxiway, apron, or ramp area of an airport.” Ex1001, 1:7-9.

53. Traditionally aircraft are guided to their docking position by a marshal in front of the plane providing visual guidance to the pilot and wing watchers stopping traffic and ensuring there are no obstacles for the wings. Over the years systems have developed to automatically aid the pilot in reaching the docking point. At least one of these, Advanced Visual Docking Guidance System (A-VDGS), provides active azimuth guidance with deviation calculated by the system. The general goals of these automated systems include increasing the accuracy of the guidance in order to minimize hazards from obstacles in the gate area, as well as reducing manual errors and increasing consistency of the docking process, and better utilize the limited space in the docking area. Some prior art automated systems use LIDAR, which suffers from lack of long range detection, poor detection of dark aircraft, degradation in thick snow/fog/heavy rain or precipitation, and the lack of images for incident analysis. Other prior art systems use cameras, but these may require frequent calibrations, lack redundancy, and have issues with accuracy of distance measurements. In general, prior art systems fall short in their ability to meet the critical requirements of today's airports, which can include: “having a long scan range of, for example, more than 150 m; being

operationally flexible and adaptable; being auto-calibration able, allowing for detection and tracking of aircraft, vehicles, people, etc.; providing aircraft type and/or sub-type identification; providing accurate and repeatable guidance; improved safety through apron mapping, wing tip clearance, obstacle detection, FOD, etc.; improved surveillance by being an extension to surveillance sensors that cover gate areas; all weather capable; and low maintenance.” Ex1001, 1:13-2:29.

54. The invention described in the '349 Patent addresses those issues by, among other things, increasing the range and accuracy of the aircraft tracking system which enables improvements in ground operations, improves aircraft turnaround time, and improves safety. The invention is beneficial at all times, day and night, and in all weather and lighting conditions, and works on all aircraft types and colors, unlike prior systems. Ex1001, 2:61-3:18.

55. The invention uses multiple sensors, including at least one camera and one or more LIDARs and/or Radars, arranged in one or more arrays. The sensors are located in the ramp area, generally view the ramp area, and at least the camera observes an aircraft in the ramp area. The ramp area also includes a lead-in line. Ex1001, 3:53-4:25. The camera sensor is disclosed to provide long-range detection of an aircraft and the LIDAR/Radar can provide guidance to the aircraft for precise docking. Ex1001, 5:20-24. As discussed above, camera output is a 2D image, whereas LIDARs and Radars output 3D point cloud data.

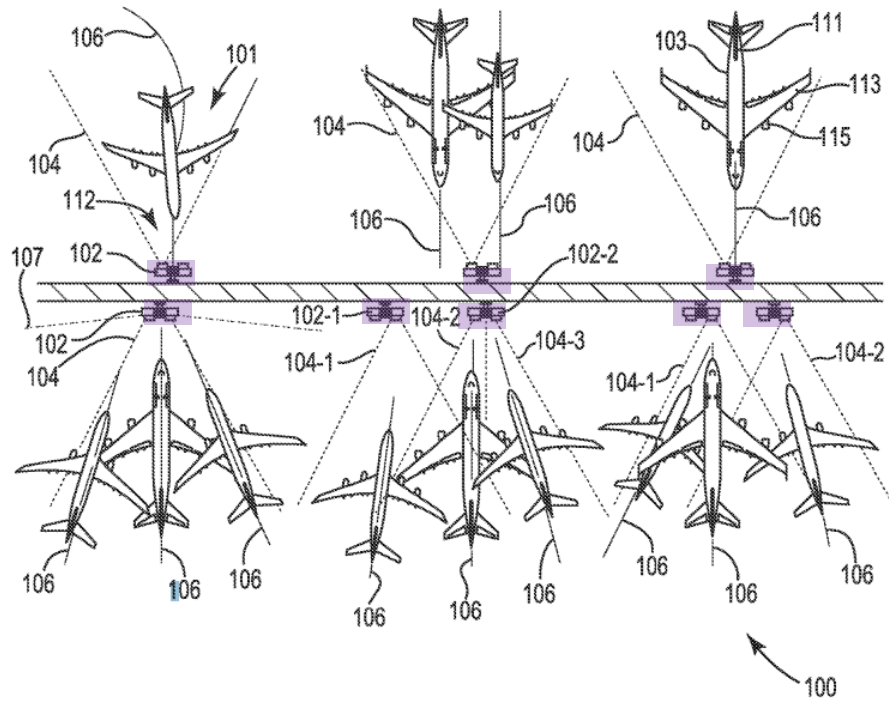


FIG. 1

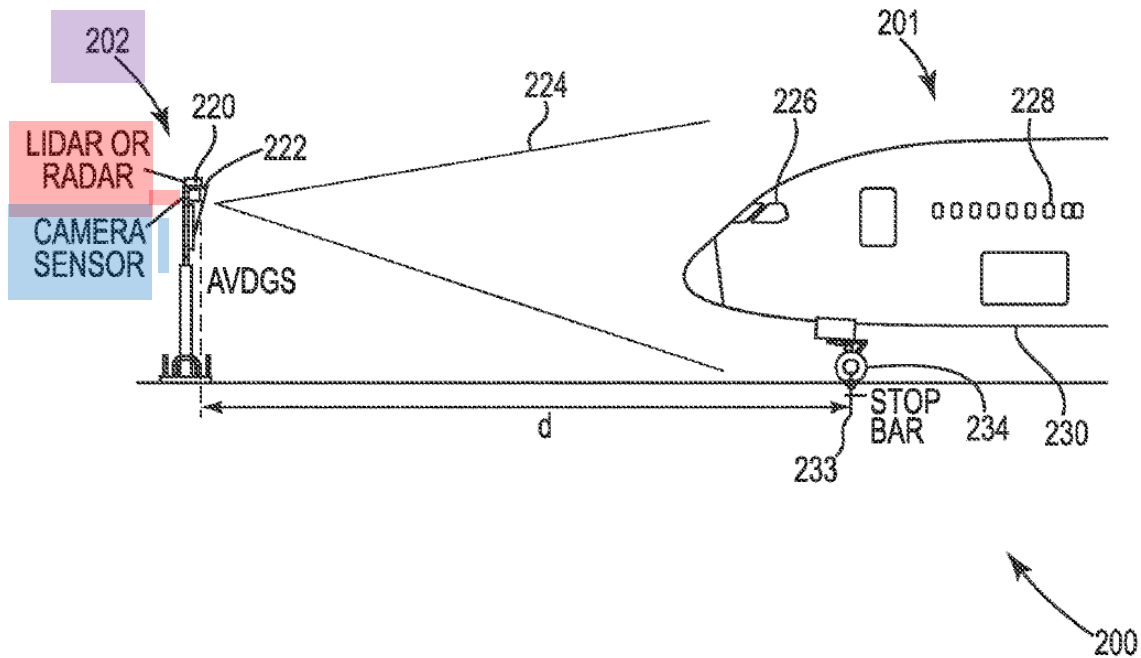


FIG. 2

56. With reference to Figure 2, characteristics of the aircraft 201, such as

shape of the fuselage 230, number, shape, position of passenger windows 228, and pilot windows 226, as well as positioning of wheels 234 to stop point 233 can be ascertained from data captured by the camera image sensor 222. Ex1001, 5:49-66. The LIDAR/Radar sensor can, for example, gauge the distance d to the aircraft to determine whether the aircraft is nearing the stop point 333. Ex1001, 5:58-60.

57. Figure 3 (reproduced below) shows an example of the processing used in at least one embodiment. Data is obtained from image sensor (camera) 346 and LIDAR/Radar 342. A proposed aircraft 3D model is also selected and validated based on data for the expected aircraft, such as ADS-B Rx, (344), camera data, and LIDAR/Radar data, including point cloud analytics (350) and comparison to known aircraft configurations (348). Ex1001; 5:29-36, 6:46-7:14, 7:43-55, 8:22-36. The camera data is fit to the 3D model to determine the 6D pose of the aircraft in the camera coordinate system (354) (Ex1001, 8:50-9:10), and the resulting 3D model is fused with the LIDAR/Radar 3D point cloud (358, e.g. with the Iterative Closest Point (ICP) algorithm) to form a merged data set and to accurately determine accurate aircraft type, speed and distance data, as well as proximity to other objects. Ex1001, 6:16-20, 8:1-14, 9:18-28, Fig. 7. This process results in an accurate 3D model of the aircraft, including its 6D pose, relative to the ramp, based on the merged data from the camera, the 3D model, and the LIDAR/Radar.

58. This data is used in a docking controller (362) to derive the remaining

distance and the horizontal deviation with respect to the center line of the path (e.g., lead-in line) that the aircraft is supposed to follow. The pilot unit display (364) provides at least remaining distance, horizontal guidance and speed guidance to the pilot. Ex1001, 10:8-19. This procedure results in increased accuracy for the aircraft pose and increased reliability for the docking process.

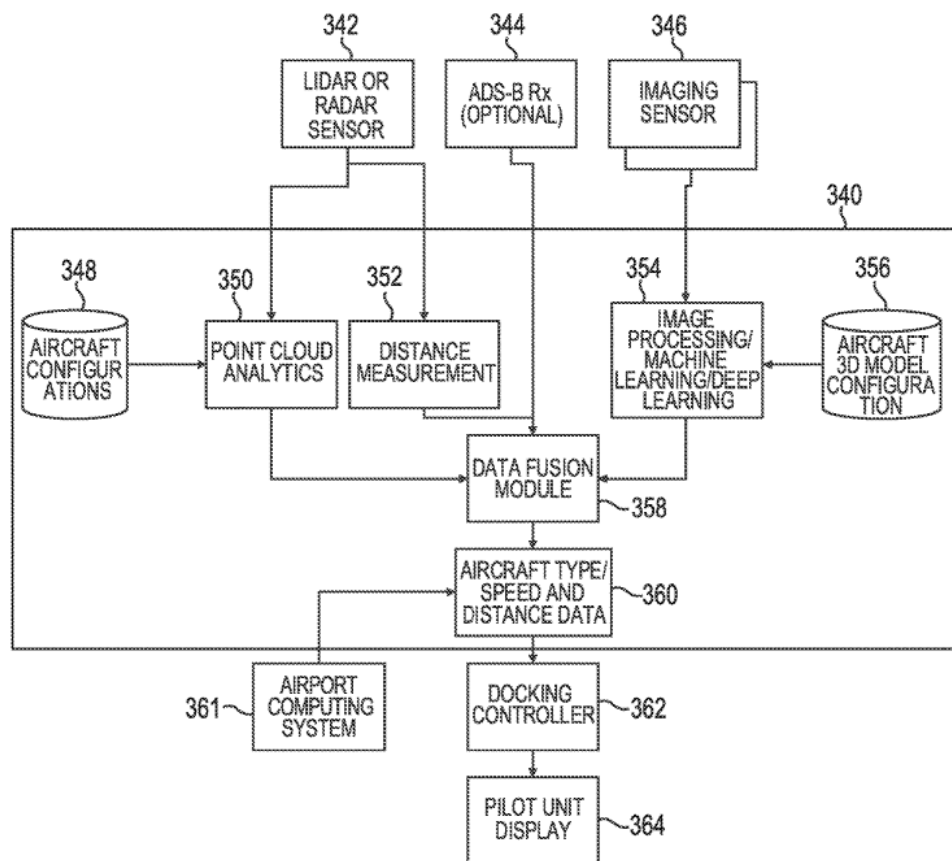


FIG. 3

59. The '349 Patent has 20 claims, including two independent method claims, 1 and 10 and independent system claim 18. Claims 2-9 depend directly or indirectly from claim 1, claims 11-17 depend directly or indirectly from claim 10,

and claims 19-20 depend from claim 18.

VI. CLAIM CONSTRUCTION

60. In order to properly evaluate these claims, I understand that the terms of the claims must first be construed. I understand that the Petitioners did not expressly propose claim constructions for any claim terms, and that the Board did not construe any terms in its Institution Decision.

61. I have been asked to provide opinions concerning how a POSITA would understand the following two phrases used within each of the independent patent claims: “directional ... guidance” and “speed guidance.”

A. “directional ... guidance”

62. Independent claims 1, 10, and 19 each recite “displaying messages to provide *directional* and speed *guidance* to a pilot.” I understand that Patent Owner proposes that the term “directional ... guidance” be construed to mean “navigational instructions, including the horizontal deviation with respect to the center line of a path.” That construction is consistent with how a POSITA would understand the term in view of its plain and ordinary meaning in the context of the claims, as well as in view of the teachings within the specification.

63. The ’349 Patent discloses that “[t]he guidance module of the central docking system can, for example, provide the remaining distance and the horizontal deviation with respect to the center line of the path (e.g., lead-in line)

that the aircraft is supposed to follow.” Ex1001, 10:8-11. The specification explains that “[t]his can provide the pilot with directions regarding how to get the aircraft to the correct location.” Ex1001, 10:12-13. In addition, the ’349 invention is intended to overcome “failed dockings where the aircraft is too far forward or back from the ramp, not parallel with or *aligned with the lead-in line or not positioned on the lead-in line*, which may cause the delays and additional adjustments by the pilot and ground crew to make the aircraft and ramp line up despite improper positioning of the aircraft.” Ex1001, 2:10-16. The specification likewise describes that the invention allows for precise adjustment during movement of the aircraft, which may include mid-course adjustment of an aircraft’s path. Ex1001, 4:32-37.

64. A POSITA would understand that the horizontal deviation is part of the directional guidance here because a goal of these instructions is to provide directions to keep the plane on the lead-in line, which would be done through information on the horizontal deviation. Likewise, another goal is to provide for mid-course adjustments to the pilot. All of this guidance informs the pilot “which direction,” including how much horizontally, it should move. That is particularly significant within the context of the ’349 Patent which clearly stresses increasing accuracy and reliability in the docking process. The ’349 Patent instruction is clearly more than an instruction to stop/go, or “proceed forward” the latter of

which are devoid of any “directional” component from the “directional guidance,” which is how Dr. Campbell and Petitioners have interpreted and applied the term.

65. It is my opinion that the proposed construction reflects the plain and ordinary meaning of the “directional...guidance” term as used in the claims and specification.

B. “speed guidance”

66. Independent claims 1, 10, and 19 each recite “displaying messages to provide directional and *speed guidance* to a pilot.” I understand that Patent Owners propose that the term “speed guidance” be construed to mean “instructions concerning maximum speeds for approaching a gate.” That construction is consistent with how a POSITA would understand the term in view of its plain and ordinary meaning in the context of the claims, as well as in view of the teachings within the specification.

67. The ’349 Patent discloses that “[t]he docking system can also provide and monitor maximum speeds for approaching a gate. These speed thresholds can be set and monitored and instructions can be passed to the pilot to slow down.” Ex1001, 10:16-19.

68. A POSITA would understand that such “speed guidance” reflects actual speed values – e.g., such as those thresholds described in the specification. It refers to an actual speed value that can be used to inform the pilot how to

proceed. This instruction is clearly more than an instruction to a stop, which avoids any actual “speed” component from the “speed guidance,” which is how Dr. Campbell and Petitioners have interpreted the term.

69. It is my opinion that the proposed construction reflects the plain and ordinary meaning of the “speed guidance” term as used in the claims and specification.

VII. ANALYSIS AND OPINIONS

A. Ground 1 - subject matter eligibility

70. I have been asked to respond to certain of Dr. Campbell’s opinions in his section related to subject matter eligibility included in at least paragraphs 78-79, where he asserts that the claims are directed to a mental process that can be performed in the human mind.¹

71. As an initial matter, the independent system claim 18 affirmatively recites a “camera image sensor” and “a LIght Detection And Ranging (LIDAR) or RAdio Detection And Ranging (RADAR) sensor.” Similarly, independent method

¹ I understand the other paragraphs of Dr. Campbell’s declaration in section VI.A of his declaration include an improper analysis of the “subject matter eligibility” requirements, such as what would be considered an “abstract idea” under controlling legal standards. Other paragraphs in this section appear to only include conclusory assertions that track the Petition. I understand that Patent Owner will be responding to those arguments in the Patent Owner Response, and that the Response will highlight that Petitioners have not met their burden to prove invalidity under the correct legal standards, in addition to providing the correct analysis under controlling law. Thus, my approach in this section does not in any way indicate that I agree with any of Dr. Campbell’s opinions in this section.

claims 1 and 10 both refer to “receiving camera image data ... while the aircraft is approaching a ramp area” and “receiving ... LIDAR or ... RADAR sensor data while the aircraft is approaching or in the ramp area.” A POSITA would have understood that the method steps recited in independent claims 1 and 10 utilize sensors to be able to receive the identified types of data and that they do this while the aircraft is moving toward the ramp. That is, the claims require specific sensors at a specific location and time; thus, the POSITA understands these to be required elements of the method claims 1 and 10.

72. The independent system claim 18 also affirmatively recites a “computing device.” Similarly, the independent method claims 1 and 10 both specifically refer to “merging” camera image data and LIDAR/RADAR sensor data. This would have been understood by a POSITA to require a “computing device” in order to receive such camera image data and LIDAR/RADAR sensor data, and then to merge or fuse the different types of data.

73. A POSITA understands that “merging” data, particularly when applied to specific data with a specific outcome, as recited in the ’349 Patent claims, requires certain concrete methods and procedures to be applied as part of the process that require a processor to perform. In addition, the specifics of merging with real-world noisy data and accuracy requirements is not possible for a human. A relevant example is fitting a 3D model to a point cloud, which loses

accuracy as the noise increases and outliers proliferate, as in the real world. This alignment is not possible for a human to perform in their mind (in particular in the depth direction), let alone putting a quantitative accuracy on the fit or determining if the proposed fit is the best fit. Thus, the recited merging process, along with the processes of receiving camera image data and LIDAR/RADAR data, require the use of a processor. Further, determining and displaying directional guidance and/or speed guidance from the merged data requires the use of a processor, as the human mind is not able to comprehend the merged data in any meaningful way in order to discern how to guide the aircraft.

74. I understand that Petitioners and Dr. Campbell assert that the claims are directed to an “abstract idea” of “receiving, merging, and displaying data.” Ex1003, ¶78. It is my opinion that this characterization is over-generalized such that it could also apply to the functions of a smart TV, a home alarm security system, or a thermostat. A smart TV *receives* “normal” TV and internet streaming channels, *merges* them, such as through picture in picture or the selection interface, and *displays* the requested content. The home alarm system *receives* data from multiple sensors, *merges* the data to determine if anything is amiss, and *displays* alarms or normal status indications. A thermostat *receives* temperature data from different temperature sensors (e.g., in different zones or within the HVAC system), as well as other status information from the system, *merges* the data from the

different sensors and the status information to determine system operational instructions and statuses, and *displays* the heating or cooling status, for example, for different zones or the system as a whole. Each of these examples meets Petitioners' and Dr. Campbell's highly generalized definition of the alleged "abstract idea" of "receiving, merging, and displaying data," and yet are very concrete and very distinct from the claimed invention in the '349 Patent involving tracking and guiding aircraft.

75. The human mind is not capable of performing the steps and functions recited in the independent claims. Humans do not have the ability to receive and process camera data (e.g., digital binary image data) from an image sensor, or 3D point cloud data from a RADAR or LIDAR sensor. A human does not possess the necessary interfaces to receive such data from such devices, nor the capacity to understand or comprehend that data in any meaningful way. For example, even if one could receive the data, a human cannot recreate an image in their mind from a stream of data (e.g., digital bits) from an image sensor any more than they could watch a TV show by directly receiving the stream of data from their cable provider. Tracking 2D locations of cells in an image data stream would likely be difficult at best (if they arrive slowly enough), incorporating the grey values, let alone color values or the 3D location in a LIDAR data stream would be impossible. That requires a computer to receive and reinterpret the data into a different form

that a human can understand (e.g., visual images). Similarly, a human also cannot receive and comprehend a stream of data from a LIDAR or RADAR sensor for the same reasons.

76. Further, the information in RADAR data looks nothing like what we see with our eyes. Imagine a large rubber or vinyl bouncy house in front of you, obvious to a camera. To a RADAR, the most obvious detail might be a metallic candy wrapper wedged in a corner and invisible to the eye. If the bulk of the bouncy house is seen at all, it is likely to be the pulsing from movement that registers, the general shape or outline of the house will likely be unobservable. Metallic objects, such as a car or airplane “scintillate.” That is, in one frame the brightest spot on the RADAR “image” of a car might be the license plate, while in the next it might be the left front hubcap with the license plate invisible. This makes it very hard to identify and track any particular spot on the vehicle, or to “group” the various returns into a single object, and essentially impossible for a human to comprehend in any meaningful or useful way.

77. A RADAR image of a human will not show the skin or hair color, or the general shape of the body. What might be easily detectable is the movement of the lungs while breathing or the pulsing of the heart.² RADARs see depth and movement, not color and surfaces. My point being that humans cannot easily

² See, for example, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7146735/>.

understand a RADAR image. The inherently 3D nature of LIDAR data is also not directly perceptible by humans, which perceive 2D images through the eyes that are then interpreted to form 3D structures. As such, similarly to RADAR data, raw LIDAR data is essentially impossible for a human to comprehend in any meaningful or useful way.

78. Humans are poor at quantifying relationships between objects, especially when data is noisy and incomplete, as real-world data often is. But quantitative assessments of the “goodness” of the data are essential when moving a \$100M aircraft, especially as the data gets noisy and incomplete. Computers and numerical calculations (and lots of them) are required to know that the system is still “good enough” and that the results are the best possible. Being able to reliably and repeatedly merge various types of data of varying quality, and to provide an accurate assessment of the validity of the merge is required when docking a \$100M aircraft.

79. Likewise, the human mind is unable to use a “merged data set” formed by merging camera image data with LIDAR/RADAR sensor data, both of which are incomprehensible to the human mind (particularly the LIDAR and RADAR data) in any meaningful way. Much as the source data from the camera image sensor and the LIDAR or RADAR sensor are undiscernible by a human, a merged set of that data further complicates the data, making it even more

undiscernible to a human mind. A human mind is incapable of understanding, and thus using the merged data set to determine any kind of directional guidance or speed guidance to display to a pilot. A human mind cannot perform this task any more than it could determine the current score of a football game by receiving the digital cable data stream of that game from the cable provider. Again, a computer is required to receive and convert the data into something else (e.g., images or a text readout) that a human mind can understand.

80. Additionally, Dr. Campbell has not adequately explained how a human could receive and merge camera image data and LIDAR/RADAR data, or determine and display message to a pilot to provide directional guidance and speed guidance to the pilot. Instead, I find Dr. Campbell's declaration to merely include a conclusory statement that receiving and merging image and sensor data, and displaying messages could simply "be performed in the human mind," without any support or explanation as to *how* that is possible. Ex1003, ¶¶78-79. As explained above, the human mind is incapable of comprehending the data from these different sensors, is incapable of merging the two distinct types of data (e.g., camera image data and 3D point cloud data from LIDAR/RADAR sensor), and is incapable of determining and displaying messages to provide directional guidance and speed guidance to the pilot.

81. Additionally, it is my opinion that the human mind is not capable of

practically performing the recited limitations within the timing requirements implicated in the claims. Even if the human mind were capable of performing all of the steps identified by the Petitioners and Dr. Campbell (which it is not), it could never do them in the time required by the '349 Patent claims. The patent is intended to “reduce aircraft turnaround time” (Ex1001 at 2:67-3:1), and is performed “*while* the aircraft is approaching a ramp area for parking the aircraft on an airside of an airport” (Ex1001, claims 1, 10, and 18). That is, the operation must be faster than current operations, as well as being reliable and working during the time that a plane arrives so that it can provide “directional and speed guidance.” A POSITA would understand that the calculations would have to be performed in seconds, and preferably much quicker, in order to provide meaningful guidance to a pilot, and this would have to be done under all mental states and weather conditions.

82. Even Dr. Campbell admitted at his deposition that if this hypothetical process were to occur in a person’s mind, that would take “a long time” – at least a day for a single scan. Ex2003 at 89:14-90:11. This process would need to be repeated over and over again, multiple times per second for each new frame and set of data, thereby compounding the delay to provide any meaningful guidance, which he admitted would take much longer. Ex2003 at 98:12-21. By the time any useful guidance is determined and provided by a human for even one determined

location of the aircraft during a docking procedure, the aircraft would have already moved significantly – having already docked, deplaned, reloaded, and departed again. As such, the human mind is entirely incapable of performing this task within the timing boundaries set forth in the claims and that a POSITA would understand is required by the claims. Additionally, there are accidents during docking now (which the '349 Patent is trying to alleviate) where the marshal relies on only visual images received by their eyes. Adding in the act of receiving, understanding and merging additional LIDAR, RADAR or camera data would only increase the error rate.

83. Similarly, it is my opinion that the human mind is not capable of practically performing the function in claim 19 of “wherein the LIDAR/RADAR sensor data is analyzed using a point cloud process to correlate points in the LIDAR/RADAR sensor data to points in the camera image data.” The specification explains that the claimed “point cloud process” is performed to accomplish “a transformation between the coordinates of the system and a vision coordinate system of the camera image system,” and that this transformation is part of the data fusion process. Ex1001, 8:64-9:10. Claim 19 requires that the point cloud data from the LIDAR/RADAR be aligned or correlated with points in the camera image data. The POSITA, in reading the specification, understands that the camera image data includes a 3D model of the aircraft in the camera’s coordinate

system, and is processed by aligning a 3D model of the aircraft with the camera image in order to generate an initial aircraft 3D model. Ex1001, 7:1-2 (“a 3D model of an aircraft composed from camera image data”), 8:41-43 (“image data can be used to create a 3D model of the aircraft”), 8:50-63, Fig. 3 (e.g., items 354, 356). As discussed above, the RADAR data and LIDAR data look nothing like the camera image data or a 3D model of the aircraft (see Ex1001, FIG. 4, 10:39-46), and a POSITA would understand that the human mind is not practically capable of accurately correlating points in a RADAR “image” with points in a camera “image”, and the process may be entirely impossible when the data is incomplete or noisy, as may be the case.

84. In addition, the human mind cannot visualize and cannot easily align 3D points, as required for combining point cloud data from the LIDAR with camera or RADAR data. A POSITA would understand that aligning two point clouds (or any two 3D sets of points) in depth is not possible for humans. Depth perception relies on various visual clues not present in 2D images, which is generally how point clouds are displayed to humans.

B. Ground 2 - anticipation/obviousness challenge to claims 1, 6-10, and 13-20 in view of Berkmo.

85. I have been asked to opine on and respond to Petitioners’ and Dr. Campbell’s assertions related to the disclosure of Berkmo with respect to claims 1, 6-10, and 13-20 of the ’349 Patent. As set forth below, it is my opinion that

Berkmo does not disclose certain of the limitations of each of the independent claims 1, 10, and 18 and dependent claims 7 and 19.³

a. *Berkmo does not disclose or suggest displaying the type of messages recited in each of the independent claims.*

86. Berkmo does not disclose any of the three components of the displayed messages set forth in the independent claims: (1) “directional guidance”; (2) “speed guidance”; and (3) “the merged data set.”

(1) “Displaying messages to provide *directional ... guidance to a pilot*”

87. Each independent claim of the ’349 Patent specifically requires displaying “messages to provide directional ... guidance to the pilot.” It is my opinion that Berkmo does not disclose displaying the required directional guidance to a pilot.

88. Rather, Berkmo provides only two types of maneuvering guidance, “stop the aircraft” (*see, e.g.*, Ex1004, Fig. 8, ¶¶55, 63, 76, 79, 80, 135, 136, 143, 145) and either “approach the stand” (*see, e.g.*, Ex1004, Fig. 8, ¶¶58, 145) or equivalently “continue approaching the stand” (*see, e.g.*, Ex1004, Fig. 8, ¶¶143), neither of which is “directional guidance.” Dr. Campbell asserts that “Berkmo ... discloses guidance information to ‘instruct the pilot to continue approaching the

³ Neither the Petitioners nor Dr. Campbell present any “obviousness” arguments or evidence concerning any of the limitations that I addressed below. Thus, I am unable to address any “alternative” obviousness arguments because none have been presented.

stand,’ which is providing directional guidance, i.e., direction toward the stand.” Ex1003, ¶134. In my opinion this is not directional guidance, nor would a POSITA consider it so. At best, this provides an instruction to continue approaching the stand, and in the context of a plane approaching a gate, is simply the converse of “stop.” There is no “directional” component at all.

89. “Approach the stand” is equivalent of “proceed” or “go” (the equivalent of a green traffic light) and does not provide directional guidance. “Approach the stand” is permission to proceed into the protected area, *see* Ex1004, ¶¶48, 50, 53, 65, 66, 143, 145, claim 42, each discussing “*allowing*” the aircraft to approach the stand. Berkmo discloses that guidance is for safety reasons –that is proceed if it is safe for the plane to enter the protected gate area or stop if the area is not clear or there is a safety threat. *See*, for example, Ex1004, ¶2 (docking “in a safe and reliable way”); ¶65 (“the aircraft may be ordered to stop, as safety cannot be guaranteed”); ¶76 (bridge not properly stowed); ¶¶79, 135 (collision course with objects); ¶¶80, 136 (other objects not predicted to leave stand area before aircraft arrives); ¶¶55, 143-144 (unable to determine type or model of aircraft); ¶¶57-63, 145 (unable to detect backscattering signals). None of these examples are “directional” guidance. Indeed, Berkmo provides no guidance regarding horizontal deviation with respect to the center line of a path, as required by the proper construction of the “directional guidance,” as discussed above.

90. Berkmo also lacks any detail or examples that would describe a system's technical ability to resolve the lateral position of an aircraft accurately enough to provide directional guidance including horizontal deviations with respect to the center line of a path required by the proper construction of the claims of the '349 Patent. Berkmo's goal is to ensure the safety of the aircraft when it enters the docking area. This requires a great deal of sensitivity and resolution to detect that there are objects present, but does not require much in the way of accuracy in locating an object. If another object is there, its precise position does not matter in Berkmo – the aircraft is simply told to stop. Especially given the lack of disclosure that lateral guidance was possible in the system of Berkmo, a POSITA would not understand that Berkmo's sensors provided sufficient accuracy to practice the directional guidance requirements of the independent claims of the '349 Patent.

(2) “Displaying messages to provide ... *speed guidance* to a pilot”

91. Each independent claim of the '349 Patent specifically requires displaying “messages to provide directional ... guidance to the pilot.”

92. It is my opinion that Berkmo does not disclose displaying speed guidance to a pilot. Dr. Campbell asserts that “Berkmo discloses the guidance information includes ‘instructing the pilot to stop the aircraft,’ which is providing speed guidance, i.e., speed is 0.).” Ex1003, ¶134. This is not speed guidance as

required, rather this is revoking permission to proceed, as discussed above. This also does not provide any information as to a maximum speed. In my opinion a POSITA would not consider this to be speed guidance as the term is used in the '349 Patent. Instead, a POSITA would understand the stop instruction to be an instruction to cease approaching the gate, rather than speed related instructions for approaching the gate.

93. Additionally, Dr. Campbell relies on Berkmo's permission-based stop/go instructions for *both* the speed guidance and the separate directional guidance. Ex1003, ¶134. A POSITA would not understand that the paired "stop" and "continue" instructions can provide ***both*** speed and directional guidance to a pilot. While it is my opinion that neither speed guidance nor directional guidance is provided by Berkmo, it is clear that Berkmo does not provide both with the singular set of stop/go instructions.

(3) "Displaying messages to provide ... guidance to a pilot *with* the merged data set"

94. Each independent claim of the '349 Patent specifically requires displaying "messages to provide ... guidance to the pilot with the merged data set."

95. It is my opinion that Berkmo does not disclose displaying the guidance to a pilot *with* the merged data set, as required in the independent claims. The use of the word "with" in the claim means that at least some of the merged data set is displayed to the pilot. The phrase occurs in the claims directly after a

clause listing elements of the merged data set, (see, i.e., Ex1001, 12:48-56 of Claim 1), and the specification specifically discloses displaying at least some of these elements to the pilot. See 10:19-23 (“in some embodiments, the determined speed, position, orientation, and/or direction can be sent to a ramp docking system controller device in the ramp docking system and then passed to the pilot unit computing device”).

96. Petitioners and Dr. Campbell do not address this element of the claims. As discussed above, Berkmo only discloses displaying the permission-based “stop” or “continue” instructions to the pilot. In my opinion, Berkmo does not disclose this limitation, nor do the Petitioners assert that Berkmo or any of the prior art does so.

b. Berkmo does not disclose or suggest “merging” camera image sensor data with LIDAR/RADAR sensor data from each of the independent claims.

97. It is my opinion that Berkmo does not disclose “merging the camera image data and the LIDAR/RADAR-sensor data into a merged data set,” as recited in independent claim 1, or “merging the camera image data and the LIDAR/RADAR sensor data associated with the aircraft into a merged data set,” as recited in independent claims 10 and 18.

98. As an initial matter, Dr. Campbell primarily relies on Berkmo’s disclosure of “combined output data” in paragraph 129 as a disclosure for the

“merging” limitations included in the claims. Ex1003, ¶117.

99. Dr. Campbell asserts that the “merging” element is disclosed in Paragraph 129 of Berkmo, which refers to using “**combined output data** from said radar-based system 110R, on the one hand, and from the one or more additional systems.” Ex1003, ¶117 (emphasis in original). Dr. Campbell then asserts that the “one or more additional systems” includes imaging system 110C. Ex1003, ¶117. However, that is not true. Paragraph 129 of Berkmo specifically states that the disclosed example is referring only to using radar plus laser sensors, and Dr. Campbell agreed at his deposition that the relied upon embodiment was limited to those two types of sensors. Ex2003 at 107:11-19.

100. Moreover, there is no disclosure of combining the camera data in the same manner as the Radar/LIDAR combination. Notably, the camera data is qualitatively different from the LIDAR or radar data as, for example, camera data is 2D, while radar and LIDAR data are 3D. Combining radar with LIDAR data (3D x 3D) cannot use an identical process to combining radar or LIDAR data with camera data (3D x 2D), and no suitable process is addressed or disclosed by Dr. Campbell or Berkmo. A POSITA reading Berkmo would not understand that the 2D camera data is to be combined with the 3D radar/LIDAR data, nor how that would be done.

101. Contrary to Dr. Campbell’s statement that “Berkmo teaches a

merging process that effectively uses a point cloud process” (Ex1003, ¶118), camera data is a 2D type of data and not readily amenable to a 3D “point cloud process.” Berkmo does not disclose or suggest that the point cloud process would be applied to 2D camera data and how that would be done.

102. Dr. Campbell also refers to a specific method of “combining” which he appears to assert meets the limitations of “merging” in the following passage of his declaration:

Berkmo also teaches a specific method for combining or fusing (i.e., merging) the output data from each of the systems. In particular, Berkmo describes determining a spatially resolved weighted average of the combined output data, such as based on statistical weights for each of imaging system 110C, laser system 110L and radar system 110R. *Id.* [Ex1004], ¶¶0022-0025, 0129-0130. The weighted average can be a matrix of average data values, where each average data value corresponds to a specific spatial location on the stand area and is calculated as a sum of weighted data values corresponding to the same spatial location. *Id.*, ¶¶0025, 0130.

Ex1003, ¶118.

103. The relevant passage he appears to be relying on here is in Berkmo ¶130 which discloses “a spatially resolved weighted average of *the* combined output data.” Ex1004, ¶130. First of all, it is not clear what “the combined output data” refers to in Berkmo. Following traditional rules of English grammar, it would appear that it refers to the “combined output data” of the previous paragraph 129 discussing an embodiment with just radar and laser data. In addition, the “weighted average” in this citation, or anywhere else in Berkmo, never refers to

using camera data, nor is the manner identified in which one would “average” 3D radar data with 2D camera image data ever disclosed or explained. These two facts are reconciled by the POSITA’s understanding that Berkmo’s “averaging” process does not pertain to the 2D camera data, and instead, the camera data is used for identifying objects rather than being combined with the other sources.

104. The other paragraphs of Berkmo cited by Dr. Campbell (paragraphs 22-25) discuss ways of using the sensor data in general. They discuss “automatically” shifting from one system to another, with no indication of a “merged” output. Ex1004, ¶22. They also discuss combining radar data with other data using weighted averages, but nowhere is camera data identified as being used in the merged data set. The lack of identification of camera data in any of the “weighted average” discussions is understandable given that Berkmo specifically only addresses combining LIDAR and radar data and because of the non-compatibility of the different types of data.

105. The Petition and Dr. Campbell’s declaration also include a “*see also*” citation to Berkmo’s paragraphs 126-127, 134, 137-139. Ex1003, ¶117. However, no explanation is provided as to how those cited paragraphs disclose “merging” or creating a “merged data set.” Further, none of those passages refer to the imaging system. Paragraphs 126 and 139 even specifically state that the passage is referring to “the laser based system 110L” – and not the imaging system.

Paragraphs 137 and 138 refer to tracking “other objects” and not the aircraft.

c. Dependent claim 7

106. Berkmo does not disclose “comparing the camera image data and the LIDAR/RADAR sensor data to identify that the aircraft is present in both the camera image data and the LIDAR/RADAR sensor data before merging the camera image data and the LIDAR/RADAR sensor data,” as recited in dependent claim 7 (which depends from claim 1).

107. Dr. Campbell relies on and partially cites Berkmo’s disclosure in paragraph 138 (italics indicate the quoted portions, while non-italicized portions were not quoted):

The airport stand arrangement 300 is further configured to detect and track an object of said other objects 11,12 based on output data from the imaging system 110C, and verify the existence of said detected and tracked object based on output data from a further system 110L of the one or more additional systems and/or output data from the radar-based system 110R.

Ex1004, ¶138.

108. Dr. Campbell then goes on to assert that “[s]ince aircraft 10 is another object detected and tracked by the combined system 310, a POSITA would have understood that Berkmo also teaches verifying aircraft 10 by comparing camera image data of imaging system 110C with sensor data of laser system 110L and/or radar system 100R.” Ex1003, ¶138. That is, Dr. Campbell is asserting that an

aircraft is an “other object” according to Berkmo. This is incorrect. Berkmo is clear that “[o]ther objects may include any objects *other than the approaching aircraft.*” Ex1004, ¶78 (emphasis added). Berkmo goes on to list several examples of “other objects,” which may be moving or stationary, and which include ground support equipment, people, further aircraft accidentally entering the stand, dropped luggage. “Other objects” 11 and 12 in Berkmo’s example are luggage dolly 11 (stationary) and food delivery truck 12 (moving). Ex1004, ¶¶78, 133. There is no indication that “other objects” might include the subject aircraft. Ex1004, ¶78. Contrary to Dr. Campbell’s opinion, it is my opinion that a POSITA would not have understood the subject aircraft to be “another object” according to Berkmo, thus I find that his paragraph 138 is unsupported.

109. Dr. Campbell makes a second argument premised on the idea that “this verification” is performed by “comparing output data” from the sensors, and the sensor’s output data is lost in the combination process, ergo the comparison must take place before the combination process. Ex1003, ¶139. This argument fails for several reasons. First, the term “this verification” appears to refer, at least in part, to “verifying aircraft 10” of the last sentence in Dr. Campbell’s previous paragraph. However, as discussed above, there is no “verification” of “aircraft 10” disclosed in Berkmo, as the aircraft 10 is not “another object.” As such, Berkmo does not “expressly teach” the verification as Dr. Campbell claims. Secondly, I do

not agree that Berkmo discloses “combining the output data of all three systems by using a spatially resolved weighted average.” Ex1003, ¶139. As discussed above, I see no evidence for the combination of the camera data with the radar data, nor any method for combining it. Third, even if the verification and combination steps were as Dr. Campbell suggests (they are not), there is no reason the “verification” step needs to be done prior to the combination. It may be done as a part of the combination process, which would be computationally efficient in that the data would only need to be accessed once.

110. Dr. Campbell makes a further argument that the required comparison would be obvious to a POSITA based on the need to “overcome the drawback of imaging system 110C.” Such drawbacks include “mistakenly identifying image artifacts.” Ex1003, ¶140. First of all, the drawbacks identified are all associated with “other objects,” and there is no indication that these drawbacks apply to detecting the subject aircraft. Berkmo is clear that each of the sensors alone can detect the aircraft. See Ex1004, ¶¶22, 130, 134. Secondly, this does not address the issue of when the verification is done (before, during or after the combination). Third, as Berkmo discloses combining the data in making an assessment about the presence/location of the subject aircraft, there is no obvious benefit to the alleged verification step.

111. Additionally, Petitioners and Dr. Campbell assert that, “[e]ven if

Berkmo does not expressly or inherently teach this comparison to verify aircraft 10, it would have been obvious to a POSITA to perform that comparison and verification based on the teachings of Berkmo, and a POSITA would have been motivated to do so.” Ex1003, ¶140. This is unsupported by any evidence, and contradicted by the fact that Berkmo specifically excluded the subject aircraft from the “other objects” to which the verification step is applied.

112. Dr. Campbell’s final argument is that “[t]here are only two options here: performing the comparison and verification before merging; or doing so after merging” and that doing so prior to combining the data ensures the comparison is with unaltered version of the output data. Ex1003, ¶141. As discussed above, the third option is that any validation be done as a part of the combination process, which would be most efficient from a data handling perspective.

113. Berkmo explains that the camera has a primary role in detecting small objects on the in the stand area. Ex1004, ¶36. Berkmo discloses this camera data is validated with laser and/or radar data since the camera data can be subject to image artifacts, which may result in inconsistencies between the data sources. However, Berkmo is clear that the subject aircraft can be detected by the laser-based systems or radar on their own (although the relative accuracy may vary - “The airport stand arrangement may then predominately base its detection and tracking on the output data from the most accurate system,” Ex1004, ¶22) and that

they can each act as the primary sensor. Thus, there is no need to perform a validation step on the camera data for the subject aircraft as it is not required for the combined LIDAR/radar processing of Berkmo.

114. For the above reasons, it is my opinion that Dr. Campbell does not demonstrate, and that Berkmo does not disclose, comparing image data and LIDAR/RADAR data to identify that the *aircraft* is present in both of those data sets before merging.

d. Dependent claim 19

115. Berkmo does not disclose “wherein the LIDAR/RADAR sensor data is analyzed using a point cloud process to correlate points in the LIDAR/RADAR sensor data to points in the camera image data” as recited in dependent claim 19 (which depends from claim 18).

116. For context, this claim requires using a “point cloud process” to correlate camera and LIDAR/RADAR data. A point cloud is “a collection of points in the 3D space representing the structure of the scene.” As background, to help understand the different process being used by Berkmo, I will first explain how the ’349 Patent specification describes this process.

117. The ’349 Patent specification describes analyzing the sensor data “using a point cloud process to correlate points in the sensor data to points in the camera image data.” Ex1001 at 9:8-10. “Sensor data,” as used in this citation, is

clearly different from “camera image data” and thus is understood to be LIDAR/RADAR sensor data, the alternative type of sensor data identified in the specification. The ’349 Patent goes on to disclose that “[t]he process also can include: registering point cloud data generated out of the 3D model and 3D point cloud data from the sensor, through an iterated point cloud algorithm (ICP).” Ex1001 at 9:18-20. The “iterated point cloud algorithm (ICP)” referred to here is the “Iterative Closest Point (ICP)” algorithm for registering or correlating data from two 3D point clouds. The first point cloud is the LIDAR/RADAR point cloud, (“The LIDAR/Radar system provides its data as a plurality of LIDAR/Radar data points, referred to herein as a LIDAR/Radar point cloud.” Ex1001 at 6:16-18, Fig. 4, and Title). The second point cloud to be processed by the ICP algorithm is the combined image sensor/aircraft 3D model developed in step 354 of Figure 3. This second point cloud is the 3D model of the aircraft (which would be a more sparse point cloud consisting of key points on the aircraft’s surface) which has had its 6 degrees of pose determined based on the camera data – “the camera can, for example, use a camera based pose detection algorithm that uses 3D models of aircraft and image contours to estimate six dimensions (6D) of pose (i.e., x, y, z, roll, pitch, and yaw) of the aircraft to perform a vision pose estimation process.” Ex1001 at 8:50-54. This is step 354 shown in Fig 3. The ’349 Patent explains that “[i]n embodiments of the present disclosure, an image processing system is used to

create an initial aircraft 3D model (these functions are shown at 354 and 356 of FIG. 3).” Ex1001 at 6:46-48. The ’349 Patent also discloses that the 6D pose can be accomplished by comparing the projection of the 3D airplane model to the camera image. Ex1001, 8:55-63.

118. The ’349 Patent discloses that “once the camera image data and [LIDAR/RADAR] sensor data have been collected, a data fusion process can occur, [which involves] ... calculat[ing] a transformation between the coordinates of the system [LIDAR/RADAR] and a vision coordinate system of the camera image system... This transformation can be accomplished... using a point cloud process to correlate points in the sensor data to points in the camera image data.” Ex1001 at 8:64-9:10. This spatial transformation between 3D coordinate systems is exactly what the ICP algorithm derives, and would occur where the two data streams come together, the “Data Fusion Module (358)” of Fig. 3.

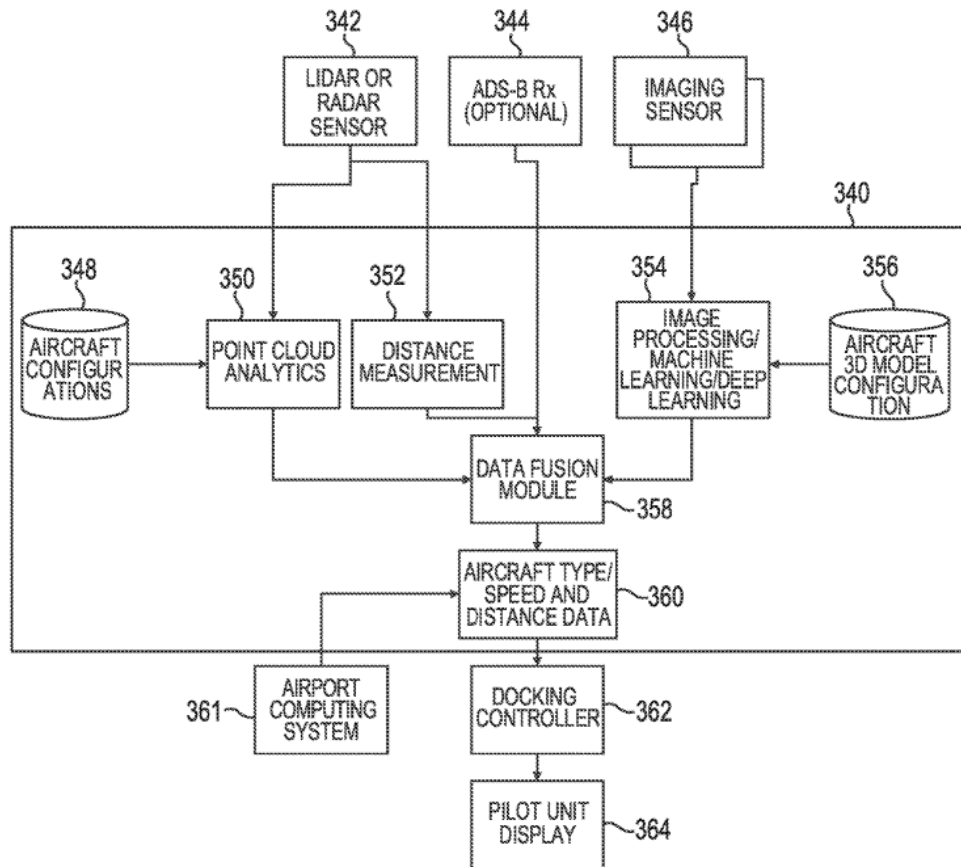


FIG. 3

119. Petitioners are incorrect in characterizing Berkmo’s “algorithm [which] may run a pre-processing sub-algorithm to determine corresponding spatial regions of the output data (e.g. pixel-to-pixel matching)” (EX1004, ¶129) as the “point cloud process to correlate points in the LIDAR/RADAR sensor data to points in the camera image data” of Claim 19. Petition at 66-67. Paragraph 129 is directed to a specific embodiment “the example embodiment 100” which is that of a radar and “laser-based system,” and does not disclose limitations of a camera-

based system, as required by claim 19. Furthermore, the paragraph repeatedly refers to the radar and laser systems (and never the camera system). As such, a POSITA would not understand the content of paragraph 129 to apply to a camera based system.

120. Rather, a POSITA would understand the “pixel-to-pixel” matching of Paragraph 129 to refer to the point cloud comparison of the 3D LIDAR/Radar sensors being discussed in that paragraph. That makes sense because both types of sensors are collecting 3D data that can be readily matched. In contrast, the camera image data collects 2D data, and there is no disclosure of using that data with the 3D point LIDAR/Radar. Further, while Berkmo discusses using a “weighted average process” in Paragraph 130, the discussion only appears to relate to using the two sets of 3D data from the laser sensor and radar sensor with its weighted average process (discussed in the preceding paragraph 129), as Berkmo provides no description of performing this process with 3D laser or radar data and 2D image data, which are two different and incompatible sets of data.

C. Ground 3 – obviousness challenge to claims 1-20 over Berkmo in view of Richman.

121. I have been asked to respond to Petitioners and Dr. Campbell’s opinions related to the motivation to combine Berkmo with Richman in support of Petitioners’ Ground 3 concerning the obviousness of Berkmo over Richman.

122. It is my opinion that Petitioners’ motivation to combine Berkmo and

Richman is unsupported. Dr. Campbell proposes several reasons how the invention of Berkmo might be improved by the teaching of Richman, but, in my opinion, the supposed improvements do not improve the system described in Berkmo but are based on hindsight.

123. In paragraph 163 Dr. Campell proposes that the POSITA would be motivated to combine Berkmo and Richman because they both use similar laser systems. The similarity of the sensors is itself not a motivation to combine.

124. In paragraph 164, the proposed motivation is to improve location and orientation, but there is nothing in Berkmo to indicate that the location accuracy is insufficient for the system's purposes. Indeed, I note that Dr. Campbell even testified at his deposition that: "I didn't say that Berkmo was not accurate," which appears to contradict the whole reason to combine the references in the first place. Ex2003 at 56:20.

125. In paragraph 165, Dr. Campbell proposes increased detection rate for incoming planes. Again, there is no indication that Berkmo's system has any problem in detecting an aircraft. In addition, Dr. Campbell argues detection rate would go up since Richman's system can provide a better match for partial sensor returns, but matching is not required for detection, and Dr. Campbell provides no theory for how matching partial sensor returns would affect detection rates.

126. In paragraph 166, Dr. Campbell proposes the motivation is improved

identification of the type of aircraft using Richman's "feature extraction" for "[f]eatures such as nose wheel and wing wheel intra-wheel distances and height and size of wings, fuselage and rudder would be used to determine type of aircraft." EX1005, 4:1-7." Ex1003, ¶166. However, Berkmo already discloses this: "[t]he aircraft stand arrangement 100 may then compare the dimensions of the aircraft type with dimensions of the aircraft inferred from an analysis of the output data received from the combined system 110." Ex1004, ¶126. A POSITA would not need Richman to know that "aircraft dimensions" include the height and size of wings, etc.

127. Finally, Dr. Campbell proposes that "detecting location and orientation information from detections of objects" provides motivation to combine. Ex1003, ¶167. This seems to be the same or a similar argument to the one made in Dr. Campbell's paragraph 164 – improved location and orientation of objects. But again, as noted above, Dr. Campbell appeared to undercut this assertion at his deposition when he testified that he "didn't say that Berkmo was not accurate." Ex2003 at 56:20.

128. Moreover, Dr. Campbell proposes to incorporate "Richman's 3D modeling, orientation detection, and template matching functionality" ... "into Berkmo's laser sensor." Ex1003, ¶163. Neither Petitioners nor Dr. Campbell have explained *how* this combination would work, nor would it be apparent to a

POSITA. The laser sensors of Richman and Berkmo are sensors which gather certain data and pass that data to other systems for processing. They do not perform processing other than the low level processing of the laser returns to form a point cloud. However, Petitioners and Dr. Campbell propose to add “Richman’s 3D modeling, orientation detection, and template matching functionality” into Berkmo’s laser sensor. These “functionalities” in Richman are distributed throughout several elements external to the ladar (see Fig. 2 of Richman) and a POSITA would not understand how to include them in the “laser sensor” of Berkmo.

129. In addition, the “functionalities” of Richman would need to be integrated with the radar and camera systems of Berkmo, along with the processing of Berkmo. Dr. Campbell provides no indication of how that would be done, nor would it be readily apparent to a POSITA.

VIII. SIGNATURE

130. I hereby declare that all of the statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on: June 7, 2024


Christopher K. Wilson

APPENDIX A – Curriculum Vitae

CHRISTOPHER K. WILSON

Redwood City, CA 650.867.2621 Chris@CWcons.com <http://www.linkedin.com/in/cwilson7>

Connected Vehicle & Telematics Consultant – Testifying Expert

I have been developing vehicle telematics and safety systems since 1991, mostly for safety and Advanced Driver Assistance Applications (ADAS). I participated in the early development of key connected vehicle telematics and safety technologies, including radar, positioning, communications, and mapping, worked with many automakers, suppliers, and government agencies, and was involved in the deployment and assessment of many telematics systems from Automatic Collision Notification to systems for Stability Control and Driver Assistance. I also helped set requirements and requirement testing methodologies for many ADAS systems.

I currently work as a consultant for Connected and Automated Vehicle applications (vehicle and infrastructure), and map databases. I am also an expert witness and have written over 80 reports regarding intellectual property and vehicle injury matters and testified 16 times. I am an industry insider with a gift for explaining complicated ideas in a convincing and easy to understand manner.

Expertise in:

- Vehicle Safety & Safety Systems Assessment
- Navigation, Telematics, Data Science
- Radar, camera, & Lidar sensors
- Vehicle & infrastructure interaction
- Remote diagnostics, Sensor & Software Management (OTA updates)
- Vehicle data collection, analysis & applications
- Positioning, communications & mapping technology
- Vehicle & traffic technology and deployment
- Accident Reconstruction

AREAS OF EXPERTISE (with representative dates)

Vehicle Telematics and Safety Systems

- Developed one of the first Automatic Collision Notification systems based on airbag deployment and biomechanical studies. Worked with first responders & ER physicians. 1994.
- Developed systems for the collection and processing of vehicle information for traffic assessment. 1995-2011.
- Algorithms for skid protection and dynamic vehicle control, braking & speed systems. 1999.
- Developed predictive safety systems based on map information, speed control. 1998.
- Developed metrics for regulatory evaluation of active safety systems including Forward Collision Warning, Blind Spot Monitoring, Stop Sign Warning, Curve Speed Warning. 2002.
- Litigation support for Various radar-based safety systems. 2016.
- Telemetry analysis (missiles, spacecraft, ground vehicles). 1981-Present.

Sensors

Radar

- Designed and operated Over-The-Horizon radar. 1984.
- Synthetic Aperture Radar assessment and evaluation. 1989.
- Evaluation of radar algorithms for F16 radar systems (MTI). 1987.

- Automotive radar development for ACC & FCW systems. 1995.
- Assessed various radar-based safety systems. 2002-2017.

Image sensors & algorithms (camera and video)

- Image recognition & processing algorithms for various reconnaissance assets. 1986.
- 3D scene reconstruction from imagery, photogrammetry. 1987, 2017.
- Assessment of image based FCW, AEB and lane following systems. 2002-2016.
- Photogrammetry for HD mapping applications. 2018.

Lidar

- Evaluated and utilized Lidar systems for Forward Collision Warning. 2003.
- Developed Lidar processing applications for mapping. 2008-2018

Communications

- Developed Vehicle-to-vehicle technologies (DSRC). 1999-2016.
- Extensive use and evaluation of cellular communications for vehicles. 1995-2018.
- Use of paging network for emergency services. 1993.
- Developed various vehicle telematics and infotainment systems. 1993-2016
- Evaluation and development of satellite communications systems. 1984-2016.

Positioning

- Evaluation and use of GPS and many high precision enhancements. 1984-2018
- Requirements specification for GPS III and Galileo. 2004.
- Developed precision location techniques for vehicles. 1996-2018.

Maps

- Responsible for 2nd generation map concepts and specifications for industry (HD Maps). 2000.
- Functional safety for map databases. 2016-2018.
- Developed high precision maps for automated vehicles. 1999-2018.
- Developed tools for incremental updates and quality management. 2000-2018.

Vehicle Diagnostics

- Remote diagnostics of powertrains for warranty and repair planning. 2001.
- Monitored infotainment systems to assess driver preferences and system functionality. 2002.
- Diagnostics of driving style for safety and efficiency evaluations. 2012.
- Telemetry diagnostics of air and space vehicles. 1985.

Cooperative Systems

Insurance- Developed methods and tools for peer comparisons to assess driver risk. 2015.

Transportation Operations- Understanding vehicle movements and implications for traffic and signals based on vehicle probes. 1994-2018.

Outreach

- I was the primary instigator and public advocate for vehicle-to-vehicle communications and grew this effort from “can’t be done” to deployment based on my advocacy.
- I have raised money for 4 startups selling a technical vision.
- Park docent leading trips on various nature topics.

PROFESSIONAL EXPERIENCE

Consultant, Intellectual Property and Connected Vehicles.	2012 – Present
ATG Risk Solutions, Seattle, WA	2016 - 2016
VP Bus Dev. (<i>Developing telematics-based risk assessment for Insurance</i>)	
Vehicle Data Science Corporation, Redwood City, CA	2013 - 2016
CEO (<i>Start-up building kinematic maps for automated vehicle applications.</i>)	
TomTom BV, Redwood City, CA	2008 - 2011
Director of Program & Product Mgmt., Advanced Driver Assistance Systems (2009 – 2011)	
Director of R&D (2008 – 2009)	
DaimlerChrysler Research and Technology North America Inc., Palo Alto, CA	1996 - 2008
Vice President, ITS Strategy & Programs (2002 – 2007)	
Group Manager, Telematics & Safety (1998 – 2002)	
Senior Research Scientist (1996-1998)	
Information Access Inc., San Francisco, CA	1995 - 1996
Director of Product Development (1995-1996)	
TRW Inc., Sunnyvale, CA	1986 - 1995
Program Manager (1991 - 1995)	
Senior Systems Engineer (1986 - 1991)	
GTE Government Systems Inc., Mt. View, CA	1983 - 1986
Systems Engineer (1983 - 1986)	

EDUCATION/TRAINING

PhD Candidate (1982), Astrophysics, University of California, San Diego
BA (1981), Physics, Princeton University, Princeton, NJ
 Advanced courses in business, strategy, & technology @ Harvard, Stanford, Berkeley, MIT
 Training in **Software Forensics** (copyright infringement, software theft).
Accident Reconstruction. Certificate from Society of Automotive Engineers. ACTAR certified #3846.

PROFESSIONAL ASSOCIATIONS

Member, Institute of Navigation (ION); Society of Automotive Engineers (SAE); Institute of Electrical and Electronics Engineers, Senior Member (IEEE); California Association of Accident Reconstruction Specialists (CA2RS); Accreditation Commission for Accident Reconstruction (ACTAR) #3846, National Association of Professional Accident Reconstruction Specialists.
Board Member, *Inside GNSS* magazine (advisory board); *IEEE Consultants Network of Silicon Valley* (former Chair); ITS California (former), Vehicle Infrastructure Integration Consortium (Founding Director, previous); Alliance of IEEE Consultants Network Coordinating Committee (AICNCC, former Chair).

PATENTS AND PUBLICATIONS

10 US patents in vehicle positioning and vehicle data processing and analytics and numerous foreign patents.

McGraw-Hill *AccessScience* article on “Intelligent Vehicles and Infrastructure”, 2017
Chapter on Probe Data in Springer-Verlag’s *Handbook of Intelligent Vehicles*, 2012
Widely quoted in publications such as Scientific American and Telematics Update
Many presentations to industry groups, often as a representative of the automotive industry.

LITIGATION EXPERIENCE

20+ depositions, 40+ IPRs, 80+ expert reports, majority patent related (partial listing).

- Expert for BMW (Finnegan) against navigation system complaint. Few hours consulting. 2012
- Supported primary expert (for TomTom) in technology understanding for invalidity and non-infringement. 2013.
- Expert against OnStar in remote diagnostics case. Developed infringement arguments. Case settled in 2013.
- Expert for Hyundai (Finnegan) in remote diagnostics case. Prepared technology tutorial and multiple IPR declarations. Case settled, 2014.
- Expert for Honda (Jones Day) in remote diagnostics case. Multiple IPR declarations. 2014.
- Expert for Toyota in Telematics/ navigation case. IPR declaration. 2015.
- Expert for BMW on remote data processing case. 2015.
- Expert for BMW (DLA Piper) in vehicle safety technology case (radar, occupant sensing). Invalidity and non-infringement reports, deposition testimony. 2015.
- Expert for Wavetronix (Workman Nydegger) in traffic radar case. IPR declaration, deposition. 2016.
- Expert for BMW (DLA Piper) on remote infotainment systems. 2017.
- Expert for Domino’s (DLA Piper, Australia) on fleet monitoring systems. 2017.
- Expert for BMW (DLA Piper) on digital radio systems. 2017.
- Expert for Unified Patents on location-based services. 2017.
- Expert for Velocity v. FCA on vehicle management system. 2018.
- Expert for Unified Patents on map data management and display system. 2018.
- Expert for Blue Dot Systems against Omnitracs on Fleet Management Trade Secrets. 2018
- Expert on vehicle safety for negligence in personal injury matter. 2019.
- Expert for BMW (DLA Piper) on location-based services patent. 2019.
- Expert for Unified Patents on pairing vehicles with remote devices. 2019.
- Expert for DEI (Cooley) v. ADS in vehicle remote starter patents. 2019.
- Expert for Unified Patents on navigation systems. 2020.
- Expert for BMW (DLA Piper) on connected vehicle systems. 2020.
- Expert for Equipmentshare.com (DLA Piper) on rental equipment remote starter patents. 2021.
- Expert for Unified Patents on pairing vehicles with remote devices. 2021.
- Expert for Tesla (Arnold&Porter) on vehicle charging infrastructure. 2022.
- Expert for Unified Patents on infrastructure-based tracking systems. 2022.
- Expert for multiple pedestrian Automatic Emergency Braking liability related matters. 2023.
- Expert against Omnitracs on Fleet management systems (King and Spalding). 2023.
- Expert in Patt v VW, liability matter related to seatbelt pretensioners. 2023.
- Expert for Honeywell in matter concerning aircraft docking systems. 2024.