

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner

v.

YECHEZKAL EVAN SPERO,
Patent Owner

Case IPR2023-00315
U.S. Patent No. 9,955,551

**PETITIONER VOLKSWAGEN GROUP OF AMERICA, INC.'S REPLY TO
PATENT OWNER RESPONSE**

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PETITIONER’S UPDATED EXHIBIT LIST

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1001	U.S. Patent No. 9,955,551 B2 to Spero (“the ’551 patent”)
1002	File History of Ex Parte Reexamination of U.S. Patent No. 9,955,551, Control No. 90/014,815
1003	Declaration of Dr. Jianzhong Jiao
1004	Curriculum Vitae of Dr. Jianzhong Jiao
1005	U.S. Patent No. 6,144,158 to Beam
1006	<i>Intentionally Left Blank</i>
1007	<i>Intentionally Left Blank</i>
1008	U.S. Patent No. 6,049,749 to Kobayashi
1009	WIPO Patent Publication No. 2002/004247 to Braun <i>et al.</i>
1010	WIPO Patent Publication No. 1998/054030 to Karlsson
1011	<i>Intentionally Left Blank</i>
1012	U.S. Patent No. 5,588,733 to Gotou
1013	English Translation of Japanese Unexamined Patent Application Publication H7-65603 to Nakamura <i>et al.</i>
1014	English Translation of Japanese Unexamined Patent Application Publication H7-101291 to Satonaka <i>et al.</i>
1015	Westermann, “History and Scientific Back-up,” 48th Session of GRE, EUREKA Project 1403, Informal Document No. 30, April 30, 2002
1016	“Adaptive Front Lighting Systems (AFS),” 48th Session of GRE, EUREKA Project 1403, Informal Document No. 28, April 12, 2002
1017	Hogrefe <i>et al.</i> , “Adaptive Light Pattern – A New Way to Improve Light Quality,” SAE Transactions, Vol. 106, No. 6, February 27, 1997
1018	Löwenau <i>et al.</i> , “Adaptive Light Control – A New Light Concept Controlled by Vehicle Dynamics and Navigation, SAE Transactions, Vol. 107, No. 6, pp. 33-38, February 26, 1998
1019	Manassero <i>et al.</i> , “Adaptive Headlamp: A contribution for Design and Development of Motorway Light,” SAE Transactions, Vol. 107, No. 6, February 26, 1998
1020	Michael Hamm, “System Strategies for Adaptive Lighting Systems,” 2001 Symposium: Progress in Automobile Lighting (PAL), pp. 368-380, September 26, 2001
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1022	<i>Intentionally Left Blank</i>
1023	Manassero et al., Adaptive Lighting Systems: Technical Solutions and Methodological Approach for Photometric Specifications, Progress in Automotive Lighting Vol. 6, pp. 514-525 (1999).
1024	Hanno Westermann, Lighting Performance Requirements in Vehicle Lighting Exemplified by System Requirements for AFS, Progress in Automotive Lighting Vol. 6, pp. 807-820 (1999).
1025	Diem et al., Analysis of the Eye-Movement Behaviour During Use Moveable Headlamps, Progress in Automotive Lighting Vol. 5, pp. 185-207 (1999).
1026	Kobayashi & Sugimoto, Development of the Phase-I AFS Front Lighting System, Progress in Automotive Lighting Vol. 5, pp. 449-464 (1999).
1027	Alejandro Vukotiich, Evaluation of the applicability of digital maps for the reconstruction of the real street shape, Progress in Automotive Lighting Vol. 6, pp. 774-790 (1999).
1028	Bernhard Wörner, Adaptive Frontlighting – Experimental System, Development and Functional Evaluation, Progress in Automotive Lighting Vol. 6, pp. 844-853 (1999).
1029	Mark van den Berg, Development of high Brightness LED's for Automotive Applications, Progress in Automotive Lighting Vol. 9, 987-993 (2001).
1030	Assessment of Headlamp Glare and Potential Countermeasures, Survey of Advanced Front Lighting System (AFS) Research and Technology, National Highway Traffic Safety Administration (2005)
1031	Watanabe et al., The Research on the Effectiveness of AFS Bending Lamp in Japanese Road Environment, Progress in Automotive Lighting Vol. 9, 1042-1053 (2001).
1032	<i>Intentionally Left Blank</i>
1033	<i>Intentionally Left Blank</i>
1034	U.S. Patent No. 6,127,947 to Uchida <i>et al.</i>
1035	Ex Parte Reexamination Certificate of U.S. Patent No. 9,955,552 to Spero, issued Aug. 19, 2022
1036	U.S. Patent No. 5,523,193 to Nelson
1037	U.S. Patent Application 2004/0052090 to Pederson
1038	U.S. Patent No. 4,662,746 to Hornbeck
1039	U.S. Patent No. 5,061,049 to Hornbeck

Exhibit #	Description
1040	U.S. Patent No. 5,933,183 to Enomoto et al.
1041	<i>Intentionally Left Blank</i>
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1051	United States District Courts – National Judicial Caseload Profile, June 2022
1052	Supplemental Declaration of Dr. Jianzhong Jiao
1053	Transcript of the Deposition of Matthew A. Turk, Ph.D., in IPR2023-00315 regarding U.S. Patent No. 9,955,551
1054	Transcript of the Deposition of Matthew A. Turk, Ph.D., in IPR2022-01586 regarding U.S. Patent No. 11,208,029
1055	Definition of “classify”, <i>Webster’s New Explorer Large Print Dictionary</i> , Merriam-Webster, Incorporated (2000)
1056	Moddel, G., Spatial Light Modulators: Processing Light in Real Time, <i>Optics and Photonics News</i> , pp. 17-21 (March 1997)
1057	U.S. Patent No. 6,132,072 to Turnbull et al.
1058	U.S. Patent No. 5,754,217 to Allen
1059	U.S. Patent No. 6,195,136 to Handschy et al.
1060	U.S. Patent No. 11,208,029 to Spero
1061	Bishop, C.M., <i>Neural Networks for Pattern Recognition</i> , Clarendon Press, Oxford (1995)
1062	U.S. Patent No. 4,907,044 to Schellhorn et al.
1063	Leighty, et al., “Developing Technologies for Army Autonomous Land Vehicles (U),” Army Engineer Topographic Labs, Fort Belvoir, October 1985 (accessible online at https://apps.dtic.mil/sti/tr/pdf/ADA187972.pdf , last accessed October 30, 2023)
1064	Lowrie, et al., “The Autonomous Land Vehicle (ALV) Preliminary Road-Following Demonstration,” Proceedings of SPIE, Vol. 579 Intelligent Robot and Computer Vision, 1985 (accessible at

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	https://home.ttic.edu/~mturk/pubs/ALVpreliminary-SPIE1985.pdf , last accessed October 30, 2023)
1065	Surface Vehicle Recommended Practice, SAE International, J1383, May 2018
1066	Standard No. 108; Lamps, reflective devices, and associated equipment, 49 C.F.R. § 571.108 (November 3, 2023)
1067	Terminology: Motor Vehicle Lighting, SAE J387, November 1987
1068	“The International System of Units (SI),” Bureau International des Poids et Mesures, 7th Edition (1998) (Excerpt)
1069	Certificate of Correction in U.S. Patent No. 9,955,551 C1, granted January 10, 2023

I. INTRODUCTION

Patent Owner's ("PO's") arguments fail because they misunderstand the art, misinterpret the claim language, and misunderstand how a POSA would view the issues and teachings in the art. PO's reliance on their purported expert Dr. Turk—who is not even a POSA, much less an expert, and who does not understand fundamental aspects of the relevant technology—compounds these errors. PO's and Dr. Turk's misunderstanding of the factual teachings of the art is linked to their misinterpretation of the claim language, distorting the claims to align with their flawed understanding of the art. Furthermore, the basis of much of PO's arguments against the reference combination is a "test" that Dr. Turk allegedly "supervised," yet knew almost nothing about; and that test is so flawed that a POSA would never even consider the results, much less perform the test PO describes. Finally, PO and Dr. Turk apply a misguided understanding of how a POSA would view and combine teachings of the art, highlighting Dr. Turk's lack of knowledge with the relevant headlamp technology. As the Petition showed, the Board should find that the challenged claims are unpatentable.

II. DR. TURK IS NOT AN EXPERT AND HIS TESTIMONY SHOULD HAVE NO WEIGHT.

Dr. Turk's declarations (EX2001, EX2006) should be excluded or accorded no weight because he is not a POSA. The parties agree a POSA would have "*at least 2 years of industry experience in the area of automotive lighting and lighting-*

control systems.” Pet., 7 (emphasis added unless noted); POR, 9. Dr. Turk accepts this level of skill (EX1053, 23:7-19), but does not meet it.

Only qualified experts can testify about issues of claim construction and validity. *HVLPO2, LLC v. Oxygen Frog, LLC*, 949 F.3d 685, 689 (Fed. Cir. 2020); *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1361 and n.3 (Fed. Cir. 2008). This requirement extends to “ultimate conclusions” on those issues and to “underlying technical” determinations. *HVLOP2*, 949 F.3d at 689; *Sundance*, 550 F.3d at 1363 (“it is an abuse of discretion to permit a witness to testify as an expert on the issues” from the perspective of a POSA “unless that witness is qualified as an expert in the pertinent art”).

“To offer expert testimony from the perspective of a skilled artisan in a patent case—like for claim construction, validity, or infringement—a witness must at least have ordinary skill in the art. Without that skill, the witness’ opinions are neither relevant nor reliable.” *Kyocera Senco Indus. Tools v. Int’l Trade Comm’n*, 22 F.4th 1369, 1375-77 (Fed. Cir. 2022); *see Sundance* 550 F.3d at 1363-1364.

Dr. Turk is not a POSA (EX1052, ¶¶1-49) and cannot testify on issues of claim construction or validity. There is no genuine dispute that Dr. Turk lacks “at least 2 years of industry experience in the area of automotive lighting and lighting-control systems.” Pet., 7. Dr. Turk’s industry experience relates to “computer vision methods for recognizing human faces, gestures, and activity.” EX2006, ¶12.

The closest “bit” of relevant experience Dr. Turk identified was at Martin Marietta (EX1054, 53:4–25), working on “computer vision for autonomous vehicle *navigation*,” not automotive lighting and lighting-control. EX2006, ¶¶12; EX1052, ¶¶41-49. Dr. Turk did not work on any type of headlight control, much less the type of adaptive headlamp control claimed here. There is no evidence that Dr. Turk has any requisite “industry experience in the area of automotive lighting and lighting-control systems” required of a POSA. Pet., 7; EX1052, ¶¶11-49.

Petitioner’s expert, Dr. Jiao’s, industry experience stands in stark contrast to Dr. Turk’s. EX1052, ¶¶3, 6-8; EX1003, ¶¶11-13 (discussing Dr. Jiao’s decades of experience in “adaptive front-lighting system (AFS) technologies”). As an unquestioned expert in the field—confirmed by PO’s Dr. Turk (EX1054, 58:9-19, 59:16-19)—Dr. Jiao opines that Dr. Turk lacks the requisite industry experience required of a POSA. EX1052, ¶¶11-48. For example, Dr. Jiao testified that a POSA would know that “intensity” includes direction and is not synonymous with “brightness,” which Dr. Turk does not understand. *Id.*, ¶¶13-16. Dr. Jiao also confirms that Dr. Turk does not understand other concepts readily known to a POSA including: basic terms (such as “beam pattern”), glare reduction standards, the use of zero emission light to reduce glare, and other concepts. *Id.*, ¶¶17-24. Dr. Turk does not understand how a POSA would measure, e.g., intensity (in development or under certain regulations) and is not familiar with leading

consortiums or conferences. *Id.*, ¶¶25-37, 45-49.

As further evidence of his lack of experience, Dr. Turk’s declaration describes a “test” that was so poorly designed and executed that a POSA would never rely on the results, much less perform the test. *Id.*, ¶¶117-127. Notably, Dr. Turk has never worked for a vehicle headlamp company, an LED (or other light source) company, or a general lighting company; never designed a vehicle forward lighting system; and has no patents, awards, or papers for vehicle forward lighting. EX1054, 52:18-53:1, 54:24-56:12; EX1052, ¶¶48-49.

PO may try to rehabilitate Dr. Turk’s qualifications, but the law dictates that he cannot meet the POSA requirement. His industry experience “in the area of automotive lighting and lighting-control systems,” Pet., 7, if any, amounts to nothing more than “vague reference[s]” that “fall[] short of establishing two years of...work experience” and should be “given no weight,” *Avail Medsystems, Inc. v. Teladoc Health, Inc.*, IPR2022-00444, Paper 10 at 24, 26 (P.T.A.B. July 21, 2022); *id.*, 24–26 (citing *Kyocera*, 22 F.4th at 1375–78). Regardless, PO’s arguments fail, as discussed below.

III. BEAM DISCLOSES THE EMISSION/ILLUMINATION/INTENSITY CHANGE (INDEPENDENT CLAIMS 24, 32, AND 40).¹

PO misinterprets the claims; regardless, Beam discloses PO's incorrect interpretation.

A. PO's claim interpretations are incorrect.

Claim 24 recites: “*change emission* of the selected cluster of LEDs relative to emission of other LEDs not included in the cluster;”

Claim 32 recites: “create a beam of *diminished illumination*,” and

Claim 40 recites: “*decrease intensity* of first emission from the first cluster and second emission from the second cluster relative to a third emission.”

EX1035, 1:58-59, 3:6-8, 5:1-3.

The plain language does not mention any specific emission or illumination level. EX1052, ¶¶69-76, 80-85, 87-90; EX1003 ¶¶157, 171. Yet PO argues that “emission” and “illumination” implicitly requires some non-zero light level, which PO alleges Beam does not teach. POR, 15-20. Not so.

First, a POSA would not understand “emission” or “illumination” to prohibit zero light because of how these terms are used in the claims. EX1052, ¶¶69-76, 80-85, 87-90. Specifically, the claims only require a *relative* change in emission/illumination/intensity for glare reduction. *Id.*

¹ A Certificate of Correction issued after the Petition. EX1069.

Second, dependent claims 25, 33, and 43 recite that the changed emission/illumination/intensity changes an LED to “a *non-emitting* state.” EX1035, 1:65-67, 3:32-33, 5:43-46. Therefore, independent claims 24, 32, and 40 unambiguously include non-emitting LEDs as a potential change for the relevant claim language. EX1052, ¶¶71, 83, 90.

Third, PO’s exclusion of zero emission/illumination/intensity contradicts the ’551 patent. *Id.*, ¶¶74-76. The ’551 patent refers to zero intensity or zero illumination light. EX1001, 65:31-35, 62:48-52, 87:4-5. PO cites a portion of the ’551 patent that allegedly supports its argument: “The discrete light emitting elements by operating and not operating, at full power or at a fraction of, either partially or in unison, generate light with optimal intensity, spectral distribution, and spatial distribution of intensity and spectral distribution for the viewing task at hand.” *Id.*, 19:26-30; POR, 15. But this passage shows that zero emission (not operating) can be used to create the desired beam, supporting that the claims do *not* exclude zero emission/illumination/intensity. EX1052, ¶¶74-76.

PO’s argument is also legally flawed; it relies on extrinsic dictionaries when the plain meaning is apparent from the intrinsic record. POR, 15-20; *Tempo Lighting, Inc. v. Tivoli, LLC*, 742 F.3d 973, 977 (Fed. Cir. 2014); *Phibro Animal Health Corp. v. Micronutrients USA LLC*, IPR2016-00435, Paper 10 at 9-13 (P.T.A.B. May 17, 2017) (declining to consider extrinsic evidence inconsistent

with plain meaning). PO's interpretation adds limitations that lack intrinsic support and are inconsistent with intrinsic evidence. *Id.*

Beam discloses the correct understanding of the claims even under PO's misunderstanding of Beam as using zero light for glare reduction. EX1052, ¶76.

B. Beam still discloses PO's incorrect claim interpretations.

Beam uses intermediate (non-zero) light levels to avoid glare. EX1052, ¶¶77-79, 86, 91. Beam controls LEDs individually based on sensor data, “determin[ing] which microbeams [LEDs] must be *reduced* in intensity to protect the other drivers.” *Id.*; EX1005, 4:16-19. Beam's “illumination in the shaded area [is] *reduced significantly* to protect the vision of the oncoming drivers.” EX1005, 4:21-25; Pet., 28-32. Beam's controller “uses the data [from sensor 107] to determine the size and position of the light emitters to be *dimmed*.” EX1005, 5:13-15; Pet., 31. A POSA would have understood that “reduced in intensity,” “reduced significantly,” and “dimmed” mean a reduction in intensity including intermediate illumination values, not solely zero illumination (e.g., via a change in angular distribution). EX1052, ¶¶77-79.

Even PO's Dr. Turk describes Beam as controlling its microbeams to be “*significantly reduced* in intensity” to control glare, or that glare reduction “is accomplished by *dimming* one or more of the LEDs.” EX2006, ¶¶54, 57. Dr. Turk therefore acknowledges that Beam reduces light intensity to non-zero values.

EX1052, ¶79. Additionally, in his '029 patent deposition, Dr. Turk admitted that Beam's light "attenuation" (EX1005, 4:46-48), a similar term, "means decreased,"—*not reduced to zero illumination*. EX1054, 95:6-23; EX1052, ¶72.

IV. BEAM DISCLOSES CLASSIFYING OBJECTS FOR ADAPTIVE HEADLAMP LIGHTING (CLAIM 48).

A. Without support, PO attempts to narrow the "classifying" element.

The '551 patent does not define "classifying." And the claim does not require specific objects be classified. EX1052, ¶¶92-98. A POSA would understand the plain language merely requires "placing the detected objects into categories or classes." *Id.*, ¶96.

PO impermissibly adds limitations absent from the '551 patent, and argues that Beam-Satonaka "teach a coarser level of control limited to light source detection, without any ability to distinguish between types of light sources—a necessary predicate for object classification." POR, 21. But this is not required (EX1052, ¶¶95-96) and is inconsistent with the '551 patent's description that analysis by a "detector or an imaging system *of the oncoming vehicles position (using its headlights for example)*" can be used to determine lighting parameters (EX1001, 52:62-65).

Moreover, PO's Dr. Turk for the first time during his deposition deviated from the parties agreed-upon "plain meaning" (Pet., 45-46; POR, 21), asserting

that classifying means “[t]o perform multi-class classification or recognition or determining the identity of an object.” EX1053, 82:15-19. But Dr. Turk’s “multi-class” modifier for classification is a giveaway that his interpretation is facially *not* the plain meaning.

Beam discloses the plain and ordinary meaning of “classifying” because its algorithm differentiates between illuminated objects that are above and below a threshold. EX1052, ¶¶97-98; Pet., 45; EX1003, ¶186. “The spatial scene data from sensor 107 is *thresholded* to eliminate weak signals and becomes the input to a processor 1105.” EX1005, 5:34-36. As Dr. Jiao explains, this means that objects detected by the sensor are separated into classes: those that emit or reflect light above the threshold, and those that do not. EX1052, ¶¶97-98.

B. The art discloses “classifying” even under PO’s incorrect multi-class classification interpretation.²

First, Beam classifies objects even under Dr. Turk’s interpretation. EX1052, ¶99. Beam’s thresholding function separates objects into different classes: those below the threshold and those above it. *Id.*; Pet., 34, 45; EX1005, 5:34-36. Thus,

² Should the Board adopt PO’s incorrect interpretation, Petitioner must have an “opportunity in reply to present argument and evidence under that new construction.” *Axonics, Inc. v. Medtronic, Inc.*, 75 F.4th 1374, 1383 (Fed. Cir. 2023).

Beam provides “multi-class classification” as Dr. Turk alleges is required.

EX1052, ¶99; EX1053, 82:15-19.

Second, Beam’s disclosure of this element is unsurprising—the ’551 patent acknowledges this element as admitted prior art:

Outputs from the CCD arrays are analyzed by appropriate computational means employing trained pattern recognition technologies, to *classify*, identify or locate the contents. *These techniques known in the art* are covered in texts such as: Schalkhoff, Pattern Recognition, statistical, structural and neural approaches, John Wiley and Sons, New York, 1992 and Neural Networks for Pattern Recognition by Christopher M. Bishop, Chris Bishop, Oxford University Press; (January 1996) included herein by reference.

EX1001, 44:67-45:9.

Indeed, Dr. Turk admitted this was known and that he was familiar with Bishop, which discloses, for example, a multi-class classification technique separating handwritten characters into the letters of the alphabet. EX1053, 84:21-85:3; EX1052, ¶¶100-101.

Third, further confirmation is in Satonaka (combined with Beam here), which classifies vehicle targets into oncoming vehicles or preceding vehicles. Pet., 10, 18; EX1014, ¶8; EX1052, ¶¶101-102. Once classified, Satonaka applies different lighting to improve glare reduction and headlamp performance. EX1014, ¶¶12, 48; EX1052, ¶¶101-102.

V. BEAM DISCLOSES NON-CONTIGUOUS LEDS.

PO's Dr. Turk agreed that Beam discloses non-contiguous LEDs as described in the Petition. EX1053, 100:3-101:6; Pet., 36-37. This contradicts PO's argument that Beam does not disclose the "non-contiguous" LEDs of claims 25, 27, 33, 35, 41, 43, 49, and 51. POR, 21-24, 40-41. PO advocates, wrongly, for exclusion of multiple vehicles targeted by a single cluster, based on a flawed understanding of the claims. POR, 21-24.

A. Dr. Turk agrees that Beam discloses non-contiguous LEDs.

Dr. Turk agreed that the Petition's multiple vehicle explanation (Pet., 36-37) was correct: "I think that's correct, they [the LEDs] would not be contiguous." EX1053, 100:3-101:6; EX1052, ¶¶104-105. Thus, there is no technical dispute regarding the non-contiguous element. EX1052, ¶105; EX1053, 98:14-99:20.

B. PO's non-contiguous argument is premised on a flawed claim interpretation.

PO seeks to narrow the claimed cluster to be "directed to a singular 'other vehicle.'" POR, 22. But the plain language does not require a cluster be assigned to a single vehicle. EX1052, ¶¶106-107.

For example, independent claim 24 recites "select a cluster of the LEDs that emit light toward at least a portion of the other vehicle," and claim 25 recites "the cluster includes non-contiguous LEDs." EX1035, 1:54-55, 2:1-2. The plain language only requires that the cluster include LEDs that emit light toward at least

a portion of the other vehicle. EX1052, ¶¶106-107. There is no restriction on the cluster having additional LEDs pointed at a second vehicle. *Id.*

This is supported by the '551 patent, which states that “[i]n general a cluster may be deemed a separate grouping *due to a function it performs*” and that clusters “may overlap and be discontinuous.” EX1001, 53:30-31. Glare reduction is a function performed for any number of vehicles; thus, the recited cluster can encompass the glare reduction LEDs for multiple vehicles, including those that are non-contiguous. EX1052, ¶108. Further, the '551 patent confirms that the cluster itself can be discontinuous—physically separated or non-contiguous—as in Beam’s multi-vehicle scenario. *Id.*; EX1001, 53:36-37.

VI. BEAM DISCLOSES THE CLAIMED OPTICAL CONTROL ELEMENTS.

PO’s argument is flawed for at least two reasons. POR, 24-26. First, PO is incorrect that Beam does not disclose a spatial light modulator with LEDs. Pet., 39; EX1003, ¶¶151-152. Beam specifically states that these elements are present in the same device. EX1005, 8:4-12; EX1052, ¶¶50-56, 109-111. PO does not otherwise argue that an SLM is not an optical control element. POR, 24-26; EX1052, ¶¶109-110.

Second, Beam’s optical control system 106 includes “reflectors and lenses [that] can control the light from at least one of the microbeams (e.g., emanating from its LEDs).” Pet., 39 (citing EX1005, 5:17-21). A POSA would have

understood this is accurate, and PO does not present technical arguments otherwise. EX1052, ¶111.

VII. IT WOULD HAVE BEEN OBVIOUS TO COMBINE BEAM AND SATONAKA.

The Board should reaffirm its initial finding in the Institution Decision because PO’s arguments against the Beam-Satonaka combination are substantially similar to the POPR arguments the Board considered and rejected. *Compare* POPR, 39-43 *with* POR, 26-40; DI, 12. Additional details in the POR do not change the substance of the POPR arguments.

A. The parties agree that the Beam-Satonaka combination is functional.

PO first argued that Beam-Satonaka is inoperable (POPR, 47-48), but now backtracks, merely alleging that Beam-Satonaka “would not work well in real-world conditions.” POR, 40; *see also* EX2006, ¶148. Petitioner disagrees with this qualification, but agrees that Beam-Satonaka would function (well, in fact). EX1052, ¶¶112-116.

B. PO’s argument is premised on a flawed “test” that a POSA would not find reliable.

PO bases their analysis here on a supposed test shown in the three images below. POR, 26-40. The POR does not explain how this test was set up or conducted, and Dr. Turk’s declaration provides little additional explanation. POR, 37; EX2006, ¶141; EX1052, ¶117.



POR, 37.

During his deposition, Dr. Turk admitted to not knowing details of the test he allegedly “supervised”:

Q. I see. So at the end of paragraph 142 and before paragraph 143, there’s three pictures in the declaration. Correct?

A. Correct

Q. Who took those pictures?

A. *I actually don’t recall the name of the person* who took those.

...

Q. Okay. Were you present when those pictures were taken?

A. No, I was not at that location.

Q. Do you know where those pictures were taken?

A. Not precisely. We talked about, you know, the context where they should be and on a roadway and such, but I don't know specifically where.

EX1053, 104:22-105:14.

Q. Okay. You say, “A digital camera was placed at multiple locations on the first vehicle.” Do you see that?

A. I’m looking for it. Yes, I see that.

Q. Do you know what kind of digital camera was used?

A. No, not specifically.

Id., 106:16-107:6.

Q. Were the cameras placed outside of the headlamps in the vehicle that was used?

A. I believe so. I don’t think they were put inside the headlamps.

Q. But you’re not sure; is that correct?

A. I didn’t ask specifically, but I wouldn’t know a way to do that so I probably would have heard if somehow that was done.

Q. And what about the camera position near the rearview mirror, was that inside the car or outside of the car, the camera?

A. I believe it was inside the car touching the rearview mirror, but I don’t recall for sure.

Id., 109:17-110:4.

Q. Were there any standards or regulations that you referred to when creating the setup for this test?

A. No. This was to investigate a particular technical question relevant to the proposed combination, so it wasn't really relevant to a standard to my knowledge.

Id., 110:10-14.

Dr. Turk was not present when the photos were taken, did not know who took the pictures, did not know details regarding the positioning or types of vehicles, and did not know details regarding the camera positioning. EX1052, ¶¶117-121; EX1053, 104:22-110:14. Further, Dr. Turk admitted that no standards or regulations were used for the test. EX1053, 110:10-14.

As Dr. Jiao explains, these are just some of the significant flaws: “[t]his is not how any POSA, let alone expert, would have set up an experiment of this type, and certainly not the type of test a POSA would rely on to support any conclusions.” EX1052, ¶¶121-127. Given the supposed importance that camera viewpoint/position plays in PO’s arguments, the complete lack of detail or scientific rigor in this test renders any analysis based on it fatally flawed. *Id.*

C. The Beam-Satonaka combination would not decrease Beam’s performance.

PO’s bottom line argument is that after modification, Beam would perform worse because of the camera viewpoint change. POR, 26-40. But PO misunderstands that Beam’s camera viewpoints are not changed in the combination. EX1052, ¶¶128-129. Beam is modified with Satonaka’s teachings for

the “coordinates of the pixels” in the image. Pet., 20-21; EX1003, ¶¶108-110. As the Board correctly noted, “Beam already tracking upcoming vehicles does not undermine a reason to also use Satonaka’s teachings.” DI, 12. This basic image analysis step that is independent of viewpoint would not work poorly with Beam’s camera viewpoints. EX1052, ¶¶129-130. PO’s bodily incorporation argument does not account for how a POSA would routinely adapt the algorithmic concepts to Beam’s viewpoint. EX1052, ¶130; *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007) (“A person of ordinary skill is also a person of ordinary creativity, not an automaton.”).



POR, 37.

PO’s argument also misunderstands how a POSA would modify Beam in view of Satonaka. POR, 39-40. A POSA would not directly copy Satonaka’s recognition window into Beam. EX1052, ¶¶131-134 (citing EX1005, 4:9-31; EX1014, ¶¶27-33). A POSA would instead preserve, rather than exclude, Beam’s ability to find *all* targets in the illuminated field of view for glare reduction, as both

Beam and Satonaka teach. *Id.*; EX1005, 4:9-31; EX1014, ¶¶27-33.

VIII. BEAM-SATONAKA-KOBAYASHI DISCLOSES THE ROAD CURVATURE DEPENDENT CLAIMS 26-29, 34-37, 42-45, AND 50-53.

PO misunderstands Beam when alleging “Beam expressly requires maximal use of the high-beam at all times except where blanked to avoid blinding oncoming traffic.” POR, 42. Accordingly, PO and Dr. Turk incorrectly conclude that “there is nothing to ‘adapt’ or modify toward the upcoming road curvature, rendering Kobayashi’s map data useless.” EX1052, ¶¶135-142; EX2006, ¶154. As Dr. Jiao explains, PO’s and Dr. Turk’s understanding of Beam is wrong. EX1052, ¶137. Beam expressly states that the *angular position* or *attenuation* “of each of these microbeams is independently set by controller 108,” which is controlled in a dynamic environment of moving vehicles. EX1005, 4:46-52; EX1052, ¶¶137-140; EX1003, ¶70; Pet., 34, 47. Indeed, “Beam’s control is ‘*dynamically varying* in position and in size,’ in response to the control input.” EX1052, ¶139 (citing EX1005, 5:46-54, 6:24-27); *see also* Pet., 8, 10; EX1003, ¶¶70-78. Thus, Beam *does* disclose changing direction of microbeams to form its beam patterns—Beam-Satonaka-Kobayashi includes beam patterns to adapt to a curve. EX1052, ¶¶143-146.

IX. KARLSSON DISCLOSES USING AN LED LIGHT SOURCE AND A CAMERA TOGETHER.

A. Karlsson’s sensor 23 is a camera.

PO and Dr. Turk admit that Karlsson discloses a camera (sensor 23) even though he incorrectly stated that “[o]nly the light modulator embodiment includes a camera. Karlsson illustrates the light-sensitive sensor 23 adjacent to the light modulator 3 in Figures 3, 5a, 7, 10.” EX2006, ¶173; POR, 50. Karlsson’s light source includes LEDs, making PO’s embodiment distinction meaningless. EX1052, ¶¶147-149; EX1010, 21:13-17.

B. Karlsson’s light source includes LEDs.

Karlsson’s “lighting means [includes] a plurality of light sources and/or light modulators which are known per se in practice. Examples of light sources are, inter alia, filament lamps, gas discharge lamps, halogen lamps or *Light Emitting Diodes* (LEDs).” EX1010, 21:13-17. Karlsson does not limit which lighting means can include LEDs, including, for example, Figures 3, 5a, 7, and 10. EX1052, ¶¶150-151. Regardless, the Petition extensively cites at least Figure 3, which includes both the camera sensor 23 and LEDs. Pet., 58-60, 68-69, 71-72.

X. KARLSSON DISCLOSES PERFORMING GLARE REDUCTION FOR MULTIPLE VEHICLES (CLAIM 40).

The Petition explained “Karlsson would repeat its dimming process for all detected vehicles.” Pet., 76; EX1003, ¶261. PO’s argument fails because it relies on an unsupported hypothetical operation of Karlsson, as opposed to the Petition’s

explanation, which is based on Karlsson’s existing dimming process. EX1052, ¶¶153-155.

PO argues that “Karlsson could alternatively form a large dark box encompassing all detected lights,” and not teach the claimed second cluster. POR, 51. PO’s hypothetical alternative makes no sense. Karlsson would use the *same strategy*, forming its dimmed or dark box, around each target source instead of using some alternative, undisclosed dimming strategy. EX1052, ¶¶153-155; EX1010, 9:18-26.

XI. KARLSSON DISCLOSES NON-CONTIGUOUS LEDs.

Like Beam, Karlsson discloses non-contiguous LEDs when tracking multiple vehicles. EX1052, ¶¶156-158; POR, 52, 53, 67; Pet., 69-70, EX1003, ¶¶275-278; Section V. PO’s argument here relies on a flawed understanding of these claims, and Karlsson discloses these claims—despite PO’s misunderstanding of Karlsson’s disclosure of random beam patterns. EX1052, ¶¶156-158. No POSA would have understood Karlsson’s patterns to be completely random, as Dr. Turk suggests. *Id.*

XII. IT WOULD HAVE BEEN OBVIOUS TO COMBINE KARLSSON AND NAKAMURA.

First, PO argues that the Petition fails to explain how or why embodiments in Karlsson are combined. POR, 53-54. But, Karlsson specifically teaches using LEDs and the Petition does not mix embodiments. Section X; EX1052, ¶¶164-166;

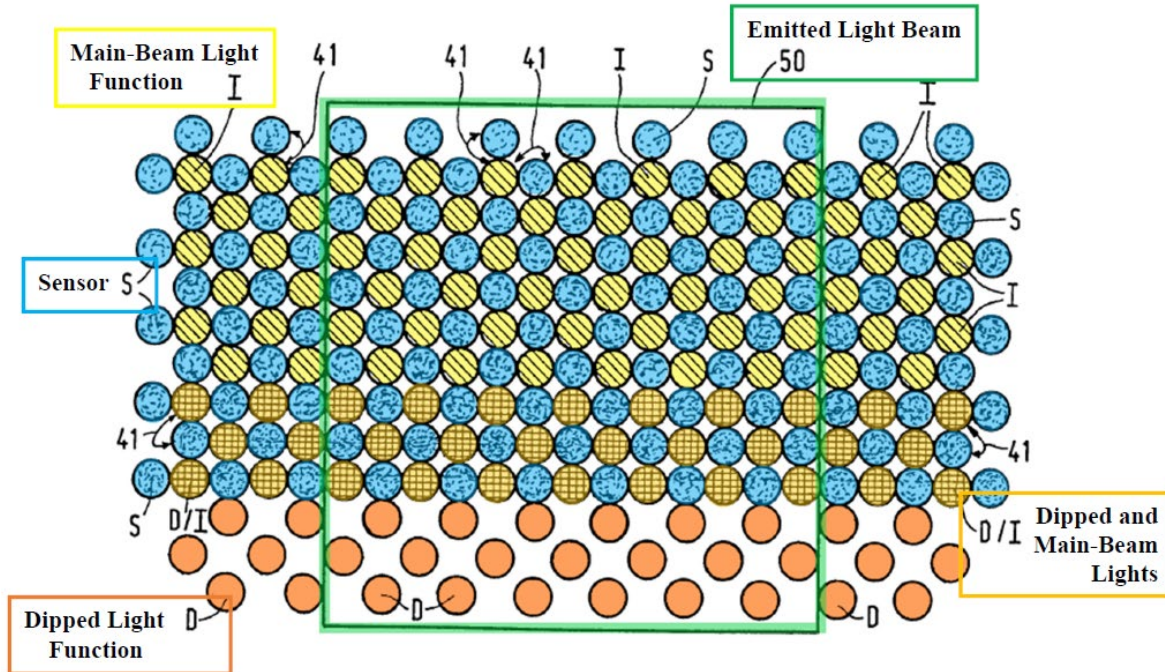
Pet., 59-64.

Second, PO argues that a POSA would not have been motivated to modify Karlsson in view of Nakamura. POR, 54-61. A POSA would have done so for the reasons in the Petition. Pet., 54-58; EX1003, ¶¶232-243; EX1052, ¶¶167-168. PO's argument tracks its flawed Beam-Satonaka combination argument—as Dr. Turk confirmed. EX1053, 138:22-139:5. Similarly, a POSA would have been motivated to combine Karlsson and Nakamura. Section VIII; EX1052, ¶168.

XIII. KARLSSON-NAKAMURA-GOTOU DISCLOSES THE ROAD CURVATURE DEPENDENT CLAIMS 26-29, 34-37, 42-45, AND 50-53.

PO's road curvature claim arguments against the Karlsson ground mirror those against the Beam ground. POR, 61-66. But Karlsson does not operate only at a maximum intensity, and has directional control. EX1052, ¶¶169-172; EX1003, ¶¶91-92.

PO and Dr. Turk wrongly conclude that Karlsson forms emitted beam 7 by “using the entire beam array at full intensity, except when avoiding glare, at which point, window 50, of reduced illumination (Fig. 14) is created to address glare situations.” POR, 61-62; EX2006, ¶82; EX1052, ¶¶172-173. This is incorrect because Karlsson's “emitted light beam 50 is represented as a window that shifts in the plane from left to right and from top to bottom, based on the data from inputs to Karlsson's controller. EX1010, 19:18-20:3.” EX1052, ¶¶169-172 (citing EX1003, ¶¶91-92).



EX1010, FIG. 14 (annotated).

Window 50 is only a subset of the LEDs available. EX1052, ¶¶172-173. Dr. Jiao explained how shifting this window controls light beam directionality. EX1052, ¶¶172-174; EX1010, 19:29-34; EX1003, ¶¶90-92; Pet., 13-14. PO's Dr. Turk agreed that Karlsson's beam 50 can (1) vary its shape and dimension, (2) vary depending on the desired beam pattern and direction, and (3) its dimension can vary depending on the desired beam pattern and direction. EX1054, 132:15-25, 133:6-7, 134:2-7, 134:13-15.

Nothing suggests to a POSA that Karlsson operates with all of its LED spotlight beams active except to implement glare control. EX1052, ¶¶175-177. PO's incorrect understanding ignores Karlsson's optimally adapted system with individually and group controllable LEDs resulting in emitted light beam 50, based

on the data from inputs to Karlsson's controller. *Id.*; EX1010, 19:18-20:3.

A POSA would have understood that Karlsson-Nakamura-Gotou beam patterns—like known adaptive beam patterns at the time—would vary in direction, length, and width (angular distribution) from a bird's eye view, or driver's view with varying intensity points along a projected distance. EX1052, ¶¶178-182 EX1003, ¶¶335, 337. Thus, Karlsson can, and does, control its beam directionality and does not, as PO and Dr. Turk argue, disclose maximum illumination at all locations. EX1052, ¶¶183-184.

XIV. THE PETITION SHOWED ALL CLAIM ELEMENTS WERE IN THE PRIOR ART.

A. The Petition showed the prior art's image data is used to control light emitted from headlamps (claims 33, 41, and 49).

Both Beam and Karlsson use image data from their cameras to control light emitted from their headlamp systems. In Beam, “[i]mages from ‘the sensor and are converted to video or other electrical signals’” that “‘drives controller 108, which uses the data to determine the size and position of the light emitters to be dimmed.’” Pet., 28 (citing EX1005, 5:10-13), 31 (citing EX1005, 5:13-15); EX1003, ¶¶133, 161. Thus, Beam's controller uses image data from its camera (the “video or other electrical signals”) to control emitted light. EX1052, ¶¶64. These signals are image data, as Dr. Turk acknowledged. EX1052, ¶¶61-65; EX1053, 81:14-20.

Karlsson's image data is used to control light emitted from its headlamp:

“control means 14 are arranged to selectively switch the individual small light sources, or a group of individual small light sources, on and off ... in response to a control signal from sensor means 23.” EX1010, 14:22-30. Thus, Karlsson's control means 14, which includes a processor, is in communication with sensor 23 to receive the control signal.

Pet., 62-63 (citing EX1003, ¶256); EX1052, ¶¶150-161.

The Petition also explained that “the processor in control means 14 is processing the information from the cameras in Karlsson.” Pet., 64. This information from the camera is image data transferred from Karlsson's camera to the controller to control the light emitted from Karlsson's headlamps. EX1052, ¶¶159-161.

B. The Petition showed the cameras are positioned to take an image to be used for headlamp beam pattern control (claim 32).

PO ignores the Petition's discussion of Beam's/Karlsson's cameras positioned to “capture an image of at least one target.” POR, 11; EX1035, 2:59-61. Specifically, “Beam's ‘imaging sensor (such as a video camera) faces forward.’” Pet., 28 (citing EX1005, 6:12-14). And “scene data [received by the camera] is in the form of ‘pixel[s].’” Pet., 29 (citing EX1005, 5:36-39). Thus, Beam's camera meets this claim element. EX1052, ¶¶66-68.

Similarly, “Karlsson's ‘sensors 9 and 23 are preferably designed to be

capable of precisely determining the direction and the intensity of the detected light 11.” Pet., 63 (citing EX1010, 12:19-22, 9:18-22); Pet., 64 (citing EX1010, 8:19-23, FIG. 1). Thus, Karlsson’s camera meets this claim element. EX1052, ¶¶162-163.

C. The Petition addressed “classifying” objects (claim 48).

PO argues that there is no analysis of [48.9a]. POR, 12-13. The Petition addresses this element, referring to it as part of element [48.8], a typographical error. Pet., 45-46, 77-78. But clearly the substantive discussion addresses the relevant claim elements, supported by Dr. Jiao’s declaration cites, which includes the correct claim language. EX1003, ¶¶185-192, 318-325.

XV. SECONDARY CONSIDERATIONS DO NOT SUPPORT NON-OBVIOUSNESS.

A. There is no nexus.

Dr. Turk does not independently analyze PO’s secondary consideration evidence; he merely adopts opinions of a third party that is not available for cross-examination here. EX1053, 124:5-137:16. Nonetheless, PO fails to show any nexus. Because PO has no product corresponding to the claims (POR, 70-71), secondary consideration evidence must be “the direct result of the unique characteristics of the claimed invention.” *Fox Factory, Inc. v. Sram, LLC*, 944 F.3d 1366, 1373-74 (Fed. Cir. 2019) (internal quotations omitted). That burden cannot be met by “a feature that was known in the prior art,” *Campbell Soup Co. v.*

Gamon Plus, Inc., 10 F.4th 1268, 1277 (Fed. Cir. 2021) (internal quotations omitted), or “non-patented features,” *Intex Recreation Corp. v. Team Worldwide Corp.*, 2023 WL 6969790, at *4 (Fed. Cir. Oct. 23, 2023) (non-precedential).

Instead, PO’s evidence must be the “direct result” of the “inventive aspect[s]” of its claimed invention. *Fox Factory*, 944 F.3d at 1374, 1378 (quoting *Ethicon Endo-Surgery, Inc. v. Covidien LP*, 812 F.3d 1023, 1034 (Fed. Cir. 2016)).

First, PO’s three alleged unique characteristics are directed at only some claims, waiving their nexus arguments for all other claims (24, 25, 32-33, 38-39). POR, 70-71.

Second, the features PO identifies fail to show nexus because they are not unique. EX1052, ¶¶186-195. PO never disputes that Kobayashi and Gotou teach the “Predictive Curve Illumination” feature. *Id.*, ¶189. PO’s argument against the relevant claims addresses elements unrelated to the “Predictive Curve Illumination” feature. *Id.*; Sections VIII, XII.

For the “light in-between” feature, PO also fails to show nexus. Claim 40 was known in the art. Indeed, PO never challenges the corresponding feature of claim 40, and as Dr. Jiao explains, this feature is taught at least by Beam and Karlsson. EX1052, ¶192; EX1005, FIG. 1.

Finally, for the “classifying” feature (claim 48), PO does not dispute that Karlsson discloses this element, and PO’s argument against Beam is wrong.

EX1052, ¶¶10--191; Section IV. The '551 patent even admits that classifying was known. EX1001, 44:67-45:9. Thus, these features are not “unique characteristics.”

B. PO's evidence is not the direct result of the alleged unique characteristics.

For example, regarding Predictive Curve Illumination, PO cites an article that mentions “provid[ing] visibility for upcoming curves.” POR, 71 (citing EX2023, 727). But this is much broader than the claimed feature, allegedly represented by claim 26’s “accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the at least one headlamps.” EX1035, 2:9-11; EX1052, ¶196. Regarding the “light in-between” feature, PO does not explain what claim language is allegedly applicable—without that, PO cannot show any tie to its proffered evidence. Finally, regarding the “classifying” feature, PO cites “‘intelligent lighting’ technology to recognize cars that are being followed as well as oncoming traffic. (Ex. 2023 at 729-734).” POR, 71. But, claim 48 recites “the first light determined based at least in part on classifying the object based at least in part on the data,” which says nothing about recognizing preceding and oncoming cars. EX1035, 6:63-65; EX1052, ¶196. Thus, even if these alleged characteristics were unique (they are not), PO’s nexus analysis fails.

C. The alleged secondary considerations evidence is from regulatory barriers.

The alleged secondary considerations do not support nonobviousness because they are based on regulatory barriers to implementing advanced headlight systems. EX1052, ¶¶197-198. The alleged unmet need evidence advocates changing the regulatory barriers to allow implementation of existing (foreign) headlamp technology. *Id.*, ¶¶178-179. Thus, there was no actual technological unmet need, so PO's purported evidence is irrelevant. *Id.*, ¶¶196-197. The purported industry praise evidence also praises the known foreign headlamps. *Id.*

XVI. PO'S PARALLEL PETITION ARGUMENT IS IRRELEVANT.

PO's argument against instituting two petitions is untimely and baseless. POR, 72-73. PO's allegation of "gamesmanship" is also irrelevant and illogical. *Id.*, 73. The Petition met all requirements without duplicative grounds.

XVII. CONCLUSION

The Board should cancel the challenged claims as unpatentable.

Respectfully submitted,

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CERTIFICATE OF WORD COUNT (37 C.F.R. § 42.24(d))

1. This Petitioner's Reply complies with the type-volume limitation of 5,600 words, comprising 5,530 words, excluding the parts exempted by 37 C.F.R. § 42.24(c).

2. This Petitioner's Reply complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word 2016 in 14-point Times New Roman font.

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CERTIFICATE OF SERVICE (37 C.F.R. § 42.6(e))

I certify that the above-captioned **PETITIONER VOLKSWAGEN
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entireties on December 6, 2023, upon the following parties:

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