

IN THE 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

**DECLARATION OF JIANZHONG JIAO, PH.D., IN SUPPORT OF
PETITIONER'S REPLY**

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WGoA EX1052
VWGoA v. Spero
IPR2023-00315

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I, Dr. Jianzhong Jiao, hereby declare as follows.

I. INTRODUCTION

1. I have been asked by Volkswagen Group of America, Inc. (“VWGoA” or “Petitioner”) to provide my opinions in the above-captioned *inter partes* review (“IPR”) proceeding involving U.S. Patent No. 9,955,551 (“the ’551 patent,” EX1001). I previously submitted a declaration (EX1003) in support of the Petition for *inter partes* review of the ’551 patent. This declaration is in support of Petitioner’s Reply to Patent Owner’s Response in the same proceeding, IPR2023-00315.

2. I understand that Patent Owner Yechezkal Evan Spero (“Patent Owner”) submitted a Patent Owner Response (“POR,” Paper 13) along with a Second Declaration from Matthew A. Turk, Ph.D. (EX2006) in support of the POR.

3. My background and qualifications were provided in paragraphs 9-20 of my First Declaration, Exhibit 1003, and my CV was submitted as Exhibit 1004. My statements and opinions in my First Declaration regarding my review of the ’551 patent and related materials remain unchanged. In reaching my opinions in this declaration, I reviewed the POR, my First Declaration, and the materials reviewed as part of my First Declaration. EX1003, ¶21 (listing references considered in my First Declaration). In addition, I reviewed and refer to the

following materials:

Paper/ Exhibit No.	Description
11	Institution Decision
16	Patent Owner's Response
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)

Paper/ Exhibit No.	Description
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 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
2001	First Declaration of Matthew A. Turk, Ph.D. (“the First Turk Declaration”)
2006	Second Declaration of Matthew A. Turk, Ph.D. (“the Second Turk Declaration”)
2010	Jianzhong Jiao and Ben Wang, “Etendue Concern for Automotive Headlamp Using LEDs,” SPIE Proceedings Vol. 5187, (January 2004) (Available at https://www.spiedigitallibrary.org/conference-proceedings-of-spie/5187/0000/Etendue-concerns-for-automotive-headlamps-using-white-LEDs/10.1117/12.504363.short)
2011	Michael Bass, <i>Handbook of Optics</i> 3RD Edition Volume II, (McGraw-Hill, 2010) (Available at https://www.worldcat.org/title/555545456)

Paper/ Exhibit No.	Description
2012	Ben Wang and Jianzhong Jiao “Studies for Headlamp Optical Design Using LEDs,” SAE Technical Paper Series 2004-01-0434, (March 2004) (Available at https://www.sae.org/publications/technical-papers/content/2004-01-0434/)
2013	Ben Wang and Jianzhong Jiao “Optical Transform Limitations in Headlamp Photometric Performance,” SAE Technical Paper Series 2005-01-0861, (April 2005) (Available at https://www.sae.org/publications/technical-papers/content/2005-01-0861/)
2015	Jianzhong Jiao and Ben Wang “High-Efficiency Reflector Optics for LED Forward Lighting,” SPIE Proceedings Vol. 6670, (September 2007) (Available at https://www.spiedigitallibrary.org/conference-proceedings-of-spie/6670/66700M/High-efficiency-reflector-optics-for-LED-automotive-forward-lighting/10.1117/12.730524.short)
2016	Navigant Consulting “Energy Saving Estimates of Light Emitting Diodes in Niche Lighting Applications” Building Technologies Program Office of Energy Efficiency and Renewable Energy U.S. Department of Energy (September 2008) (Available at Energy Savings Estimates of Light Emitting Diodes in Niche Lighting Applications (Technical Report) OSTI.GOV.)
2017	PCT Publication No. WO 86/05147 to Flaaten
2018	Transcript of Deposition of Jianzhong Jiao, Ph.D. taken on August 23, 2023
2019	Alliance for Automotive Innovation website retrieved September 11, 2023 https://www.autosinnovate.org/about/our-members
2020	Michael Bass, <i>Handbook of Optics</i> 3RD Edition Volume V, (McGraw-Hill, 2010) (Available at https://www.worldcat.org/title/557121959 .)
2021	Texas Instruments/Digikey “How DLP Technology Works,” (Available at https://www.digikey.com/en/product-highlight/t/texas-instruments/dlp-technology .) (Accessed September 12, 2023.)

Paper/ Exhibit No.	Description
2022	Texas Instruments “Introduction to +/- 12 Degree Orthogonal Digital Micromirror Devices (DMDs) (Available at https://www.ti.com/lit/an/dlpa008b/dlpa008b.pdf?HQS=dis-dk-null-digikeymode-dsf-pf-null-ww&DCM=yes&distId=10) (Accessed September 12, 2023.)
2023	Certified File Wrapper of Reexamination Application 90/014815 dated January 11, 2023

4. I have reviewed all other materials cited herein. I confirm that to the best of my knowledge the accompanying exhibits are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.

5. My work in this case is being billed at a rate of \$400 per hour, with reimbursement for actual expenses. My compensation is not contingent upon the outcome of this proceeding.

II. LEVEL OF ORDINARY SKILL IN THE ART

6. I incorporate by reference my opinion of the person of ordinary skill in the art (“POSA”) as set forth in paragraphs 44-46 of my First Declaration (EX1003), particularly that a POSA at the time of the alleged invention “would have had a bachelors degree (B.S.) in mechanical engineering, electrical engineering, optical engineering, applied physics, or an equivalent field, *as well as*

at least 2 years of industry experience in the area of automotive lighting and lighting-control systems.” EX1003, ¶44 (emphasis added throughout unless I note otherwise).

7. I understand that Dr. Turk agrees with my opinion regarding the level of ordinary skill. EX2006, ¶¶46-48; EX1053, 23:7-19.

8. After reviewing the First Turk Declaration (EX2001), the Second Turk Declaration (EX2006), the transcript of the Turk Deposition for this proceeding (EX1053), and the transcript of the Turk Deposition in the IPR of the related U.S. patent 11,208,029 (“the ’029 patent”, EX1060), I am convinced that Dr. Turk is neither an expert in the relevant art, nor is he a POSA.¹ Rather he has shown through his lack of knowledge (as I explain throughout this declaration) and experience that he has never been an expert, or a POSA, as laid out and accepted by him. EX2006, ¶¶46-48; EX1053, 23:7-19. More specifically, Dr. Turk does not have at least 2 years of industry experience in the area of automotive lighting and lighting-control systems, which he acknowledges a POSA would have had. EX2006, ¶¶46-48; EX1053, 23:7-19. Accordingly, in my opinion Dr. Turk is not qualified to opine in this matter as an expert or from the perspective of a POSA.

¹ The ’029 patent is a continuation of U.S. Patent 10,894,503, which is in turn a continuation of the ’551 patent. EX1060, (63).

III. LEGAL STANDARDS

9. I incorporate by reference my understanding of the legal principles, including my discussion of claim construction and obviousness, as set forth in my First Declaration. EX1003, ¶¶22-43, 353.

IV. DR. TURK HAS SHOWN THAT HE IS NEITHER AN EXPERT NOR A POSA IN THE RELEVANT FIELD, AND NEVER HAS BEEN.

10. Again, after reviewing the First Turk Declaration (EX2001), the Second Turk Declaration (EX2006), and the transcript of the Turk Deposition in this proceeding (EX1053), the transcript of the Turk Deposition in the IPR of the related '029 patent (EX1054), and Dr. Turk's CV (EX2002), each indicates to me that Dr. Turk is neither an expert in the relevant art, nor is he a POSA. Rather he has shown through his lack of knowledge and experience that he has never been an expert, or a POSA, and is not qualified to opine on what a POSA would have understood either in the individual references here, the '551 patent itself, or the proposed obviousness combinations.

A. Dr. Turk acknowledges he does not understand basic concepts related to automotive lighting, and lighting in general, is not aware of major projects and technical events in the relevant art, and separately accepts my knowledge and expertise in the field.

11. In the sections below, I explain several aspects in which Dr. Turk has indicated to me that he is not, and never has been, a POSA under the definition that he has agreed with and adopted in this proceeding.

1. Dr. Turk has shown he does not understand basic terms a POSA would have understood within the field of automotive lighting and lighting control.

12. As I previously opined, none of the claim terms require specific construction and should receive their plain and ordinary meaning in the context of the '551 patent specification. EX1003, ¶68. But Dr. Turk repeatedly has indicated that he does not understand the plain and ordinary meanings of several claim terms.

13. For example, Dr. Turk appears to not understand what the term “intensity” means in the context of automotive lighting and lighting control. When asked for his understanding of “reduce intensity,” as it relates to one of the '551 patent claims, he answered “[i]t’s to reduce from one level of illumination to a lower -- change from one level of illumination to a lower level of illumination.” EX1053, 72:13-17. It is not clear to me what Dr. Turk is discussing here, but I do not believe it is the concept of intensity as would be understood by a POSA. Instead, it seems he is discussing the concept of brightness of the light here based on his discussion of changing a “level of illumination,” because that phrasing appears to be referencing the brightness of the light.

14. Similarly, in a deposition of the related '029 patent, when Dr. Turk was asked during his deposition, “[w]hat does ‘maximum intensity’ mean in the context of automotive lighting?” he answered “In general, *I don’t know....I think it*

means you can't make it any brighter, any higher in terms of its intensity."

EX1054, 103:13-20. Dr. Turk was asked as a direct follow up: "You said, though, that you don't know in general what 'maximum intensity' means in the context of automotive lighting?" and he answered "Not as a general term in all circumstances, no." EX1054, 103:22-25.

15. But in the automotive lighting context, a POSA would have readily understood that "intensity" refers to luminous intensity measured in the unit candela (cd) in the International System of Units. EX1068, 18. The candela value is a measurement of luminous flux per unit solid angle emitted by a light source *in a particular (or a given) direction*. It is a quantitative measurable widely known and regularly used by a POSA in the field of lighting including automotive lighting. It is not, contrary to Dr. Turk's misunderstanding, an illumination brightness level or similar to or synonymous with "brightness," which is a human perception measurement. *See* EX1054, 62:18-25.

16. Dr. Turk's misunderstanding of the term "intensity" is also present in his declarations in this proceeding. For example, paragraphs 51 and 52 in the Second Turk Declaration relating to Beam's "maximum intensity" further clarify that he was conflating brightness (perception) and intensity (measured physical and physiological quantity that *includes directionality*). EX2006, ¶¶51-52, citing EX1005, 6:40-44, 3:8-15.

17. Dr. Turk also incorrectly stated that “beam pattern” is “related to brightness and darkness of illumination within the shape.” EX1054, 43:2-4. Like the ’029 patent claims, features of the ’551 patent claims aim to control the beam pattern, for example, by “chang[ing] emissions of the selected cluster of LEDs” as recited in claim 24. EX1035, 1:58-60. This makes Dr. Turk’s misunderstanding of this fundamental highly relevant. And this also directly conflicts with the Second Turk Declaration here (EX2006, ¶26), where he quotes *from an article that I co-authored*, where I explained that “[a]ny automotive headlamp beam pattern, either high-beam or low-beam, is a light luminous intensity (candela) angular distribution.” EX2010, 237. Such a misunderstanding and contradiction indicates to me that he does not understand the art, relevant literature, regulations, etc., that a POSA would possess. I am convinced he has never had the knowledge of a POSA.

18. Indeed for automotive lighting, specifically for headlamps, beam pattern includes directionality, and a change in beam pattern includes a change in direction of the light. EX2010, 237; EX1017, FIGs. 1 and 3-5. For example, for headlamps with at least both high beam and low beam functions, a POSA would understand that high beam and low beam are aimed in *different* directions. EX2010, 237; EX2012, 8, FIGs. 11A, 11B; EX2013, 7. That is, high beam and low beams have different “maximum intensities,” and such “maximum intensities” must be understood also with regard to the change in beam pattern and direction.

Dr. Turk has acknowledged that he does not understand such beam patterns, or their foundation in the FMVSS that he cites (without any understanding, much less that of a POSA in automotive lighting and lighting control). *See* EX1054, 42:23-43:9.

19. I previously explained the concept of beam pattern in my First Declaration, for example, in the context of adaptive headlamps and adaptive front lighting systems. EX1003, ¶¶47-56. As an example, I previously explained with reference to background art Hogrefe at paragraph 55 of my First Declaration (EX1003) that as an example, Hogrefe shows how known adapted light patterns can increase safety on curved roads, at high speeds, and within cities, for example, by varying improved lateral illuminance (shaping light around curves), increasing length of the beam to improve visibility, and expanding the beam shape to capture a wider angle, for example. And as Hogrefe's Figure 3 explains, "the individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern." EX1017, FIG. 3 (emphasis in original).

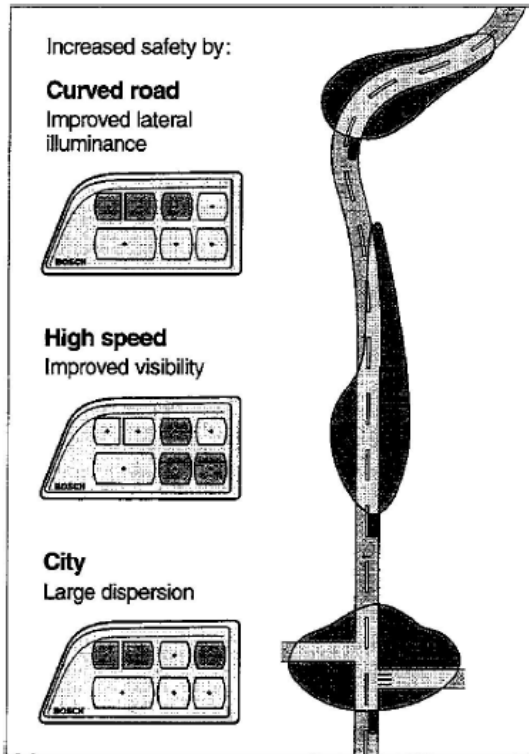


Fig. 1: Three standard driving situations with adapted light pattern seen from the bird eye's view.

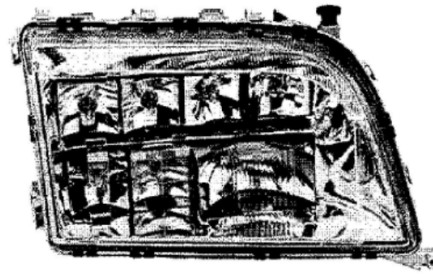
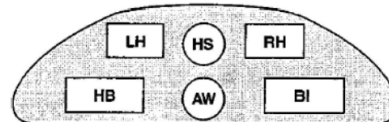


Fig 4: ALP headlamp sample



Single components:

LH Left hand bend BI Basic illumination
RH Right hand bend AW Adverse weather illumination
HB High beam HS Hot spot

Fig. 5 Advanced ALP sample layout

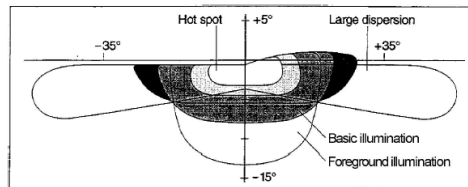


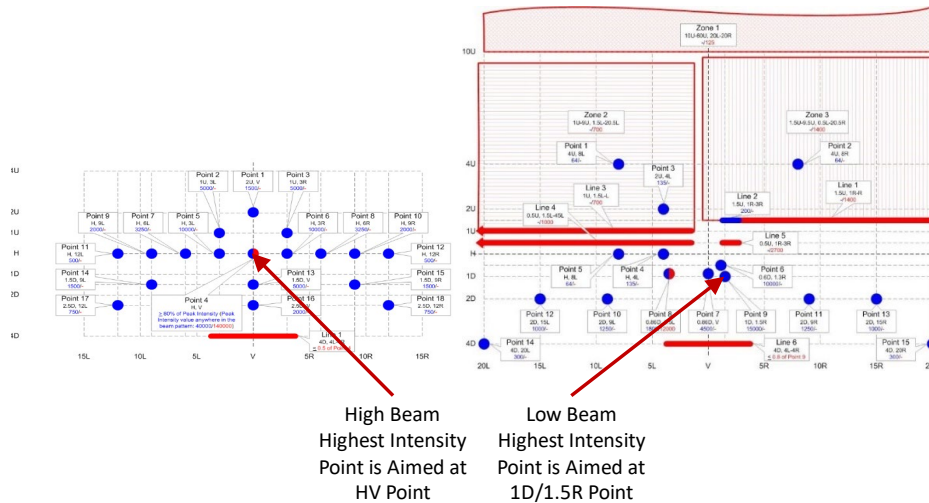
Fig. 3: Light pattern of multiple beam headlamp (Isolux curves in wall projection): The individual light pattern of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGs. 1 and 3-5.

20. As shown above, the headlamp beam pattern includes variation in light direction and projected length and width on the road from a bird's eye view (in EX1017, FIG. 1) or driver's view, with intensity points along a projected distance (in EX1017, FIG. 3). Known patterns include large dispersion, curved-road light, and high speed long reaching beams as shown above.

21. A POSA would also have understood, for example, that high beams' hotspot, the highest light intensity point is aimed at the so called "HV point" – the center of the vehicle; while low beams' hotspot, the highest light intensity point is aimed in a different direction (specifically, aimed at 1-degree down and 1.5-degree

right point), per U.S. regulation FMVSS 108 as well as industry standard SAE J1383) – not the center of the vehicle but toward the right-hand side, for right-hand side drive as in the U.S., as I have illustrated in Figures 5 and 6 below:



EX1065, FIGs. 5 and 6 (Headlamp Beam Pattern Comparison of the U.S. High Beam and Low Beam, annotated).

22. Indeed, Dr. Turk seems not to be familiar with any standards with respect to vehicle headlamp glare, much less SAE J1383 or FMVSS 108:

Q. Do you know, in the context of automotive headlamps, if there is any standard that regulates the level of permissible glare to oncoming vehicles?

A. I believe there probably are such standards. I don't know them in detail.

EX1053, 65:22-66:1.

23. A POSA would have readily understood the standard and regulation

requirements for headlamp glare, in particular for low beam headlamps. The red-colored testing lines and zones in the above (right) figure are the clear indications in SAE J1383 and FMVSS 108 for the maximum intensity (candela value) allowed for the purpose of glare light control. A POSA also would have understood that the automotive lamp features or functions can be “optically combined,” within the applicable standards and regulations contrary to Dr. Turk’s inaccurate assertion that “a POSA would not have considered combining features from lamps having different functions..., fog lamps, or cornering lamp,” (EX2006, ¶26), because such combinations have routinely been allowed and practiced. *See, e.g.*, EX1066, 4, (noting in its definitions that “[o]ptically combined means a lamp having a single or two filament light source or two or more separate light sources that operate in different ways, and has its optically functional lens area wholly or partially common to two or more lamp functions.”); *see also* EX1067, 5.

24. Optically combined headlamps *must* be able to change direction in order to achieve at least the high beam and low beam functions. And the above diagram shows such directional change for both beams. In the above Figures 5 and 6, H denoting the horizontal line, V denoting the vertical line. This is the angular coordinate system for all automotive lighting light intensity, or candela value, measurements. Numbers listed in the diagram above on the coordinates are the FMVSS 108 and SAE J1383 (EX1042) required candela values, color blue is for

the minimum, and color red is for the maximum allowed. More simply put, the high beam is a narrow-spread beam that is aimed for far-distance illumination (preferably 140 meters or farther). To be sure, in regulatory terms, FMVSS 108 requires at 12-degree left and right measured at H (0-degree) for 1500 cd and 2.5-degree down for 1000 cd min, and HV for 40000 cd min. 49 C.F.R. § 571.108. Low beam has wider spread. FMVSS 108 requires at 20-degree left and right measured at 4-degree down for 300 cd min. 49 C.F.R. § 571.108. Dr. Turk acknowledged that he did not know how intensity would be measured for automotive headlamps when asked during the '029 patent deposition. EX1054, 103:13-20. "Maximum intensity" as a term used in the art (EX1005, 6:11-12) is understood by a POSA as the relevant regulation and standard allowed the highest luminous flux or candela (cd) value, at a specific (angular) testing point, line, or zone for a given lamp (low beam, high beam, fog lam, etc.) beam pattern. There is no universal maximum intensity for any beam pattern. Often, the regulation and standard do not have the requirements for the maximum intensity such as the high beam expect at one test point (HV), and one line (4D, 4L to 4R). As such, the maximum intensity can be depending on different applications for desired road illumination used in AFS and ADB.

25. Based in my work in the field, a POSA would also have understood that OEMs often add further specifications for wider low beam spread measured up

to 40-degree left and right with certain candela values. I previously worked for 4 years on automotive lighting including technology development, product design, testing, and compliance for standards and regulations for General Motors before transitioning to North American Lighting, where I implemented adaptive front-lighting system and other lighting technologies for 14 years. EX1003, ¶¶11-12. I then worked at OSRAM Opto-Semiconductors on automotive lighting for an additional 8 years of industry experience with continuation in automotive and other lighting applications. EX1003, ¶13. In my experience, a POSA would have appreciated that for commercial applications in the U.S., high beam only has one maximum intensity point at HV, and would have appreciated that there is no maximum intensity requirement for other angles. As above, this shows that a POSA would have readily understood that such beam pattern *always includes direction*. Again, unsurprisingly, Dr. Turk acknowledged that he would not know which standards a POSA would look to, e.g., to know the standard methodology for measuring high-beam light output (headlamp with high beam and low beam functions is a highly regulated and consistently enforced automotive lighting device in the U.S. and rest of the world). EX1054, 154:20-155:15.

26. Dr. Turk also seems unfamiliar with other basic concepts that I would expect a POSA to readily understand. For example, he does not know if a LED die is a directional light source—which is a basic level of understanding I would

expect from any POSA:

Q. Is an LED die a directional source?

A. Excuse me, you said an “LED die”?

Q. Correct, d-i-e.

A. I hadn't really thought about that so I'm not sure how to -- how specific I can answer that at the moment.

EX1053, 32:3-13, 32:24-33:1.

27. These incorrect statements and misunderstandings in Dr. Turk's declarations and depositions, along with the dearth of experience in the field reflected on his CV, convince me that he is not a POSA, and does not understand fundamentals in automotive lighting and lighting control with no knowledge of basic concepts, lighting principles, lighting metrics and measurements, lighting regulations and standards, which a POSA would have. The examples include the basic terms of “intensity,” “brightness,” high beam, low beam, and other automotive lighting devices and their well-defined functions and requirements, how those lighting devices are optically combined, and other basic and commonly used terms that a POSA would readily understand. He does not understand how a POSA would go about measuring such lighting quantities (e.g., in development or under certain regulations, EX1054, 103:22-108:14, 150:23-156:3), or what a POSA would have found obvious to combine with respect to the applied references

discussed here and in my First Declaration, EX1003.

- 2. Dr. Turk has shown he is not familiar at all with basic developments in controllable headlamps, including, for example, the major EUREKA project and technical events, etc.**

28. I was shocked that Dr. Turk was not aware of the EUREKA project, one of the most well-known, major projects that involved internationally joint research that included developing adaptive front lighting systems (AFS) and legislative proposals related to automotive lighting and lighting control standardization. EX1054, 149:17-18 (“Q: Doctor, are you familiar with the EUREKA Project? A: It does not ring a bell at the moment.”). Indeed, I specifically commented on the Eureka Project in my First Declaration: “The EUREKA Project was a well-known consortium that a POSA would have been aware of.” EX1003, ¶51. He also acknowledged that he is not familiar with the Progress in Automobile Lighting conference (PAL), which revolves around developments in automotive lighting and lighting control, in the technological, design, testing, and regulation aspects. EX1054, 149:19-23 (“Q: Are you familiar with the Progress in Automobile Lighting Conference, also referred to as PAL?....A: I don’t recall that conference at the moment, no.”).

29. A POSA certainly would have been familiar with the EUREKA project and technical events such as PAL, especially with reference to adaptive front lighting systems. Several of the background references in my First

Declaration are articles from conference proceedings of PAL, a well-known, well-attended, bi-annual international conference. Members of the companies and organizations that participated in the EUREKA Project often attended the PAL Symposium and contributed technical papers. I personally attended the PAL Symposium in both 1995 and 1997, and my technical papers were published in both proceedings. This major project and conference/proceedings would readily be recalled by a POSA, and Dr. Turk's lack of knowledge of even their existence shows he is not a POSA.

30. Relatedly, while the EUREKA project and PAL both show that the adaptive front lighting systems were well-known many years ahead of the '551 patent's earliest possible priority date, I also note that Dr. Turk references industry praise for functions such as "automatically adjust[ing] a car's headlamps to deliver 'glare free' illumination," in a way that makes it seem he thinks that the '551 patent purports to invent such systems (EX2006, ¶218) and does not appreciate that such systems were well known prior to the '551 patent.

31. But a POSA would know that such systems were developed long before the '551 patent's earliest possible filing date, as I explained in the background of my First Declaration. EX1003, ¶¶47-52. Indeed, I explained at length in my First Declaration, the development of such systems. *See, e.g.*, EX1003, ¶¶47-52, 55-58.

- 3. Dr. Turk acknowledges my expertise when discussing considerations of a POSA—and even though he cites several papers I co-authored, he ignores their substance and does not appreciate what a POSA would actually have understood.**

32. As explained above, Dr. Turk also incorrectly states that “beam pattern” is “related to brightness and darkness of illumination within the shape.” EX1054, 43:2-4. And this is in direct conflict with the Second Turk Declaration’s paragraph 26 here, where he quotes *from an article that I co-authored*, explaining that “Any automotive headlamp beam pattern, either high-beam or low-beam, is a light luminous intensity (candela) angular distribution.” EX2010, 237. This misunderstanding and conflicting testimony indicates to me that he does not understand the art – his misunderstanding during deposition should have at least been consistent with documents he himself quotes and relies on. Such an inconsistency and demonstrated lack of understanding calls into question, in my mind, whether he actually read my co-authored articles in order to attempt to form an opinion on them.

33. Further, in the Second Turk Declaration, Dr. Turk even acknowledges *my* expertise and qualifications to opine on what a POSA would have understood in vehicle forward lighting, including automotive lighting and lighting control. EX2006, ¶¶30-38, quoting various articles that I co-authored, for example, EX2010, EX2012, EX2013, and EX2015. He also acknowledged this that I am

expert in vehicle forward lighting and LED headlamps during a deposition of the related '029 patent. EX1054, 58:9-19, 59:16-19.

34. I have reviewed the other articles Dr. Turk cites that I co-authored, along with others, and *none* support his arguments that a POSA would have found challenges in automotive lighting related to LEDs, regulations, design tradeoffs, hardware, optical systems, heat management, packaging, or cost to suggest any of the claims of the '551 patent are patentable. EX2006, ¶¶29-34, 36-38. Rather, his disjointed citations indicate to me that he does not understand the subject matter of those articles, and further indicates to me that he is unaware that the '551 patent does not purport to *solve any* such issues.

35. While LED lighting had progress to make before wide commercial adoption, and certain regulatory restrictions limited commercial implementation of, for example, LED headlamps, AFS, and ADB systems, it is *not* the case that such developments are purported to be solved by the '551 patent or its claims. Nor would such progress required to be commercially viable be a deterrent for a POSA to seek to improve known systems via modification or adoption of other known systems. Indeed, Dr. Turk does not dispute the teachings of LEDs in headlamps found in both of the primary references in my First Declaration.

36. Rather, I gave several examples of the known state of the art in my First Declaration. *See, e.g.*, EX1003, ¶57. Specifically, I explained citing extensive

background literature, that a POSA would have understood that:

Further, arrays of independently controlled narrow-beam directional light sources, for example, light emitting diode (LED) arrays, were developed with sufficient illuminance, directionality, and dynamic control as an alternative to traditional incandescent and gas discharge bulbs to provide adaptive light patterns and real-time feedback.

EX1005, 1:5-3:44, 4:9-59; EX1010, 1:10-26, 9:18-26, 20:29-32;

EX1015, 6-18, 21; EX1009, 16:6-25, 20:15-33.

EX1003, ¶57.

37. With respect to AFS, I gave several examples of the known state of the art in my First Declaration with respect to *directional* control. For example, I stated “Adaptive lighting commonly used multiple directional light sources (e.g., multiple directional beams, such as light modules or beam contributors) to produce an adaptive light pattern (angular light intensity distribution) by varying illumination characteristics including beam intensity, beam shape, beam color, beam direction around curved roads, and glare reduction.” EX1003, ¶54.

38. Also with respect to AFS, I gave several examples of the known state of the art in my First Declaration with respect to *glare* control. *See, e.g.*, EX1003, ¶¶47-52. For brevity, I reproduce only the text of paragraph 57 of my First Declaration, which summarizes my conclusions:

By 2000, adaptive headlamp systems with multiple directional light beams were developed with various means of sensors to detect surroundings while driving and resulted in glare reduction for oncoming and preceding vehicle drivers. EX1005, 1:5-3:44, 4:9-59; EX1010, 1:10-26, 9:18-26, 20:29-32; *see also* EX1015, 6-18, 21; EX1016, 1-19 (“[A]ll GRE experts acknowledge the experience with the new technology of front lighting, designed to improve the illumination and to adapt it to various driving situations, whilst reducing glare.”); EX1009, 6:4-7; 16:6-25, 20:15-33 (“According to an aspect of some embodiments of the present invention, the pattern recognition application identifies oncoming vehicles and automatically adjusts illumination provided by the luxels to prevent glare from light provided by the luxels from blinding a driver of the oncoming vehicle.”). Further, arrays of independently controlled narrow-beam directional light sources, for example, light-emitting diode (LED) arrays, were developed with sufficient illuminance, directionality, and dynamic control as an alternative to traditional incandescent and gas discharge bulbs to provide adaptive light patterns and real-time feedback. EX1005, 1:5-3:44, 4:9-59; EX1010, 1:10-26, 9:18-26, 20:29-32; EX1015, 6-18, 21; EX1009, 16:6-25, 20:15-33.

EX1003, ¶57.

39. A POSA would have been familiar with these developments and state

of the art, and Dr. Turk's lack of understanding of automotive lighting and lighting control makes clear that he is not a POSA, and never has been.

40. Moreover, because Dr. Turk ignores this well-known information that a POSA would have appreciated—even after I provided a detailed discussion of what a POSA would have appreciated with regard to automotive lighting and lighting control—his entire analysis presented in each of his declarations is flawed such that he *could not* have taken into account the knowledge of a POSA in his observations.

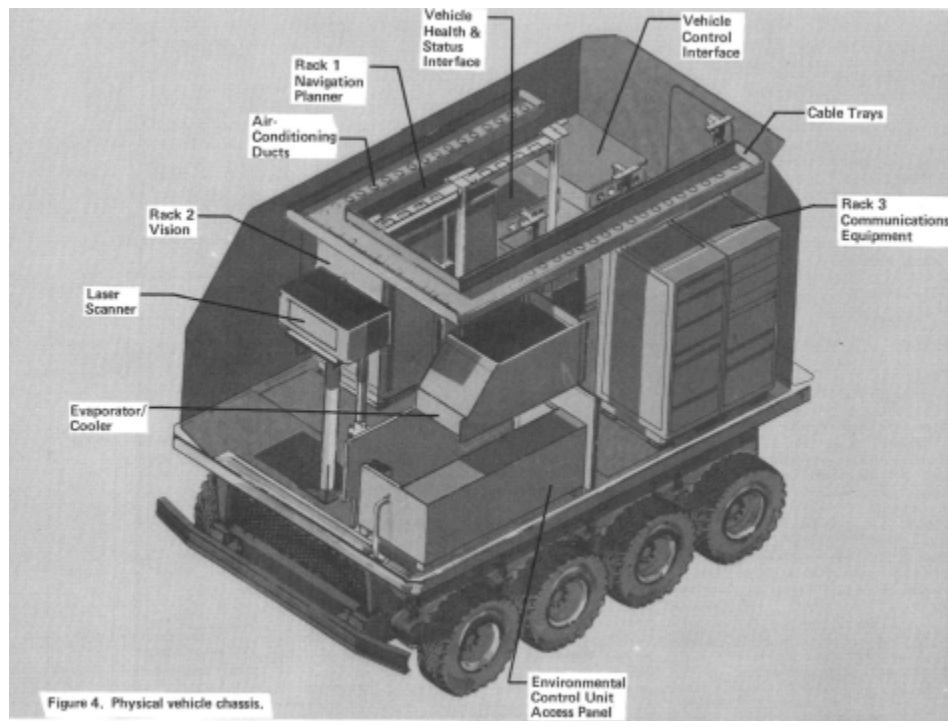
B. I am convinced that Dr. Turk's inadequate, tangential experience related to self-driving systems is not adequately relevant to the subject technology to qualify him as a POSA.

41. When asked about his experience as a POSA in the related '029 patent deposition, I note that Dr. Turk pointed to just one experience he found “a bit” relevant to his experience as an alleged POSA, specifically, work related to autonomous vehicles at Martin Marietta Denver Aerospace. EX1054, 53:4-25. After reviewing that experience and public records documenting that project related to autonomous vehicles, I confirm that this experience is not adequate to establish that Dr. Turk is a POSA.

42. This project, known as the “Autonomous Land Vehicle” or “ALV” project, utilized standard testbeds with a known vehicle chassis that included the headlamps of those vehicles. EX1063, 10-12 (Section titled “Demonstration Plan”,

noting that General Dynamics and/or FMC provided the chasses, *which has no relevance to the art of passenger vehicle's headlamp system disclosed in the '551 patent*).

43. Indeed, a paper co-authored by Dr. Turk shows a figure of the project installed over “a drive chassis supplied by Standard Manufacturing,” and notes that “[t]his physical platform is considered to be sufficient to support the electronics for all projected demonstrations and experiments.” EX1064, 338.



EX1064, FIG. 4.

44. The same paper co-authored by Dr. Turk, includes a figure of the “Long-range ALV system architecture”:

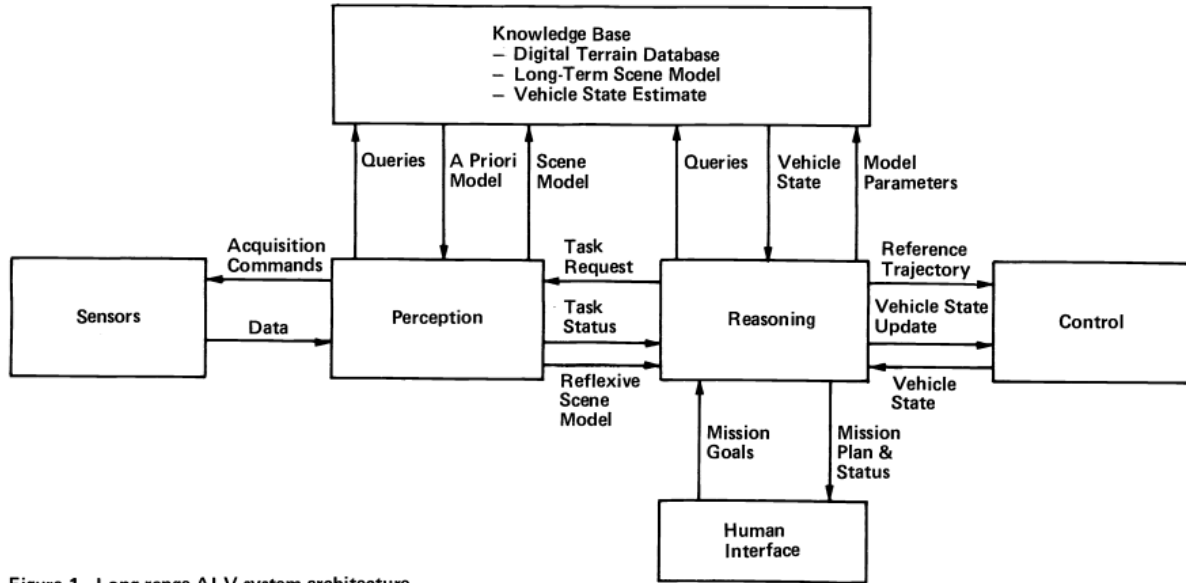


Figure 1. Long-range ALV system architecture.

EX1064, FIG. 1.

45. The system architecture of what Dr. Turk considers to be his most relevant experience with automotive lighting and lighting control does not even include any mention of either automotive lighting or lighting control. EX1064. The system architecture of the ALV makes no mention of any lighting parameters, characteristics, inputs, outputs, considerations, etc. There is no discussion of glare reduction or adapting to road curvatures.

46. Last, to be clear, I understand that in developing self-driving systems, lighting may be included, for example, as developed by the makers of the *standard chassis*. However, such experience is limited and tangential at best, and bears no resemblance to work an actual POSA would be involved in under the umbrella of automotive lighting, much less adaptive headlamps using LEDs with lighting control such as the subject of the '551 patent.

47. Assuming the ALV had headlamps, they were part of a standard, pre-manufactured chassis or subsystems that did not require any additional work or design, or any automotive lighting and lighting control that is the subject of the '551 patent. This further indicates to me that Dr. Turk has no relevant experience in the field of automotive lighting or lighting control, and he does not qualify as a POSA under his accepted definition.

48. Dr. Turk acknowledges that he has no experience in the field of automotive lighting, lighting control, general lighting, light measurements, and lighting device development, design, process, testing, standard and regulation compliance. He never worked for a vehicle headlamp company, has never worked for an LED (or any other light source) company, has never worked for a general lighting company, has not designed a vehicle forward lighting system, has no patents for any vehicle forward lighting, has never won any awards for vehicle forward lighting, and has no papers on vehicle forward lighting. EX1054, 52:18-53:1, 54:24-56:12. Without any such experience, I fail to see how Dr. Turk can hold himself out as a POSA under his accepted definition, much less an expert qualified to opine on what a POSA would have understood. Dr. Turk has not participated in any lighting professional associations' activities, is not a member of the Society of Automotive Engineers (SAE International), International Society for Optical Engineering (SPIE), or Illuminating Engineering Society (IES), EX1054,

57:9-17 (a few major lighting professional organizations), which is further indicative of a lack of any focus or even awareness on automotive lighting and lighting control—his lack of participation in SAE International, in particular, even suggests a lack of focus on automotive engineering in general.

49. As I understand it from his CV, declarations, and deposition testimony, Dr. Turk’s *industry experience* relates to “computer vision methods for recognizing human faces, gestures, and activity.” EX2006, ¶12 (defining Dr. Turk’s “industry experience”). Even if Dr. Turk is an expert in “computer vision,... concerning automatic face recognition,” EX2001, ¶¶7, 10, 12, 15-16 (detailing Dr. Turk’s experience with facial recognition technologies); EX2006, ¶¶9-10, 12, 14, 17-20 (same), EX1054, 22:15-17, 22-24 (same), this is *not a case about automatic facial recognition*. The closest experience in Dr. Turk’s CV appears to be his work at Martin Marietta Denver Aerospace, working on computer “vision for autonomous vehicle *navigation*,” not automotive lighting and lighting control or even lighting technology. EX2002, 5-6. The patent claims at issue concern automotive lighting and lighting control, and Dr. Turk has not indicated that he has any requisite “industry experience in the area of automotive lighting and lighting-control systems” required to be a POSA. EX1003, ¶44.

V. DR. TURK DOES NOT UNDERSTAND THE FUNCTIONS AND BENEFITS OF A SPATIAL LIGHT MODULATOR.

A. Spatial light modulators were well-known structures and provided additional functionality to LED-based headlamps.

50. I reviewed Dr. Turk's brief section on spatial light modulators ("SLMs"). EX2006, ¶35. Dr. Turk seems to misunderstand basic aspects of the use of SLMs in headlamps that would be well known to any POSA, specifically the use of SLMs in controlling beam pattern directionality.

51. To start, Dr. Turk's conclusion that a POSA would never combine an SLM and LEDs is based on a misunderstanding of how LEDs function. EX2006, ¶35. An LED by itself is usually used in the form of an LED array or LED module is a light source that emits a light beam with a *fixed* light angular distribution when a secondary optic is added onto an LED die or dies to form into an LED package. Such an LED light source typically has a light spread angle of tenths of degrees, e.g., as the '551 patent acknowledges, "Present day LEDs come in very narrow aimings such as two half angle 8 degrees which may not be narrow enough or with a (a 10 meter spread for 150 meters down the road which may be sufficiently aimed to the right) but with need, smaller angles are also feasible." EX1001, 52:55-59. Without the secondary optics (e.g., lens), an LED die has the Lambertian light distribution (uniform angular distribution in a hemisphere). EX1062, 1:51-61. In the lighting industry, when referring to LED light sources, the term "secondary

optics” is commonly known as the optical element (e.g., a lens) that is assembled with a LED die and other electrical and mechanical elements into an LED package.

An LED array or LED module usually consists of multiple LED packages.

EX1057, 11:49-53. Secondary optics on the LED package provides a fixed but not very narrow (tens of degrees) spread for light angular distribution. The LED emission of light can be varied by controlling the input electrical power (operating current) provided to the LED, but absent some other mechanism, the LED’s light angular distribution cannot be changed. EX1057, 10:25-29. The brightness of the light in that distribution may be changed, however, by controlling the input power used by the light for illumination. This means that if a headlamp was only formed from LEDs, it could not control the directionality of its light beam outside of the fixed constraints of the directions of the LEDs in the array. For this reason, a POSA would have known to include mechanisms to alter the light directionality.

52. The primary ways for an LED light source to alter its angular distribution is to either physically move the LED to change the direction the LED points or aims or to use additional, known optics to control the light distribution from the fixed LED. For example, physically moving the LED would be analogous to a light fixture mounted to a ceiling by a movable structure (like a flexible arm or hinge). Indeed, the ’551 patent discloses that “by the alteration of fixture geometry, moving structures or arms on which the light sources are mounted or by changing

the LEDs' refractor or reflector geometry, the direction of the light emanating from groups or even individual light sources is modified so as to generate an overall site specific light distribution pattern." EX1001, 59:22-27. The light fixture can be moved to point at different parts of the room or illuminated object, thus changing the angular distribution of the light. This strategy is similar to how embodiments in both Kobayashi and Gotou function to control their light beam patterns to account for road curvature. EX1008, 6:4-39 (changing light directionality by either swiveling the entire lamp mechanism or moving specific optical control elements such as reflectors); EX1012, 3:31-41, FIG. 2 (pivoting lamp unit via a rotary a swing mechanism). As an alternative to physically moving LEDs, changes in angular distribution can also be accomplished by using additional optics, for example, optical control elements like lenses and reflectors that are typically separate from the light source (e.g., LED package, LED array, or LED module consisting of LED die(s) with secondary optics). To further extend my analogy, this would be like holding a hand mirror up to the fixed ceiling light fixture and moving the hand mirror to reflect light to different parts of the room. Kobayashi discloses this well-known strategy in some embodiments to adapt to road curvature changes. EX1008, 11:5-14 (discussing altering the spatial arrangement of optical elements such as reflectors to control beam direction).

53. SLMs fall into this category of additional optics. They can be used to

shape or change the directionality of a light beam, including light produced by LEDs. EX1059, 2:56-63, 6:19-30, 2:65-3:1, Abstract (disclosing a spatial light modulator used to control light from an LED array); EX1058, 3:62-4:24 (disclosing using a spatial light modulator to control light emitted from LEDs). Indeed, Dr. Turk cites one type of spatial light modulator, a “digital mirror device” or DMD, that uses an array of micromirrors to control directionality. EX2006, ¶35 (citing EX2022); EX2022, 2. Exhibit 2022 explains that “[t]he DMD pixel is an opto-mechanical element in that these two positions [of the micromirror] determine the direction that light is deflected.” EX2022, 2. And controlling angle, or directionality, is a known function of SLMs. EX1056, 19 (“SLMs may reflect or transmit the readout light, and modulate its intensity, phase, polarization, or *angle* depending on the light modulating medium.”). Karlsson discloses other examples of SLMs, including “Suspended Particle Devices,” “Liquid Crystal Devices,” and “Quantum Wells.” EX1010, 5:11-15. Similarly, Beam discloses spatial light modulator examples including “digital mirror devices, liquid crystal devices, and grating light valves.” EX1005, 8:4-12. Thus, any POSA would understand that if directional control of LEDs is desired, an SLM is one way to achieve that directional control. This provides the benefit of having directional control over the light emitted from the LEDs, instead of only having control of the brightness of that light.

B. Beam discloses to a POSA a system that includes both an LED array and a spatial light modulator, contrary to Dr. Turk’s demonstrably false assertions.

54. Turning to Beam specifically, Dr. Turk opines that Beam’s LED array renders its “spatial light modulator....superfluous.” EX2006, ¶¶56-57. Moreover, Dr. Turk takes the untenable position that “[a] POSA would never interpret the SLM as being included in the LED embodiment because the functionality of the two components is *redundant*, and thus unnecessary.” EX2006, ¶60. But this is demonstrably false, as exemplified by Beam’s claim 4. EX1005, 8:4-12; EX1003, ¶116. Indeed, I note that when confronted during his deposition for the related ’029 patent, Dr. Turk acknowledged that, for example, Beam’s claim 4 does, in fact, expressly disclose a system that includes both an array of LEDs and a spatial light modulator. EX1054, 89:21-90:9, 90:17-91:8.

55. An SLM with an LED array is not superfluous and was known in the art. EX1059, 2:56-63, 6:19-30, 2:65-3:1, Abstract; EX1058, 3:62-4:24. Indeed, Beam’s disclosure includes a beam pattern comprising many—on the order of 300,000—individual, narrow angle microbeams, which may come from LED sources. EX1005, 4:41-44; EX1003, ¶73. Of course, Dr. Turk acknowledged that Beam would not include 300,000 LEDs, rather, a spatial light modulator would be included. EX1054, 101:4-102:15. Beam’s microbeams are “diverted or attenuated” (EX1005, 5:65-66) which a POSA would understand means, for example changed

direction or dimmed. A POSA would not conflate these concepts as Dr. Turk did during his deposition for the related '029 patent, where in responding to a question that asked whether his understanding of Beam is that the term “angular position” is the same thing as “attenuation,” he responded that “...the angular position of each microbeam is equated to the attenuation of each microbeam.” EX1054, 94:21-96:12.

56. Nonetheless, Dr. Turk ultimately acknowledged that each of Beam’s microbeams can be directed by Beam’s SLM:

Q. This passage also describes that the microbeams are individually directed, right?

A. Yes.

Q. What is “directed” in this context?

A. I believe this, in this context, it's describing the modulator embodiment and so direction of the microbeams refers to as either the mirror positioned to send the light out or the mirror positioned to not send the light out.

EX1054, 100:14-22.

57. Thus, Dr. Turk agrees that Beam’s microbeams are directed. Beam discloses that its microbeams can be created by LEDs, and thus the LED microbeams are directed by the SLMs. EX1005, 4:41-44, 8:4-7.

- C. **Karlsson discloses to a POSA a system that includes both an LED array and a spatial light modulator, contrary to Dr. Turk's demonstrably false assertions.**

58. Similarly, Karlsson discloses embodiments that have both a spatial light modulator and LEDs. For example, in Karlsson, Figure 7 (shown below) includes “light source 2 [that] is comprised of a plurality of separate small light sources.” EX1010, 14:22-23; EX1003, ¶¶251, 256, 263. And Karlsson discloses that light source 2 can include “Light Emitting Diodes (LEDs),” which a POSA would know are a plurality of separate small light sources. EX1010, 21:13-17. Thus, the light source in Figure 7 is formed from LEDs.

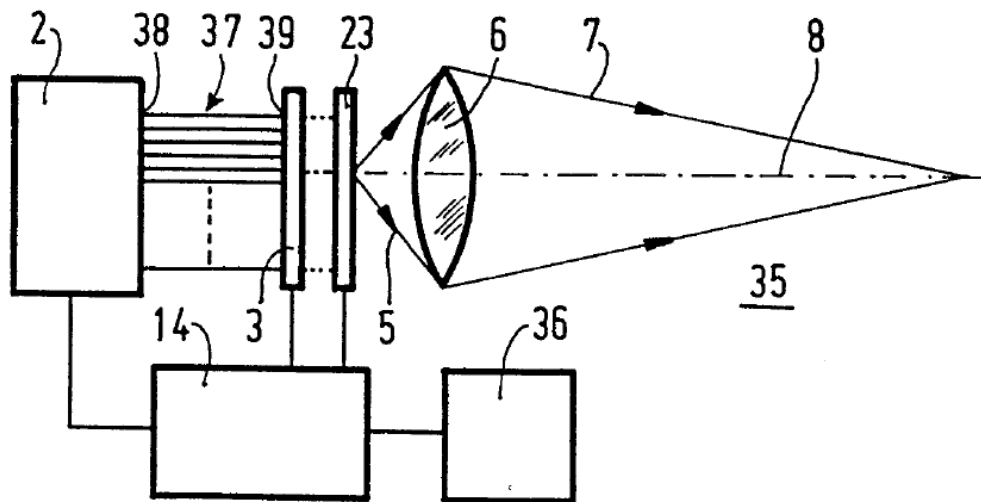


FIG. 7

EX1010, FIG. 7.

59. As shown above, Figure 7 also includes a “light modulator means 3,”

which is Karlsson's term for an SLM. EX1010, 14:35-36, 5:11-15 (discussing embodiments of light modulator means as "spatial light modulators"); EX1003, ¶263. Light modulator means 3 is positioned to control the light emitted from light source 2 (e.g., LEDs). Thus, Karlsson's Figure 7 specifically discloses to a POSA both SLMs and LEDs. *See* EX1053, 36:19-21 (Dr. Turk confirming that Figure 7 includes both an SLM and light source); EX1053, 38:15-25 (Dr. Turk agreeing that Karlsson's light source 2 can be LEDs). Karlsson's Figure 3 also includes a light source 2 and light modulator means 3, and therefore is another example of an SLM being used with LEDs. EX1010, 11:7-15, FIG. 3.

60. In summary, the First Turk Declaration, the Second Turk Declaration, and the Turk Depositions all demonstrate his lack of or mis-understanding of the functions and benefits of spatial light modulators (SLMs). Yet Dr. Turk has acknowledged that both prior art references Beam and Karlsson disclose the SLMs. He also acknowledged that Beam's microbeams and Karlsson's spotlight beams can be directed by SLMs.

VI. DR. TURK'S SUBSTANTIVE ARGUMENTS AGAINST BEAM-SATONAKA ARE INCORRECT, AT LEAST IN PART BASED ON HIS MISUNDERSTANDING OF THE ART.²

61. Dr. Turk's substantive arguments against the Beam-Satonaka combination are not correct, and I believe they are based upon his fundamental misunderstandings of the art as I have laid out above.

A. Beam's headlamp controller uses image data from its camera for glare reduction.

62. My First Declaration makes clear that Beam's video or other electrical signals produced from the images taken by Beam's camera are image data.

EX1003, ¶¶102-106, 133, 182. Dr. Turk alleges that the Petition in this proceeding did not discuss the claim term "image data" with respect to claims 33, 41, and 49.

EX2006, ¶¶100, 101, 103. This assertion is surprising to me because Dr. Turk does not disagree that Beam teaches a camera. EX1053, 80:5-10 ("It [Beam] discloses an imaging sensor such as a video camera."). And Dr. Turk also does not dispute that Beam's camera transfers image data to Beam's controller for use in determining the "corresponding position/size of microbeams" to be dimmed for glare reduction. EX2006, ¶¶53-54. Indeed, he was asked if Beam discloses image

² I understand that the '551 claim language was updated to account for changes made by a Certificate of Construction filed after the completion of my First Declaration. EX1069.

data directly:

Q. Okay. So the video or other electrical signals from the camera are used by the controller in Beam's controller 108. Correct?

A. I think so, yes.

Q. And you'd agree that the video or other electrical signals is image data. Correct?

A. Yes.

EX1053, 81:14-20 (discussing Beam, EX1005, 5:11-15, which states “[t]hey are imaged by the sensor and are converted to video or other electrical signals.”).

63. Thus, when asked about the “video or other electrical signals” that Beam discloses are sent from the camera to Beam’s controller, Dr. Turk agreed that these were image data. Indeed, Dr. Turk explains in *his* summary of Beam that “[h]eadlights of an oncoming vehicle 102 and/or taillights of a preceding vehicle 103 are transmitted through optical system 106 and detected by a sensor (camera) 107” and that “[d]ata from sensor 107 is used by controller 108.” EX2006, ¶54. So, as Beam clearly discloses and as Dr. Turk agrees, the light received from the camera used in Beam’s system is converted into image data used by Beam’s controller. Thus, Dr. Turk’s assertion that “image data” is lacking is not credible because it contradicts Dr. Turk’s own summary of Beam.

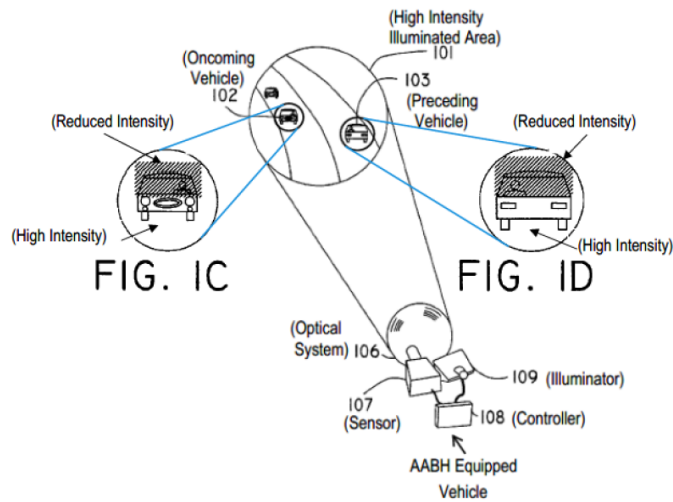
64. My First Declaration, which I understand is cited in the Petition, addressed the image data claim term. Pet., 42. As I stated in my First Declaration, “Beam selects a cluster of LEDs (the microbeams) that correspond to the known location of the target vehicle.” EX1003, ¶161. In discussing claim 32, from which claim 33 depends, I explained that “Beam’s sensor output ‘drives controller 108, which uses the data to determine the size and position of the light emitters to be dimmed’” and that “controller 108 uses the sensor data ‘to determine which microbeams must be reduced in intensity to protect the other drivers.’” EX1003, ¶¶102-106, 133, 182, 197 (citing EX1005, 5:10-15, 2:15-19). Thus, Beam discloses sending data from its sensor 107 (image data) to the controller. As I also explained, sensor 107 is an “‘imaging sensor (such as a video camera),” and “[i]mages from ‘the sensor and are converted to video or other electrical signals”” that are communicated to the controller. EX1003, ¶125 (citing EX1005, 4:32-36, 6:12-13, 5:10-13) (The incoming rays are *imaged* by the sensor 107 and are converted to video or other electrical signals used to drive controller 108, “which uses the data to determine the particular area of microbeams to be blanked.”). A POSA would thus quite clearly have understood that Beam discloses image data, that is, sensor data from the imaging sensor. Dr. Turk’s assertion ignores the straightforward explanation I included. Beam’s video or other electrical signals produced from the images taken by Beam’s camera are image data.

65. Thus, Beam teaches the image data recited in claims 33, 41, and 49 for the reasons I explained in my First Declaration. EX1003, ¶¶102-106, 133, 182, 197.

B. Beam’s camera is positioned to take an image to be used as the basis for headlamp beam pattern control as recited in claim 32.

66. Dr. Turk alleges that the Petition does not address claim 32’s limitation that the camera “capture an image of at least one target.” EX2006, ¶98. Like the previous image data element (Section VI.A), Dr. Turk’s statement seems to misunderstand the basic operation of Beam, and ignores the disclosure cited for this element. EX1003, ¶¶125-126.

67. In his summary of Beam, Dr. Turk explains that “[h]eadlights of an oncoming vehicle 102 and/or taillights of a preceding vehicle 103 are transmitted through optical system 106 and detected by a sensor (camera) 107.” EX2006, ¶54. Dr. Turk includes the following annotated image of Figures 1C-1D of Beam that shows Beam’s camera sensor 107 being positioned to detect vehicle targets. EX2006, ¶54. Dr. Turk either misunderstands or is willfully ignoring this disclosure because Dr. Turk’s own annotation shows how Beam’s camera sensor is positioned to capture images of at least one target (vehicle).



(Ex. 1005, FIG. 1C, 1D, Annotated)

EX2006, 69 (citing EX1005, FIG. 1C, 1D, annotated).

68. In my First Declaration I explained that “Beam’s ‘imaging sensor (such as a video camera) faces forward.” EX1003, ¶125 (citing EX1005, 6:12-13). I also explained how “[s]ensor 107 (the camera) is connected to processor 1105: ‘[t]he spatial scene data from sensor 107 is thresholded to eliminate weak signals and becomes the input to a processor 1105.’” EX1005, 5:34-36. “This scene data is in the form of ‘pixel[s],’ each of which have an associated ‘location’ received by the processor.” EX1003, ¶126 (citing EX1005, 5:36-39). This scene data, I explained, is “based on the presence of headlights detected by the camera.” EX1003, ¶126. Accordingly, I explained in detail how the scene data from the camera is used to detect the locations of vehicle targets by processing the specific pixels in the scene data to determine where a vehicle is in the image from the camera. EX1003, ¶126; *see* Pet., 29. Thus, Beam’s camera is positioned to

“capture an image of at least one target” as explained in my First Declaration.

EX2006, ¶98. Moreover, Beam’s disclosure of “threshold[ing] to eliminate weak signals” was a known practice to POSAs in adaptive headlamp applications.

EX1005, 5:34-36. A POSA would have known that thresholded signals for detection of taillights and headlights were used in the imaging detection and data processing when comparing to these vehicle’s daylight images for determining the location of the driver’s eyes in the preceding vehicles and oncoming vehicle.

EX1014, ¶¶26-34. This allowed the corresponding areas of headlamp beam patterns to be dimmed to avoid glare (for example, shown in Beam’s FIGs. 1C and 1D) to those drivers.

C. Beam discloses that its controller “change[s] emission” of the LEDs as recited in claim 24.

69. Dr. Turk argues that Beam-Satonaka does not teach the element “change emission of the selected cluster of LEDs relative to emission of other LEDs not included in the cluster” of claim 24 because Beam supposedly only teaches operating its LEDs at maximum intensity or no intensity (turned off).

EX2006, ¶105; EX1053, 31:4-6. Dr. Turk interprets this claim element to require that the change of emission excludes a change to zero emission, meaning Beam’s supposed on/off functionality does not meet this element. EX2006, ¶104. Dr. Turk is wrong because 1) his understanding of this term is incorrect; and 2) he misunderstands Beam’s disclosure, which does teach intermediate emission levels.

1. Dr. Turk’s understanding of claim 24 is incorrect.

70. First, Dr. Turk’s argument regarding claim 24’s “change emission” element is based on an incorrect opinion of how a POSA would understand this claim. A POSA would understand that the plain and ordinary meaning of the element “change emission of the selected cluster of LEDs relative to emission of other LEDs not included in the cluster...” requires only a change in emission relative to another emission. The plain language of this claim element does not place any restriction or requirement on what that change can be. And there is no restriction elsewhere in claim 24 that suggests prohibiting zero emission. Thus, even under Dr. Turk’s incorrect understanding (as I discuss below) that Beam’s LEDs are only at maximum intensity or off, Beam still discloses the “change emission” claim element.

71. In fact, I note that claim 25, which depends from claim 24, recites “the changed emission includes a change to at least one of intensity or color or a change of at least one LED of the cluster to *a non-emitting state*.” EX1035, 1:65-67. Claim 25 therefore requires that the changed emission in claim 24 must include a non-emitting state, or turning the LED(s) off.

72. Additionally, I note that zero emission can certainly prevent glare to other drivers, and thus meets this additional element of claim 24. I have included the instruction portion of claim 24 below:

determine coordinates corresponding to another vehicle, based on the coordinate-specific information;

select a cluster of the LEDs that emit light toward at portion of the other vehicle based on the LEDs having emission aimings associated with the first coordinates; and

change emission of the selected cluster of LEDs relative to emission of other LEDs not included in the cluster to create headlamp illumination that preserves a first level of illumination illuminating past the other vehicle while preventing glare to a driver of the other vehicle.

EX1035, claim 24, 1:51-63.

73. As shown above, claim 24 only requires that the changed emission of the selected cluster (1) be changed relative to the emission of other LEDs; and (2) prevent glare to the other driver. Zero emission would achieve both—and indeed zero emissions is included as an option in claim 25. EX1035, 1:65-67.

74. Dr. Turk’s flawed analysis relies on two pieces of evidence—extrinsic dictionary definitions and a passage in the ’551 patent that he misinterprets. First, he cites two dictionary definitions of the term “emission.” EX2006, ¶104. These definitions of the noun “emission” include, for example, “something sent forth by emitting.” EX2006, ¶104. But by relying on these extrinsic definitions, Dr. Turk fails to take into context all of claim 24, which requires only that the emission be

changed relative to the emission of other LEDs, as I discuss above. Thus, these dictionary definitions do not provide the proper understanding of the language of claim 24 when that language (quoted above) is viewed in its proper context.

75. Further, Dr. Turk’s understanding of this claim to *exclude* zero emission as a form of “chang[ing] emission” is contradicted by the ’551 patent, which refers to zero or no emission lighting in several instances. For example, when talking about room lighting, the ’551 patent states “zero or only low intensity night lighting would fall near the head of the sleeping person.” EX1001, 87:4-5; *see also* EX1001, 65:31-35, 62:48-52 (“and the lighting intensity is increased from zero power or some low level of lighting”). The ’551 patent does not change how it uses terms like intensity, meaning the room lighting intensity in this quote is used in the same manner as automotive lighting intensity. Thus, the ’551 patent itself refers to zero light intensity, which per Dr. Turk’s understanding is equivalent to zero light emissions. EX1054, 103:13-20. The ’551 patent specification, which in my opinion clearly and correctly describes how a POSA would understand the “change emission” term, thus contradicts Dr. Turk’s adoption of extrinsic dictionary definitions to suggest that emission requires some illumination level. The ’551 patent instead supports my understanding of this claim term, which is how a POSA would understand the term.

76. The second piece of evidence Dr. Turk relies on is another portion of

the '551 patent. EX2006, ¶104. In full, the '551 patent quote says: “The discrete light 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 tasks at hand.” EX1001, 19:26-30. This teaches the opposite of Dr. Turk’s understanding of claim 24’s “emission” as requiring some level of illumination, rather than just a change in illumination levels that includes zero illumination. Here, the '551 patent is stating that combinations of any or all of these three operating modes of full power, fractional power, and *no power* are used to achieve the desired lighting effect. Thus, no emission (the “not operating” mode in the quote above) is a part of the operation of the '551 patent’s system when creating the desired light pattern. This further supports the correct understanding of claim 24’s “change emission” element as *not* excluding zero emission. Thus, again, even under Dr. Turk’s incorrect understanding of Beam, Beam discloses claim 24’s “change emission” element. Furthermore, additional evidence of Dr. Turk’s lack of knowledge and experience in lighting and lighting control field is that light intensity reduction for glare control to be “zero emission” is relative to the photodetection (e.g., photocell, etc.) threshold sensitivity level. Even with some light emission while the detector can no longer detect, the output reading will show zero. Therefore, besides '551 claim element not excluding “zero emission”, Dr.

Turk's statement of "some emission" is meaningless if no photocell detection threshold is defined.

2. Beam discloses intermediate light emission, meeting Dr. Turk's incorrect understanding of claim 24.

77. To begin with, a POSA would have understood that Beam discloses independently controlling each of its LEDs. Beam discloses "an array of light sources 410 which are individually controlled," with these light sources being LEDs. EX1005, 5:4-6, 8:7; *see* EX1003, ¶¶116, 120. Beam controls LEDs individually based on sensor data, which Beam uses to "determine which microbeams [e.g., LEDs] must be *reduced in intensity* to protect the other drivers." EX1005, 4:16-19; EX1003, ¶¶125-126. As Beam explains, "the illumination in the shaded area [is] reduced significantly to protect the vision of the oncoming drivers." EX1005, 4:21-25. In other words, the controller "uses the data [from sensor 107] to determine the size and position of *the light emitters to be dimmed*." EX1005, 5:13-15; EX1003, ¶¶133-134, 138. To a POSA, phrases in Beam such as "reduced in intensity," "reduced significantly," and "light emitters to be dimmed" mean a reduction in intensity that includes intermediate, reduced illumination values, not solely zero illumination.

78. Dr. Turk's summary of Beam in his Second Turk Declaration comports with this understanding. He describes Beam as controlling its microbeams to be "significantly reduced in intensity" to control glare and that

glare reduction “is accomplished by diming one or more of the LEDs.” EX2006, ¶¶54, 57. Thus, Dr. Turk appears to agree with my explanation of how Beam functions with respect to dimming its LEDs. I note that in his deposition for the related ’029 patent, Dr. Turk also stated that “attenuation” of light, a related term, as recited in Beam “means decreased,” not reduced to zero illumination. EX1054 95:6-23. Dr. Turk was also asked “[i]n the ’551 patent here, is it your understanding that ‘off’ and ‘dimmed’ mean the same thing,” to which he answered “[n]ot necessarily, no.” EX1053, 57:10-12; 58:10-59:16. A POSA would not have thought that “dimmed” and “off” are used differently in the context of lighting in Beam versus the ’551 patent, and Dr. Turk does not explain why this would be the case.

79. Dr. Turk’s own analysis of the claim language supports my explanation of Beam. In discussing claim 24 Dr. Turk reasons that the term “emission” requires some type of level of emitted light. EX2006, ¶¶104-105. While Dr. Turk is incorrect for the reasons I discuss above (Section VI.C.1), Dr. Turk’s understanding of emission supports my position that Beam discloses intermediate light emissions. Beam uses the same language (e.g., “dimmed”), in the same technological field, as the Dr. Turk uses in his argument to require intermediate, dimmed light. A POSA would not find that these words are being used differently in Beam versus in the ’551 patent. For example, Beam discloses

“the illumination in the shaded area being reduced significantly to protect the vision of the oncoming drivers.” EX1005, 4:23-25. The word “illumination” is actually found in claim 32, where Dr. Turk reasons that illumination requires some light be present. EX2006, ¶¶107-108. Applying Dr. Turk’s reasoning, Beam’s discussion of illumination therefore means there is some level of illumination (albeit reduced) in Beam’s darkened areas. This further shows that Beam discloses intermediate, non-zero light levels that disclose the elements of claim even under Dr. Turk’s incorrect understanding. *See also* EX1001, 19:26-30 (disclosing that LED lighting, such as the LEDs used in Beam, can have three operating modes, including full, partial, and zero illumination).

D. Beam discloses the “diminished illumination” of claim 32.

80. I note that the substance of Dr. Turk’s argument here is similar to the argument for claim 24—namely that claim 32 excludes zero illumination as a diminished illumination. EX2006, ¶¶106-108. Dr. Turk is incorrect for the same reasons I discussed above. Section VI.C.

1. Dr. Turk agrees that the relevant part of claim 32 describes a similar concept discussed in the previous section on claim 24.

81. In claim 32, the relevant claim language is “diminished illumination” instead of “change emission” of claim 24. A POSA would have readily understood that these terms are patentably indistinct in view of Beam because they both are

reciting a change in lighting. EX1003, ¶¶157-159. Indeed, even Dr. Turk agreed that “the phrase in claim 24 change emission of a selected cluster of LEDs relative to the emission of other LEDs is describing the same thing as the diminished illumination in claim 32.” EX1053, 61:7-13. Because diminished illumination is “describing the same thing” as the change of emissions, Beam renders this claim element obvious. EX1053, 61:7-13.

2. Dr. Turk’s understanding of claim 32 is incorrect.

82. As in claim 24, Dr. Turk misunderstands the language of claim 32 to require some level of non-zero illumination. EX2006, ¶106. The relevant portion of claim 32 recites “create a beam of diminished illumination.” Claim 32 does not exclude zero illumination for the “beam of diminished illumination.” And there is no portion of claim 32 that requires the diminished illumination to have any specific positive value. In my opinion, a POSA would have understood the plain meaning of “diminished illumination” to include zero illumination, which Dr. Turk does not dispute is taught by Beam. EX2006, ¶105.

83. In fact, I note that claim 33, which depends from claim 32, recites “the one or more changes to characteristics of the first light include a change to at least one of intensity or color or a change of at least one LED of the cluster to a non-emitting state.” EX1035, 3:32-33. Claim 33 therefore requires that the changes to the first light that creates the diminished illumination must include a non-emitting

state, or turning the LED(s) off.

84. The '551 patent supports this understanding of this claim term. While the '551 patent does not use the term “diminished illumination” outside of claims, it does discuss the concept of zero intensity. For example, the '551 patent states that “zero or only low intensity night lighting would fall near the head of the sleeping person” in the context of room lighting. EX1001, 86:68-87:5. Thus, the '551 patent shows that a POSA would not have found that discussing zero intensity of light is a contradiction, as Dr. Turk argues. EX2006, ¶106.

85. Similarly, the '551 patent also states that “the lighting intensity is increased from zero power or some low level of lighting,” showing that zero lighting level is not, as Dr. Turk argues, a contradiction. EX1001, 62:47-52. Both of these passages in the '551 patent support my position that a POSA would understand intensity as including zero or no light. This teaching applies to “diminished illumination” because a POSA would understand that the '551 patent’s discussion of reduced intensity as including zero illumination applies equally to diminished illumination. Indeed, the underlying concept is the same, as Dr. Turk acknowledged in his deposition. EX1001, 65:31-35, 62:48-52, 87:4-5; EX1053, 71:11-16. And, my analysis above regarding the inclusion of no emission as part of the '551 patent’s lighting control scheme applies equally here. Section VI.D.1 (citing EX1001, 19:26-30). Thus, Dr. Turk’s interpretation of “diminished

illumination” to exclude zero illumination is wrong, meaning that Beam discloses this element.

3. Beam discloses intermediate light emission, meeting Dr. Turk’s incorrect understanding of claim 32.

86. As I discussed above, Beam does teach intermediate reduced or dimmed lighting levels from its LEDs in its headlamp when accomplishing its glare reduction operations. Section VI.D.2; EX1005, 4:18-25, 5:4-6, 5:13-15; EX1003, ¶¶116, 120, 125-126, 133-134, 138. Thus, even under Dr. Turk’s incorrect understanding of diminished illumination, Beam discloses claim 32.

E. Beam discloses the “decrease[d] intensity” of claim 40.

87. I note that the substance of this argument is similar to the arguments for claims 24 and 32 by Dr. Turk—namely that claim 40 excludes zero illumination as a decreased intensity. EX2006, ¶¶109-111. Here, the relevant part of claim 40 is “wherein the first and second changes *decrease intensity of first emission* from the first cluster *and second emission* from the second cluster relative to a third emission.” EX1035, 5:1-4. Instead of “change emission” (claim 24) or “diminished illumination” (claim 32), the relevant language is “decrease intensity.” Like diminished illumination, decreased intensity is a type of changed emission, meaning the same argument applies. Again, Dr. Turk’s opinions are wrong for at least the same reasons I discussed above for claims 24 and 32. Sections VI.C, VI.D.

1. Dr. Turk agrees that the relevant language in claim 40 is “referring to the same concept” as in claim 32.

88. A POSA would have readily understood that “decrease intensity” in claim 40 is patentably indistinct from the “diminished illumination” of claim 32 with respect to Beam because they both are reciting a change in lighting. Dr. Turk agreed that the “decrease intensity” language in claim 40 is similar to the language I discussed above in claims 24 and 32:

Q. Claim 32, was the term “diminished illumination,” and claim 40, was the term “decreased intensity of first emission,” is there a difference between those two terms?

A. I think they’re referring to the same concepts here in these two instances. EX1035, 7:11-16. Because diminished illumination is a changed emission, a POSA would have therefore understood that decreased intensity is also a changed emission. Thus Beam also renders this claim element obvious. EX1035, 7:11-16.

2. Dr. Turk’s construction of claim 40 is incorrect.

89. As in claims 24 and 32, Dr. Turk misunderstands the language of claim 40 to require some positive, non-zero illumination. EX2006, ¶109. The relevant portion of claim 40 states “decrease intensity of the first emission.” Claim 40 does not prohibit zero illumination. And there is no portion of claim 40 that requires the decreased intensity to have any specific positive value. In my opinion, a POSA would have readily understood the plain meaning of decrease intensity to

include zero illumination, which Dr. Turk does not dispute is taught by Beam.

EX2006, ¶105

90. In fact, I note that claim 43, which ultimately depends from claim 40, recites “least one of the first or second change to characteristics of the associate with at least one of the first or second cluster of LEDs includes at least one of a change to color, to intensity, or a change of at one LED of the respective cluster to a non-emitting state.” EX1035, 5:43-47. Claim 43 therefore requires that the first or second changes to decrease intensity includes or turning the LED(s) off. The ’551 patent supports this correct understanding of this claim term. While the ’551 patent does not use the term reduced intensity, it does discuss the concept of zero intensity in several places. For example, the ’551 patent states that “zero or only low intensity night lighting would fall near the head of the sleeping person” in the context of room lighting. EX1001, 86:67-87:5. In another section, the ’551 patent states that “the lighting intensity is increased from zero power or some low level of lighting.” EX1001, 62:48-52. Both of these quotes support my understanding of intensity as including zero or no light, meaning that a decrease in intensity can include zero light intensity. Thus, in my opinion, Dr. Turk’s understanding of this claim term to exclude zero illumination is wrong. Under this correct understanding, Beam discloses this element even assuming Dr. Turk’s flawed understanding of Beam as only turning its LEDs off is correct.

3. Beam discloses intermediate light emission, meeting Dr. Turk's incorrect understanding of claim 40.

91. As I discussed above, Beam does teach intermediate reduced or dimmed lighting levels when accomplishing its glare reduction operations. Section VI.D.2; EX1005, 4:18-25, 5:4-6, 5:13-15; EX1003, ¶¶116, 120, 125-126, 133-134, 138. Thus, even under Dr. Turk's incorrect understanding of diminished reduced intensity, Beam discloses claim 40.

F. "Classifying" objects in order to control headlamp light emission, as recited in claim 48, was known in the art.

92. Dr. Turk argues that the element "the first light determined based at least in part on classifying the object based at least in part on the data" is not addressed by the Petition (EX2006, ¶102) or taught by Beam-Satonaka (EX2006, ¶¶112-113). This is incorrect.

1. Beam teaches "classifying" objects in the headlamp lighting control context per the plain and ordinary meaning of this term in claim 48.

93. Dr. Turk's argument regarding the "classifying" limitation of claim 48 is that "Beam does not disclose identifying a particular target associated with the predetermined area around the illumination sources." EX2006, ¶112. Dr. Turk later alleges that "Beam does not associate the detected light with a particular target" and that Beam cannot determine "whether detected light is a new position of a previously detected target, or a new target." EX2006, ¶113. Dr. Turk explains his argument in the context of a hypothetical example of a headlight system

distinguishing between a sign reflecting light and a vehicle. EX2006, ¶113. Per Dr. Turk, this example shows that the system of claim 48 can identify the type of target and thus illuminates the sign while reducing illumination to the vehicle. EX2006, ¶113.

94. Dr. Turk uses words like identifying a “particular target,” the concept of determining whether a target is a “previously detected target, or a new target,” and then provides his example of differentiating between a sign and a vehicle to explain what he believes this portion of claim 48 requires. EX2006, ¶113. When asked about his understanding of “classifying” in claim 48 during his deposition, for the first time Dr. Turk stated that it means “to perform multi-class classification or recognition or determining the identity of an object.” EX1053, 82:15-19. He defined multi-class classification as “distinct from detection or verification” and meaning that the classifying “can be multiple things.” EX1053, 82:20-83:2. I note that the term “multi-class classification” does not appear in the Second Turk Declaration or in the ’551 patent.

95. Dr. Turk’s understanding of claim 48 is incorrect. *See* EX2006, ¶113. There is no discussion of separating targets into different categories or classes in claim 48, or even in the ’551 patent as a whole. EX1053, 83:3-84:2. And there is no discussion of storing targets between each subsequent light detection in claim 48. Finally, there is no mention of multi-class classification in claim 48. Dr. Turk

does not provide any explanation of how any part of claim 48, much less the “classifying” element, requires these additional, unrecited steps. EX2006, ¶113.

96. Indeed, a POSA would have understood the plain and ordinary meaning of “classifying” in claim 48 as simply placing the detected objects into categories or classes. While in my opinion this term does not require a specific definition, I note that the verb “classify” is defined as “arrange in or assign to classes.” EX1055. In the context of the technology here and claim 48, a POSA would understand that Beam discloses “classifying” because its algorithm differentiates between illuminated objects that are above and below a threshold, and more specifically it classifies the preceding vehicles with taillights, and the oncoming vehicles with headlights. EX1005, 4:9-16; EX1003, ¶191.

97. As I explained in my First Declaration, “Beam’s system determines a location of the other traffic (via headlights or taillights) using the coordinate-specific information (the video data from the camera).” EX1003, ¶186. In Beam, “[t]he spatial scene data from sensor 107 is thresholded to eliminate weak signals and becomes the input to a processor 1105.” EX1005, 5:34-36. This means that objects detected by the sensor are separated into two classes: those that reflect or emit light above the threshold, and those that do not reflect or emit sufficient light. This meets the plain meaning of claim 48’s element “the first light determined based at least in part on classifying the object based at least in part on the data”

because Beam is modifying its light based on this thresholding classification.

EX1003, ¶184; EX1005, 5:34-36.

98. I note that the fact that these objects are all detected by Beam's camera means they are some (known or preset) types of light emitting or reflecting objects, because the camera (at night) cannot detect objects that do not emit or reflect light. EX1003, ¶186. Thus, a POSA would have understood that Beam's system classifies objects at least in its thresholding step.

2. “Classifying,” even per Dr. Turk’s interpretation, was disclosed by Beam and known in the art.

99. Even under Dr. Turk's interpretation, claim 48's classifying element was known in the prior art. As this section explains, the art discloses this multi-class classification as Dr. Turk interprets this claim. It would have been obvious to include the multi-class classification as part of its image processing because doing so would allow Beam to adapt its light to different object classes. For example, glare reduction could be adjusted to account for regular size vehicles, large trucks, or motorcycles, which all have different driver positions. This allows the dimmed area to be made smaller, which improves the lighting elsewhere in the beam pattern, where the light is not dimmed. First, in my opinion a POSA would have understood that the thresholding I discuss above in Beam classifies objects even under Dr. Turk's understanding of multi-class classification. Section VI.F.1; EX1005, 5:34-36. When Beam performs its thresholding function, it is separating

objects into different classes (above and below the threshold), as I describe above.

Section VI.F.1. This would have the effect of separating or distinguishing, for example, sign lighting, roadway lighting, and other ambient lighting from vehicle headlights/taillights, because the other non-vehicle lighting will not be as bright as the light coming from an oncoming vehicle's headlight or a preceding vehicle's taillight. Headlight and taillight detection are examples of Beam's disclosed thresholds that classifies the object as an oncoming vehicle or a preceding vehicle. EX1005, 4:9-16. Thus, Beam discloses multi-class classification, which is Dr. Turk's mistaken understanding of the classifying term.

100. Second, Beam's disclosure here is not surprising because the '551 patent only mentions classifying once, stating:

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, Chis Bishop, Oxford University Press; (January 1996) included herein by reference.

EX1001, 44:67-45:9.

101. When asked about this passage, Dr. Turk agreed that the classifying techniques were known in the art. EX1053, 84:25-85:3. Indeed, Dr. Turk acknowledged that he was familiar with the Bishop text mentioned in this passage. EX1053, 84:21-84:25. I note that the first section of the first chapter of Bishop describes a classification example that separates handwritten letters into the categories of the letters “a” and “b,” and continues on to expand that example to a classification of all 26 letters of the alphabet. EX1061, 1-5. As I understand Dr. Turk’s explanation, this type of classification is a multi-class classification. Thus, the ’551 patent itself admits that classifying was known even under Dr. Turk’s narrower interpretation.

102. Third, as further support that a POSA would have readily understood that classifying as Dr. Turk describes is known in the art, Satonaka teaches classifying detected vehicles into either oncoming vehicles (vehicles in the opposite lane of travel) or preceding vehicles (vehicles in the same lane of travel). EX1014, ¶12; EX1003, ¶¶107-108. For example, Satonaka states that “[t]he vehicle headlamp device of the invention described in Claim 2 is provided with an assessment means that assess whether the other vehicle traveling in front of the vehicle concerned is a preceding vehicle or an oncoming vehicle.” EX1014, ¶12; EX1003, ¶¶107-108. Once these two types of vehicles are classified, Satonaka teaches providing different lighting outputs to improve glare reduction and

headlamp performance. EX1014, ¶¶12, 48; EX1003, ¶¶107-108.

103. In summary, Dr. Turk’s overly narrow understanding of classifying was known in the art in general, and disclosed by both Beam and Satonaka in particular. I also note that Dr. Turk does not dispute that Karlsson teaches this element, which further reinforces my position here.

G. Beam discloses the “non-contiguous LEDs” of claims 25, 27, 33, 35, 41, 43, 49, and 51.

104. Dr. Turk argues that the Beam grounds do not teach the “non-contiguous LEDs” limitations recited in claims 25, 27, 33, 35, 41, 43, 49, and 51. EX2006, ¶¶114-118, 150. Dr. Turk did not present any technical argument against my explanation of how the combinations teach this element (*see* EX2006, ¶¶114-118, 150), and in his deposition agreed that there is no technical issue with the explanation regarding this element in my First Declaration. EX1053, 100:3-101:6 (“I think that's correct, they would not be contiguous. At least in the way it appears to be shown here [in Beam’s Figures 1].”). Instead, his argument focuses on an incorrect interpretation of the claims.

1. Dr. Turk agrees with my explanation of how Beam teaches non-contiguous LEDs.

105. In my First Declaration, I explained that Beam discloses non-contiguous LEDs being dimmed to reduce glare when Beam creates multiple darkened areas to address multiple vehicles. EX1003, ¶¶149, 164, 183, 198;

EX1005, 2:62-265, FIGs. 1-1D; *see* Pet., 36-37. This is the case because target vehicles are typically spatially separated, meaning the corresponding dimmed LEDs would also be spatially separated and thus non-contiguous. EX1003, ¶¶149, 164, 183, 198; EX1005, 2:62-265, FIGs. 1-1D. When asked if he agreed with this analysis, Dr. Turk stated that “I think that’s correct, they would not be contiguous.” EX1053, 100:3-101:6. Thus, there is no technical dispute regarding the non-contiguous LEDs element.

2. Dr. Turk’s analysis of the non-contiguous LEDs element relies on a flawed interpretation of the claims.

106. Instead of disagreeing with my technical analysis, Dr. Turk argues that this feature requires “the cluster being used to control light [be] directed to a singular ‘other vehicle.’” EX2006, ¶115. Dr. Turk’s interpretation is incorrect because the claims do not limit the cluster to being directed at only one vehicle.

107. In full, the relevant claim language recites a cluster, which is first introduced in claim 24: “select a cluster of the LEDs that emit light toward at least a portion of the other vehicle.” And the relevant feature in the example of claim 25 is “the cluster includes non-contiguous LEDs.” The plain language of this claim only requires that the cluster include LEDs that emit light toward at least a portion of the other vehicle. There is no restriction on the cluster having additional LEDs associated with a second vehicle. Further, I understand that these claims use the “comprising” language that means they are inclusive, not exclusive, in nature.

Thus, in my opinion a POSA would not have understood this claim element to restrict the cluster to a single vehicle.

108. This correct understanding of the non-contiguous LEDs claim element 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*.” EX1001, 53:30-34. Here, a POSA would have readily understood that glare reduction is a function, and thus the cluster in these claims can encompass the glare reduction LEDs, including those that are non-contiguous. EX1053, 93:10-20 (Dr. Turk agreeing that clusters can be defined by a control function). Further, the '551 patent states that clusters “may overlap and be discontinuous,” confirming that the cluster itself can be discontinuous, which in the context of the '551 patent a POSA would understand means physically separated, or non-contiguous. EX1001, 53:36-37. Thus, Dr. Turk’s interpretation of the claims is incorrect, and Beam discloses the non-contiguous LEDs claim element. EX1003, ¶¶149, 164, 183, 198; EX1005, 2:62-265, FIGs. 1-1D.

H. Beam discloses optical control elements.

109. Claims 30, 31, 38, 39, 46, 47, 54, and 55 recite that the claimed illuminating device includes “optical control elements.” In my First Declaration, I explained that “Beam discloses ‘output from the active emitters [the LEDs] is projected through optical system 106.’” EX1003, ¶151 (citing EX1005, 5:15-16). I

also noted that Beam discloses these claims because of its “spatial light modulator 203.” EX1003, ¶151 (citing EX1005, 4:26-59, 5:17-21, 8:4-12, 1:63-65, FIGs. 2, 5).

110. Dr. Turk argues that Beam does not disclose this element for two reasons. First, he argues that the relevant embodiment of Beam does not include a spatial light modulator. EX2006, ¶119. But this is incorrect as I explained above, and as specifically taught by Beam, which recites LEDs and a spatial light modulator being present in the same device. EX1003, ¶151; EX1005, 8:1-12 (“wherein said light source [is] selected from the group consisting of light emitting diodes...and a special light modulator.”); Section V.B. Dr. Turk does not otherwise dispute that the spatial light modulator is an optical control element. EX1053, 91:1-3 (“Q. A special [sic] light modulator or SLM is an optical control element, correct? A. It can be considered that, yes.”).

111. Second, Dr. Turk disagrees that optical system 106 is an optical control element because he argues that my citations to Beam in my First Declaration were to the background section. EX2006, ¶121. This is incorrect. I cited to Beam’s invention disclosure at column five when discussing optical system 106. EX1003, ¶153 (citing EX1005, 5:17-21 (“an illuminator comprising lamp 202 and spatial light modulator 203, sensor 107, and optical system 106 are mounted to a unitized housing 701.”). I then explained that based on that disclosure

“[a] POSA would have understood, or at least found it obvious, that optical system 106 is a system that redirects input light to form a desired light output distribution, which is the definition of ‘optical system’. Such system includes reflective, and/or refractive features based on well-known geometric optics principles.” EX1003, ¶153. Having these reflective and/or refractive features means optical system 106 includes reflectors (for the reflective function) and refractors (for the refractive function). Thus, Dr. Turk’s argument here is based on a misunderstanding of Beam and mischaracterization of my opinion. Beam discloses the optical control element claims for the reasons I discussed in my First Declaration. *See also* EX1003, ¶¶70-78, 151-154.

I. It would have been obvious to a POSA to modify Beam in view of Satonaka.

112. Dr. Turk alleges that a POSA would not have modified Beam in view of Satonaka. He is wholly wrong on this point. Below I briefly summarize key points of the extensive rationales I provided for the Beam-Satonaka combination (*see* EX1003, ¶¶70-81, 101-110, 129-131) before I address the flaws in Dr. Turk’s analysis.

113. As I state in my First Declaration, in my opinion a POSA would have understood that Beam discloses every element of the claims of Ground 1. EX1003, ¶¶101, 104-106. However, to make the coordinate teachings of Beam clear, I combine Beam with Satonaka to provide the additional algorithmic concepts that

Beam does not teach in detail. EX1003, ¶¶101, 104-106. As I explained, “[t]his would have expressly provided the algorithm details that already exist implicitly in Beam’s system, therefore allowing the position of the headlights to be determined based on the coordinates of the pixels that are processed per Beam’s algorithm to determine the locations to be “blanked.” EX1003, ¶106; EX1005, 2:53-56, 4:9-25, 5:33-48, 8:27-28; EX1014, ¶¶25-44.

114. My combination does not change the hardware in Beam. Nor do I propose changing how Beam functions overall. Instead, my combination involves only simple software modifications, to the extent any are necessary, in view of Satonaka’s detailed algorithmic teachings. EX1003, ¶¶101-110, 129-131. As modified, Beam would continue to function the same way and provide illumination with reduced glare. Dr. Turk’s arguments regarding how Beam would function and the alleged inoperability of modified Beam are wrong for the reasons I discuss below.

1. While Dr. Turk argued in the First Turk Declaration that Beam-Satonaka would not function, he now no longer disputes that Beam-Satonaka would function.

115. I read Dr. Turk’s argument in the First Turk Declaration that Beam would not function when combined with Satonaka with considerable disbelief. Specifically, Dr. Turk stated that:

[e]ven if one were to combine Satonaka’s image processing software

with Beam's lamp co-located sensor, Petitioner fails to explain how an image from Beam's co-located and boresighted camera would be used by Satonaka's vehicle recognition zone image processing strategy that is based on a remote camera located at the top center of the windshield located at the top center of the windshield and that expressly defines subsequent processing from the visual perspective that provides.

EX2001, ¶27. This argument has no merit because adjusting for a simple change in viewpoint would have been a basic task for any POSA. EX1003, ¶¶101-110, 129-131; EX1005, 2:53-56, 4:9-25, 5:33-48, 8:27-28; EX1014, ¶¶25-44. Indeed, Satonaka discloses interpreting the image from its camera to define the proper vehicle recognition zone because the image from the camera is not coextensive or the same as the area where glare reduction is needed (the illuminated field of view of the driver). EX1014, ¶¶27-34. To take Dr. Turk's argument in the First Turk Declaration at face value would mean that any change in camera viewpoint would require entirely new processing algorithms. This is certainly not the case.

116. In the Second Turk Declaration, Dr. Turk backs away from his initial opinion and now admits that modified Beam would function, although he alleges "it would not work well in real-world conditions." EX2006, ¶148. I disagree with Dr. Turk's qualification, but concur that Beam would function as modified by

Satonaka.

2. **Dr. Turk bases his arguments on an undeniably flawed “test” that he did not perform himself and the details of which he did not even know.**

117. The basis of Dr. Turk’s arguments against the Beam-Satonaka combination are a “test” he discusses in his Second Turk Declaration. The Second Turk Declaration includes three photos that he argues illustrate three different camera viewpoints. EX2006, ¶¶141-143. The central photo supposedly represents Satonaka’s camera viewpoint, while the left and right photos purportedly represent Beam’s camera viewpoints. EX2006, ¶143. I have reproduced these images below for reference.



EX2006, 118.

118. I address the substance of Dr. Turk’s arguments that are based on these images below. First, I will address the unsoundness of the test conditions and its alleged results as a basis for Dr. Turk’s opinions. In short, in my opinion, this test provides no meaningful data or support for Dr. Turk’s opinions. Indeed, in my

opinion, a POSA would not rely on this data to draw any conclusions because of the numerous flaws with this test.

119. Regarding the setup used to create the photos above, Dr. Turk provides a single paragraph where he alleges he “supervised a test to evaluate the impact of this viewpoint shift using two vehicles.” EX2006, ¶141. He explains that “[a] digital camera was placed at multiple locations” on the vehicles to simulate the viewpoints of Beam and Satonaka’s cameras. EX2006, ¶141. He provides approximate measurements for the position of the cameras with respect to the road surface and each other. EX2006, ¶141.

120. During his deposition, Dr. Turk was asked to explain the setup in further detail. I have included several excerpts of that discussion below because I think these excerpts speak for themselves and show the flaws in this supposed experiment:

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 personal who took those.

Q. So you don't know who took those three pictures that are in there -- in your declaration there right before paragraph 143; is that correct?

A. I 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. In paragraph 141, you reference a "first vehicle." Do you see that?

A. Yes.

Q. And that first vehicle, does that represent the vehicle from which the photos were taken.

A. Yes, that's what that's describing.

Q. Okay. What kind of vehicle was that?

A. I don't recall.

Q. Do you know whose vehicle that was?

A. No, I don't.

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.

EX1053, 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 different 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.

EX1053, 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.

EX1053, 110:10-14.

121. In my opinion, these passages in both the Second Turk Declaration

and his deposition for the '551 patent demonstrate that this “test” was not conducted according to any scientific standards or engineering basis. In fact, Dr. Turk was not even present when these photos were taken, and his deposition testimony shows that he knows almost nothing about the specific setup used to take these images. EX1053, 104:22-110:14. Indeed, he stated that he could not recall if he had even communicated with the person who took the photographs. EX1053, 106:7-15. Dr. Turk also claims in the Second Turk Declaration to have “supervised” this test, but he then admitted that he only “signed off on what we actually decided to spend time and effort to do” and that signed off means “[j]ust that we discussed it...I sort of had the final word, I guess, in terms of what would be useful to make the points I wanted to look into.” EX1053, 103:17-104:21. This is not how any POSA, let alone expert, would have set up a test of this type, and certainly not the type of test a POSA or expert would rely on to support any conclusions.

122. Beyond Dr. Turk not being present and being unable to explain any details of the setup of this so-called test, there are numerous flaws from a basic science and engineering perspective. Dr. Turk could not explain how the camera was placed to take the pictures beyond the vague measurements of camera position he included in the Second Turk Declaration:

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.

EX1053, 109:17-110:3.

123. There is no explanation of why the host vehicle and target vehicles were positioned in the way they were (e.g., distances from each other). There is no explanation of the spatial positions selected for the camera, and indeed Dr. Turk acknowledges that these distances would change if the vehicle type changed.

EX1053, 109:10-16. If it is important for the camera positions to be defined for each photo, as Dr. Turk claims, it is difficult to understand the lack of specificity of the camera's locations. There is no discussion of why this particular road profile, which, based on the background of the photos includes a curve, was selected.

124. Dr. Turk's analysis based on the images focuses on the viewpoint shift in these images. EX2006, ¶¶141-148. Without at least the information above, a POSA would not even be able to verify that there actually is an effect caused by a supposed viewpoint shift, much less use that effect as the basis for analysis as Dr. Turk has done. And, Dr. Turk cannot confirm any of the minimal details he

included in the Second Turk Declaration because he was not present when the images were taken, and apparently has not even spoken with the person (or people) who took the pictures. In fact, it seems to me that Dr. Turk knows almost nothing about these images, which I find discrediting given that they are the sole supporting evidence for an argument in the Second Turk Declaration.

125. It appears that Dr. Turk believes that the driver's viewpoint relating to the camera position is critical in Satonaka's disclosure for "processing an image." EX2006, ¶140. This is false and a misunderstanding of the imaging detection and process in the Beam-Satonaka combination. First of all, both Beam and Satonaka teach image detection for other vehicles on the road, and both disclose the image processing for determining the other vehicles' positions relative to the driver's viewpoint. EX1005, 4:50-53, EX1014, ¶¶16, 37. Second, from a POSA's point of view, when a camera is used for such image detection, the camera's location relative to driver's viewpoint, (e.g., if the camera is located inside of a headlamp or near the rearview mirror) is not important. EX1003, ¶¶79, 108, 120, 127; EX1005, 4:9-59; EX1014, ¶¶16, 37. Wherever the camera is located on the vehicle, a simple calibration for camera location versus driver's viewpoint would be conducted to carry on the image processing. A POSA would have readily understood that there is no set or fixed camera location to driver's line of sight location in real-world situations – vehicle geometries are different from vehicle model to vehicle model.

A POSA would understand that integrating Satonaka's map data related algorithm into Beam's imaging process was straightforward. This was explained in detail in my First Declaration (EX1003, paragraph 128): "Satonaka's algorithm uses coordinates to quantify the spatial locations of detected headlights in a similar system" (citing EX1003, Section IX.A.2; EX1014, ¶¶25-44). Like Beam, Satonaka's system detects headlights and processes the resulting camera image to determine the location of those headlights using X, Y coordinates for each pixel. EX1014, ¶¶25-44; EX1005, 4:9-59, 5:29-54.

126. In summary, Dr. Turk's so-called test was not based on any repeatable technique or theory. There was no engineering rationale, analyses, or calculations presented. For example, when the camera location changes, what are the calculated or estimated errors introduced when applying Satonaka's algorithms if correction or calibration is used? Determining any potential errors in the results is impossible without further information, which Dr. Turk does not provide. In my opinion, no POSA or expert would have accepted this so-called test because it does not provide any meaningful results, much less a majority of POSAs in the relevant community.

127. In my opinion, a POSA or expert would not base any analysis on Dr. Turk's images because of the apparent lack of any proper scientific procedure or real-world engineering basis for the captured images in the test.

3. Dr. Turk's analysis is flawed regardless of the evidence used to support the analysis.

128. Dr. Turk uses the photographs from the “test” to support his conclusion that modified Beam would not function well in detecting targets for glare reduction. EX2006, ¶¶143-149. As I noted above, these photos are the result of a flawed test, meaning his entire argument is based on flawed data and is therefore unsupported.

129. However, regardless of the flaws of the supporting evidence, Dr. Turk's analysis is still wrong for two reasons. First, Dr. Turk alleges that it is the perspective change between Beam's and Satonaka's cameras that causes reduced performance. EX2006, ¶143 (“Regardless, a camera located in either [headlamp] location has limited functionality regarding detecting a preceding vehicle.”). The flaw with this reasoning is that Beam already has headlamp cameras, which are not changing their position or function in the Beam-Satonaka combination. Dr. Turk appears to be comparing performance between Beam and Satonaka, which is not relevant because Beam's hardware is not being modified in view of Satonaka. Beam's cameras' viewpoints are not changing before and after the modification, which does not alter Beam's hardware in Grounds 1 and 2, including its cameras. This means that Dr. Turk's viewpoint changing analysis is irrelevant because Beam's camera viewpoints do not change in the Beam-Satonaka combination.

130. To the extent Dr. Turk is arguing that modifying Beam's software in

view of Satonaka somehow reduces performance, that argument misunderstands the modification. Beam is being modified only to include the known concept of coordinate mapping to the extent Beam does not disclose that concept. EX1003, ¶¶104-106. Dr. Turk's analysis assumes, incorrectly, that every detail of Satonaka's algorithm would be incorporated in Beam and that incorporating those details would worsen the performance of Beam. As I explained, Beam is only being modified with the algorithmic details related to the "coordinates of the pixels as taught by Satonaka." EX1003, ¶106. Dr. Turk bases his analysis in part on alleged problems that the change in perspective would cause to the portion of Satonaka's algorithm that detects the lane markers. EX2006, ¶142. But I never stated that a POSA would have included that part of Satonaka's algorithm in modified Beam, making Dr. Turk's argument irrelevant. Further, Dr. Turk takes a distorted view of the combination because he assumes that a POSA would not use any of their knowledge to adapt the concepts from Satonaka into Beam's system. A POSA would have been motivated to modify Satonaka's algorithm details and concepts to adapt them to Beam's viewpoint, which would include adapting the algorithm to maximize detection of objects like lane markers. EX1003, ¶¶101-110, 129-131; EX1005, 2:53-56, 4:9-25, 5:33-48, 8:27-28; EX1014, ¶¶25-44. Thus, Dr. Turk's analysis is flawed.

131. The second reason Dr. Turk's analysis is flawed is because he bases

his conclusions on differences in the vehicle detection windows shown in red in the photos (included again below for reference). EX2006, ¶¶147-148. Dr. Turk explains that the red shapes in the left and right photos, which allegedly correspond to Beam's cameras, are distorted and would reduce sensitivity of the system to detect vehicles. EX2006, ¶¶147-148.



EX2006, 120.

132. But the red shapes shown above do not reflect how modified Beam would detect vehicles. As I have stated previously, the modification of Beam implements the concepts of Satonaka with respect to the coordinate mapping into Beam to the extent necessary. EX1003, ¶¶101, 104-106. The modification does not change how Beam functions in general, which includes that Beam continues to detect potential targets in its illuminated field of view. EX1003, ¶¶103-106. Indeed, modifying Beam to exclude detecting vehicles in the illuminated field of view would not make sense to any POSA because that detection is the basis for the operation of Beam. EX1005, 4:9-30; EX1003, ¶73. And, I note that Satonaka

teaches the same concept. EX1014, ¶¶27-33. Thus, the red shapes in the photos are not accurate because modified Beam would detect vehicle targets in the illuminated field of view, just as Beam discloses. EX1005, 4:9-30; EX1003, ¶73. Thus, Dr. Turk's analysis is flawed for this additional reason.

133. As a final comment, I note that Dr. Turk states that "Satonaka does not include a mapping of coordinates to LEDs or lights in general" in his motivation to combine argument section. EX2006, ¶144. Yet Dr. Turk does not challenge the disclosure of the coordinates recited in the claims in any other section, so he does not appear to dispute that this claim term is not met. Regardless, his assertion is wrong because Satonaka does map its coordinates to its headlamp lights when it processes the pixel coordinates to determine how to alter its light beam pattern. EX1014, ¶¶25-34; EX1003, ¶¶79-81.

134. In summary, Dr. Turk's substantive arguments against Beam-Satonaka in the First Turk Declaration, the Second Turk Declaration, and '551 patent Deposition misunderstand Beam, the '551 patent claim language, and my reasoning in my First Declaration. His analysis is fatally flawed and my opinion remains that Beam-Satonaka renders obvious the challenged claims of the '551 patent.

VII. BEAM-SATONAKA-KOBAYASHI TEACHES THE ROAD CURVATURE CLAIMS.

135. The road curvature claims are dependent claims 26–29, 34–37, 42–45,

and 50–53. These claims add elements related to lighting road curvatures and are addressed by my second Ground, which combines Beam, Satonaka, and Kobayashi. EX1003, Section XI. Dr. Turk argues that this combination does not teach the curvature element of “accommodate the upcoming road curvature by adaptation of a light pattern.” EX2006, ¶152. But Dr. Turk is again wrong. Dr. Turk’s argument is premised on a misunderstanding of how Beam functions. Dr. Turk’s analysis also fails because he does not fully consider the combination explained in my First Declaration.

A. Dr. Turk’s arguments regarding Beam’s “maximum intensity” are incorrect and reflect a lack of understanding of the art.

136. Beam explains that it *controls intensity including angular position* to a maximum desired in a given direction; it does not default to (using a colloquialism) “full blast” everywhere at all times as Dr. Turk suggests based on his misunderstanding of “intensity.”

137. Dr. Turk misunderstands what Beam discloses to a POSA. Beam discloses a system that includes at least *both* low beam and high beam achieved by its microbeams. EX1005, 1:21-13, 6:40-44. And as I have explained, high beam and low beam are aimed in *different* directions. Section IV.A.1-2; EX1003, ¶209 (citing EX1005, 1:20-34). Beam’s microbeams *must* be able to change direction in order to achieve at least the high beam and low beam functions that a POSA would have readily understood. Beam does not, however, disclose to a POSA that it is

unable to *increase light in a direction* by virtue of its “maximum intensity”—which is not “maximum brightness.” A POSA would have well understood that the term “maximum intensity” is related to the (legally allowed maximum) light intensity level that varies in different angles for different headlamp functions (such as high beam or low beam).

138. Beam discloses a plurality of headlamps, each comprising a plurality of LED light sources, which may be configured as “an array of individual, independently controllable microbeam sources.” EX1005, 8:4-17. Beam expressly discloses in claims 4 and 5 that the light source as referred to as comprising microbeams may be configured as an array of *individual, independently controllable LEDs*. EX1005, 2:53-3:3, 4:9-59, 8:4-17.

139. Additionally, I explained in paragraph 70 of my First Declaration that Beam’s system “us[es] that information to *control the intensity, and/or the angular position*, of one or more” LEDs. *See* EX1005, Abstract. Beam thus explains that it *controls intensity including angular position* to a maximum desired in a given direction, and does not default to (using a colloquialism) “full blast” everywhere at all times as Dr. Turk suggests based on his misunderstanding of “intensity.” Further, Beam’s control is “*dynamically varying* in position and in size,” in response to the control input. EX1005, 5:46-54, 6:24-27. So, what Beam discloses to a POSA is that Beam “determines a light change,” and adapts the headlamps’

light pattern in both intensity *and* spatial (angular) distribution as in the '551 patent's claims.

140. I note that Dr. Turk, incorrectly, stated that Beam could not “light outside of [its] field of view to light a curve,” in his deposition of the related '029 patent (EX1054, 119:19-120:6), but at least ultimately acknowledged that Beam could be modified to light outside of that field of view (EX1054, 119:19-120:6).

141. As I explained above with reference to Dr. Turk's lack of POSA qualifications, he appears to not understand what the term “intensity” means in the context of vehicle headlamps. It is not, contrary to Dr. Turk's misunderstanding, similar to or synonymous with “brightness,” which is a human perception measurement. *See* EX1054, 62:18-25. Dr. Turk opines that the term “intensity” in the context of the related '029 patent should be interpreted as “what intuitively we think of as brightness.” EX1054, 84:3-6.

142. Dr. Turk seemingly contradicts himself when he quotes *from an article that I co-authored*, explaining that “[a]ny automotive headlamp beam pattern, either high-beam or low-beam, is a light luminous intensity (candela) angular distribution.” EX2006, ¶26 (citing EX2010, 237). Thus, a POSA would understand that such beam patterns relate to intensity with angular distribution.

B. Beam discloses controlling the directionality of its emitted light beam.

143. As a POSA would understand, Beam's beam pattern includes

directionality, and a change in beam pattern includes a change in direction of the light. It is apparent to me that Dr. Turk does not understand Beam's disclosure from the perspective of a POSA. At paragraph 53 of EX2006, he states that Beam does not "disclose or teach changing direction of any microbeams," but this is fundamentally wrong. Beam expressly states that the *angular position* or *attenuation* "of each of these microbeams is independently set by the controller 108," which is controlled in a dynamic environment of moving vehicles. EX1005, 4:46-52. Dr. Turk equates attenuation to a decrease in illumination (EX1054, 95:12-23), but this comment does not address the angular position in this sentence in Beam. When asked about the angular position in Beam, Dr. Turk replied that this "means that the spatial light modulator is either allowing a microbeam to pass out of the device into the world or the angle has changed so that it does not pass out, it gets absorbed inside the device." EX1053, 25:19-24. This explanation makes no sense because a POSA would not use the term angular position when discussing controlling the internal angle of an SLM element, as Dr. Turk seems to be stating. Angular position of the microbeams would have been understood to refer to the external *angular position* that microbeam illuminates outside of the headlamp because it does not matter what position is illuminated by that microbeam *inside* the headlamp for controlling the beam pattern. Further, a POSA would understand that when considered in context, the angular position is being used by Beam to

discuss the angular position of the *outgoing* microbeam light, not an internal angle of an SLM element (“inside the device” as misunderstood by Dr. Turk) because internal SLM angles are not related to controlling the beam pattern. EX1005, 4:40-52.

144. A spatial light modulator is designed to modify the input light to result in the output light with direction, intensity, or color change. EX1056. A spatial light modulator is not a simple light attenuator, and Dr. Turk’s description to “either allowing a microbeam to pass out of the device into the world or the angle has changed so that it does not pass out, it gets absorbed inside the device” is incorrect—I note here, even with Dr. Turk’s statement of “pass out of the device into the world”, it does not say the pass out portion of light is all in the same direction, or in various directions as those lights are reflected by many individual digital mirrors. This indicates that he is not a POSA in the lighting and lighting control field because this statement oversimplifies the use of Spatial Light Modulators. *See* EX1010, 5:11-15 (disclosing a range of SLM options that are simple light attenuators); EX1005, 8:10-11 (same).

145. In a particular example of Beam’s teaching shown in EX1005, Figure 1, the detected oncoming and preceding vehicles where the sections of AABH are dimmed to avoid glare are the moving targets. EX1005, 4:26-40; EX1003, ¶74. Thus, the microbeams must be able to constantly change directions in order to

follow the moving targets.

146. Thus, Beam does not, contrary to Dr. Turk’s opinion, disclose to a POSA that it is unable to *increase light in a direction* by virtue of its disclosure of “maximum intensity.” Beam teaches the microbeams’ directionality change (EX1003, ¶¶201-202), thus the combination of Beam-Satonaka-Kobayashi teaches the road curvature elements of claims 26–29, 34–37, 42–45, and 50–53.

VIII. DR. TURK MISUNDERSTANDS KARLSSON’S TEACHINGS AND MY APPLICATION OF THOSE TEACHINGS.

147. Dr. Turk’s arguments related to the Karlsson-Nakamura ground are based on a misunderstanding of Karlsson and how I applied Karlsson in my First Declaration. Dr. Turk’s arguments are incorrect for the reasons below.

A. There is no dispute that Karlsson’s sensor 23 is a camera as claimed.

148. Dr. Turk’s arguments in Sections IX.C.1a-c of the Second Turk Declaration are related to Dr. Turk’s belief that Karlsson does not disclose an embodiment that includes both a camera and LEDs as a light source. EX2006, ¶¶156-175. But Dr. Turk misunderstands Karlsson’s disclosure and my First Declaration. *See* EX1003, ¶¶256-257.

149. Dr. Turk states that “[t]he Karlsson-Nakamura Combination Does Not Teach ‘one or more sensors, including one or more cameras.’” EX2006, Section IX.C.1.a. But, Dr. Turk later admits that Karlsson’s sensor 23 is a camera. For

example, he states 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, [and] 10.” EX2006, ¶173; EX1053, 38:9-19 (confirming that sensor 23 is in Figure 3). As stated in my First Declaration, I agree that light-sensitive sensor 23 is a camera. EX1003, ¶¶256-267.

B. Karlsson discloses that its light source includes LEDs.

150. Karlsson discloses that “[t]he lighting means in the lighting device according to the invention may be composed of 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. There is no limitation on which lighting means can include the LEDs. And I note that even Dr. Turk agreed that light source 2 is in several figures. EX1053, 38:2-42:6. Thus, in my opinion, a POSA would have readily understood that Karlsson is teaching that light source 2 includes LEDs in the relevant embodiments, including those of Figures 3 and 7. EX1003, ¶¶88-91, 248, 256; EX1010, 11:29-32, 13:24-29. For example, the light sources in Figures 3, 5a, 7, and 10 can be formed from LEDs. EX1010, 11:29-32, 13:24-29. This means that Karlsson does, in fact, disclose both a light source comprising LEDs and a camera sensor as I discussed in my First Declaration, in a single embodiment, such as in Figures 3 and 7. EX1003, ¶¶248, 256; EX1010,

11:29-32, 13:24-29; *see* EX2006, ¶173 (acknowledging that sensor 23 is a camera).

I note that I specifically cite Karlsson's Figure 3 embodiment extensively in my First Declaration, including in the sections where I identify the LEDs and the camera of Karlsson. EX1003, ¶¶248, 256.

151. Dr. Turk's arguments at paragraphs 156-163 and paragraphs 171-174 where he argues that there is no camera (¶¶156-163) or that there is no camera with an LED light source (¶¶171-174) are therefore wrong. Karlsson teaches that any of its light sources can include LEDs, meaning that any embodiment can include LEDs, including the camera embodiments that Dr. Turk admits are disclosed in Karlsson. I specifically cited the embodiment of Figure 3, which is one such embodiment. Thus, my First Declaration correctly explained how Karlsson-Nakamura taught the camera element of the independent claims. EX1003, ¶¶256-259.

C. Karlsson-Nakamura teaches a camera that detects coordinate-specific information to be used as the basis for controlling light emission from a headlamp.

152. Dr. Turk also argues that Karlsson cannot disclose detecting coordinate specific information because there is no camera and controller to detect and store the information. EX2006, ¶¶165-169. But, as I explained in my First Declaration and above, Karlsson *does* include a camera (sensor 23) that detects coordinate specific information. EX1003, ¶256; EX1010, 12:19-24, 8:37-9:1,

14:22-30; Section VIII.A-B; EX2006, ¶173(acknowledging that sensor 23 is a camera). For example, I specifically stated in my First Declaration that “Karlsson’s control means 14, which includes the processor, is in communication with sensor 23 to receive the control signal.” EX1003, ¶256 (referencing EX1010, 14:22-30). The control signal is received from sensor 23, which is the camera. EX1010, 14:22-45; EX1003, ¶256. Dr. Turk’s argument focuses solely on sensor 9 in Karlsson and ignores sensor 23 (and the corresponding portions in my First Declaration). EX2006, ¶¶165-169. Thus, Dr. Turk’s argument here is incorrect in view of Karlsson’s disclosure of the camera of sensor 23, and sensor 23’s connections to Karlsson’s control means.

D. Karlsson discloses or renders obvious performing glare reduction for a second vehicle in claim 40.

153. Dr. Turk also argues that Karlsson does not disclose the second LED cluster for the second vehicle recited in claim 40. EX2006, ¶¶176-177. Dr. Turk is wrong because, as I explained in my First Declaration, “Karlsson’s system automatically functions to detect and reduce illumination on any number of target vehicles, including a second vehicle having a second position, in the same manner as the first vehicle.” EX1003, ¶302 (citing EX1010, 9:18-26); *see also* EX1003, ¶261 (“A POSA would have understood that Karlsson’s system would automatically function to detect and reduce illumination on any number of targets vehicles, including a second vehicle having a second position.”). Dr. Turk’s

hypothetical argument here has no support in the evidence, and is thus only unsupported speculation of how Karlsson would function. His argument is also illogical because there is no restriction on how many vehicles Karlsson would track. In contrast, my argument is supported by Karlsson's reference to "traffic" as I explained in my First Declaration (EX1003, ¶302; EX1010, 9:18-26), and is also logical because it addresses the possibility of traffic being more than one vehicle.

154. I further included an additional rationale that points to the disclosure in Nakamura that it was obvious to detect multiple vehicles: "To the extent that Karlsson does not disclose detecting and adjust[ing] light based on multiple vehicles, it would have been obvious to modify Karlsson's programming in view of Nakamura to do so because this would improve safety and system performance in the likely event of multiple other vehicles being present." EX1003, ¶303. Thus, as I opined in my First Declaration, it would have been obvious to modify Karlsson to identify multiple vehicles to improve safety. EX1003, ¶¶303-304. Notably, Dr. Turk does not even address that rationale. EX2006, ¶¶176-177; EX1003, ¶¶303-304.

155. Dr. Turk does not cite to or address my First Declaration in this section of the Second Turk Declaration. EX2006, ¶¶176-177. Instead, he points to the Petition and alleges that Karlsson does not teach this claim element, without providing any explanation as to why he thinks my reasoning is wrong. EX2006,

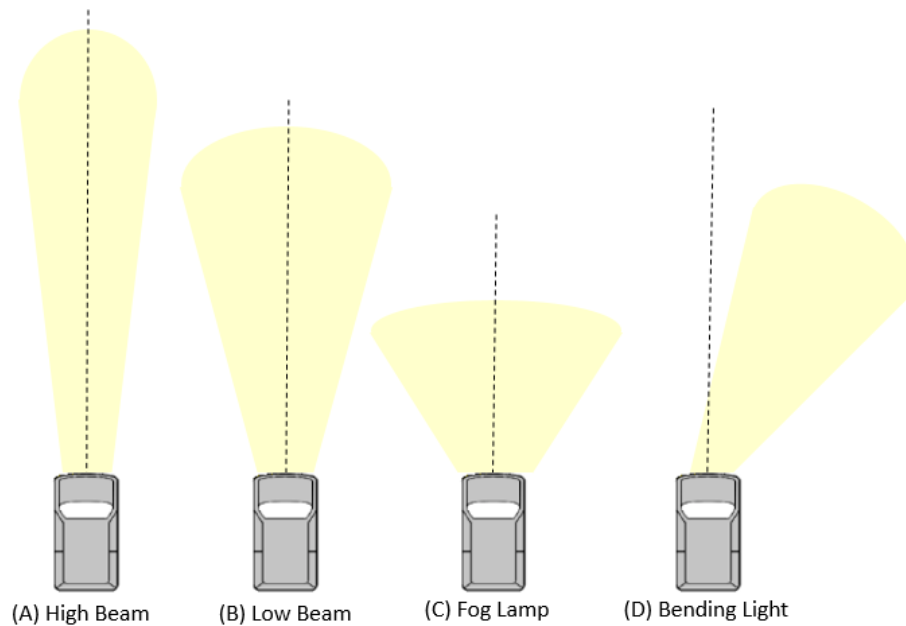
¶¶176-177. Yet the Petition explains that “[a] POSA would have understood, or found obvious, that Karlsson accommodates multiple vehicles” and cites to the relevant portion of my First Declaration. Pet., 76; EX1003, ¶¶302-304. Thus, the Petition presents the same argument as in my First Declaration, making Dr. Turk’s omissions regarding portions of my First Declaration even more unusual. My opinion regarding claim 40 and the Karlsson-Nakamura combination remains unchanged from my First Declaration.

E. Karlsson discloses non-contiguous LEDs.

156. Dr. Turk argues that Karlsson does not disclose the non-contiguous LEDs element of claims 25, 33, 41, and 49. EX2006, ¶¶179-183. I note that my First Declaration applied the same underlying logic for the Karlsson ground as I applied for these claims in the Beam ground, discussed above. EX1003, ¶¶276-277, 292-293; Section VI.G. Dr. Turk agreed that Beam would have non-contiguous LEDs when tracking multiple spatially separated vehicles. Section VI.G; EX1053, 100:3-101:6. Karlsson would also have non-contiguous LEDs for the same reasons. EX1003, ¶¶275-277. My discussion above with respect to the claim language of these claims applies equally here. Section VI.G. Specifically, the claim language at issue does not restrict the relevant clusters to a single vehicle, meaning my multiple-vehicle rationale applies to these claims. Section VI.G.

157. I also note that Dr. Turk misunderstands Karlsson’s disclosure of

forming “random patterns.” EX2006, ¶¶181-182. The relevant portion of Karlsson states that “[i]n a preferred embodiment of the invention a lighting device comprising a plurality of controllable spotlight beams is used advantageously for forming random patterns of the light beam to be emitted in an effective manner.” EX1010, 13:24-27. No POSA would have understood these patterns to be completely random, as Dr. Turk suggests. EX2006, ¶181. Rather, a POSA would have readily understood that Karlsson is discussing the ability for its controllable LEDs to create any (instead of one fixed) light beam pattern needed depending on the desired function, such as glare reduction or curve illumination. I have illustrated some examples of the patterns Karlsson could produce below, although I note that these are examples only, and do not specifically show other beam patterns that Karlsson might use when performing glare reduction, for example.



Examples of Karlsson's "Desired Beam Pattern".

158. This understanding of Karlsson's beam pattern direction capability supports my position that Karlsson would use non-contiguous LEDs when reducing glare on multiple vehicles because the beam pattern can be controlled and directed to accommodate multiple vehicles. EX1003, ¶276. Thus, Karlsson discloses the non-contiguous LEDs element.

F. Karlsson's headlamp control means uses image data from its camera to perform glare reduction.

159. Dr. Turk's argument with respect to the Beam Ground and the image data of claims 33, 41, and 49 also applies to Karlsson. EX2006, ¶¶100, 101, 103. This statement is also confusing to me because Dr. Turk admits that Karlsson's sensor 23 is a camera. For example, he states 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, [and] 10." EX2006, ¶173. Karlsson discloses that "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 camera sensor 23 sends its data, called the control signal, to Karlsson's controller. EX1003, ¶¶256-259, 263. As Dr. Turk acknowledges, data from a camera is image data, meaning that the control signal in Karlsson is image data. EX1053, 77:13-16.

160. My First Declaration, which I understand is cited in the Petition, addressed the image data claim term. EX1003, ¶256. I state that “sensor 23 is connected to the power source to enable Karlsson’s system to receive sensor data” and that “Karlsson also discloses that ‘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.’” EX1003, ¶256 (citing EX1010, 14:22-30). Further, I explain that “Karlsson’s control means 14, which includes the processor, is in communication with sensor 23 to receive the control signal.” EX1003, ¶256. I also explained that “the processor in control means 14 is processing the information (data base on detected light 11) from the cameras in Karlsson.” EX1003, ¶263. This means that the information from the camera in Karlsson is based on the detected light—namely that the data is image data.

161. Thus, Karlsson teaches a headlamp that uses image data for lighting control, as recited in claims 33, 41, and 49 for the reasons I explained in my First Declaration.

G. Karlsson’s camera is positioned to take an image to be used as the basis for headlamp beam control as recited in claim 32.

162. Dr. Turk’s argument regarding claim 32’s “capture an image of at least one target” also applies to Karlsson. EX2006, ¶98. Like the previous image data element (Section VIII.F), Dr. Turk’s argument here seems to misunderstand

the basic operation of Karlsson, and ignores the disclosure cited for this element.

163. In my First Declaration, I explain that “Karlsson’s ‘sensors 9 and 23 are preferably designed to be capable of precisely determining the direction and intensity of the detected light 11,’ which is a spatial location of the detected light.” EX1003, ¶257 (citing EX1010, 12:19-22). I also explained that “the processor in control means 14 is processing the information (data base on detected light 11) from the cameras in Karlsson.” EX1003, ¶263. Thus, the information from the camera is based on the detected light 11, which means that the camera is taking an image of the detected light (the target). Thus, Karlsson’s camera sensor 23 is positioned to capture an image of the target for use in controlling light for glare reduction.

IX. A POSA WOULD HAVE BEEN MOTIVATED TO COMBINE KARLSSON AND NAKAMURA.

A. The Karlsson-Nakamura combination does not combine disparate LED array and light modulator embodiments in Karlsson, as Dr. Turk alleges.

164. Dr. Turk argues that the Karlsson-Nakamura combination explained in my First Declaration (EX1003, ¶¶237-243) combines different, incompatible embodiments of Karlsson without providing sufficient reasoning to do so. EX2006, ¶¶185-188. This is incorrect for at least two reasons.

165. First, Karlsson specifically states that its lighting means can “be composed of a plurality of light sources and/or light modulators.” EX1010, 21:13-

15; *see* EX1003, ¶¶92-93. A POSA would have understood that the use of “and/or” means that Karlsson is explicitly teaching that both a plurality of light sources (e.g., the LEDs Karlsson discloses) *and* a light modulator can be included in the same embodiment. I note that this disclosure is aimed at all of the embodiments in Karlsson, not a specific embodiment. This means the disclosure applies to all embodiments that I cited. EX1010, 21:13-15. Thus, Dr. Turk is wrong in stating these two structures (LEDs and light modulators) are in disparate embodiments of Karlsson. EX2006, ¶¶185-188.

166. Second, embodiments like Karlsson’s Figure 7 include both LEDs and a spatial light modulator. I specifically cite the embodiment of Figure 7 throughout the relevant portions of my First Declaration. EX1003, ¶¶263, 271, 276, 292, 298, 315, 320, 331. Figure 7 includes “light source 2 [that] is comprised of a plurality of separate small light sources.” EX1010, 14:22-23. Again, Karlsson discloses that the light source can be formed from LEDs. EX1001, 21:15-23. Figure 7 also includes a “light modulator means 3.” EX1010, 14:35-36. Thus, Karlsson specifically discloses embodiments having both SLMs and LEDs. Indeed, Dr. Turk acknowledged that the embodiment of Figure 7 includes an SLM and light source 2 (which Karlsson expressly discloses can be LEDs):

Q. Okay. And Figure 7, that shows Reference Number 3 of the SLM.

Correct?

A. I believe that's still the SLM, that figure.

...

Q. So Figure 7 has Light Source 2. Correct?

A. I believe so.

EX1053, 36:19-21, 38:13-25.

B. Dr. Turk's challenge to the Karlsson-Nakamura motivation based on his supposed testing is fatally flawed.

167. Dr. Turk presents an argument directed against combining Karlsson and Nakamura that relies on the same "test" and reasoning discussed above with respect to Beam and Satonaka. EX2006, ¶¶190-200. He includes the same pictures (EX2006, 138) and has the same arguments with respect to the viewpoint shift between Karlsson and Nakamura (EX2006, ¶¶194-196). In fact, Dr. Turk agreed that the substance of these arguments was the same.

Q. Is it fair to say that your argument with respect to these three pictures is the same for the Karlsson ground here at paragraph 196 as we just discussed for the Beam ground at paragraph 142?

A. Yes, it's about the combination and the difficulties might come about trying to make that combination with the triangle-based detection method.

EX1053, 115:22-116:3.

168. My discussion above regarding the motivation to combine Beam-

Satonaka with respect to this so-called test and the corresponding analysis applies equally here because the substance of Dr. Turk's argument is the same here.

Section VI.I. Thus, a POSA would have found it obvious to modify Karlsson in view of Nakamura. EX1003, ¶¶237-243.

X. KARLSSON-NAKAMURA-GOTOU TEACHES THE ROAD CURVATURE CLAIMS.

169. The road curvature claims are dependent claims 26–29, 34–37, 42–45, and 50–53. These claims add elements related to road curvatures and are addressed by my fourth ground in my First Declaration, which combines Karlsson, Nakamura, and Gotou. EX1003, Section XIII, ¶¶334-352. Dr. Turk argues that this combination does not teach the road curvature element of “accommodate the upcoming road curvature by adaptation of a light pattern.” EX2006, ¶211. Dr. Turk is wrong and his argument is premised on misunderstandings of how Karlsson functions.

A. Dr. Turk's arguments that Karlsson operates at “full intensity” are incorrect and reflect a lack of understanding of the art.

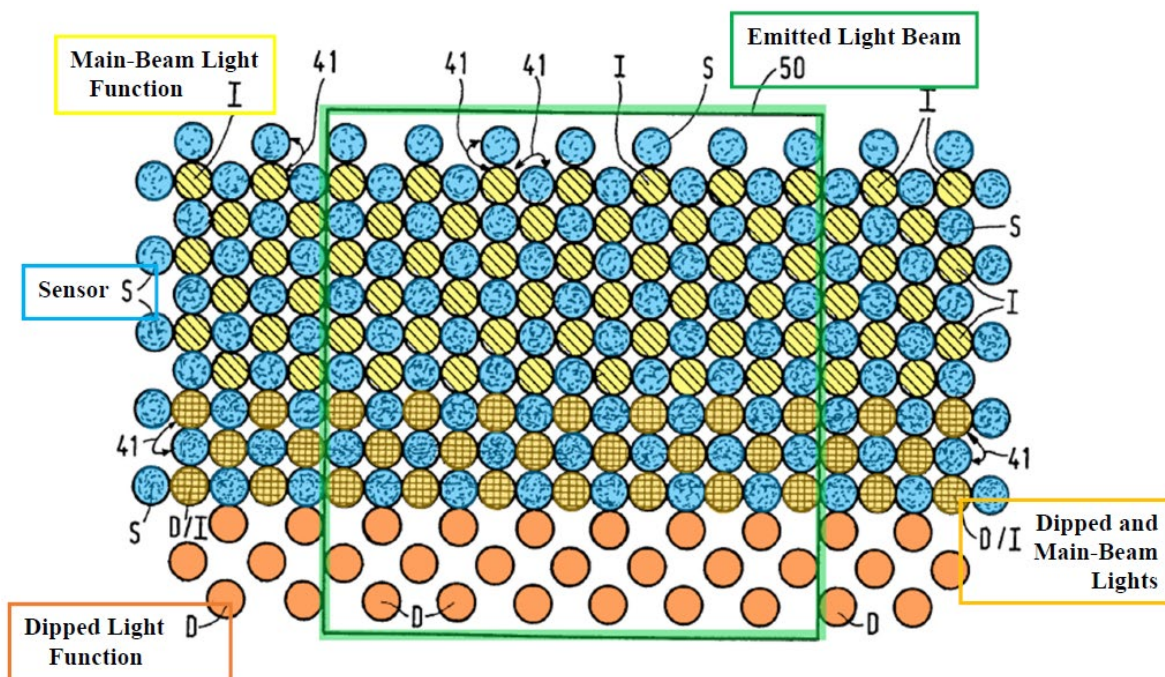
170. Dr. Turk draws an unsupported and incorrect conclusion that Karlsson forms emitted beam 7 by “using the entire beam array at full intensity, except when avoiding glare, at which point, window 50, of reduced illumination (Fig. 14) is created to address glare situations.” EX2006, ¶82.

171. In paragraph 82 of the Second Turk Declaration (EX2006), Dr. Turk

states that “Karlsson, like Beam, forms emitted beam 7 (Fig. 1) 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.” This is a gross misstatement of what Karlsson discloses to a POSA. Karlsson does not disclose full or maximum intensity at all times except to reduce glare.

172. As I previously explained, for example in EX1003, ¶¶91-92, Karlsson’s “emitted light beam 50 is represented as a window that can shift in the plane from left to right and from top to bottom and produced by LEDs based on the data from inputs, e.g., data sensed from spotlight sensors S. EX1010, 19:18-20:3.”

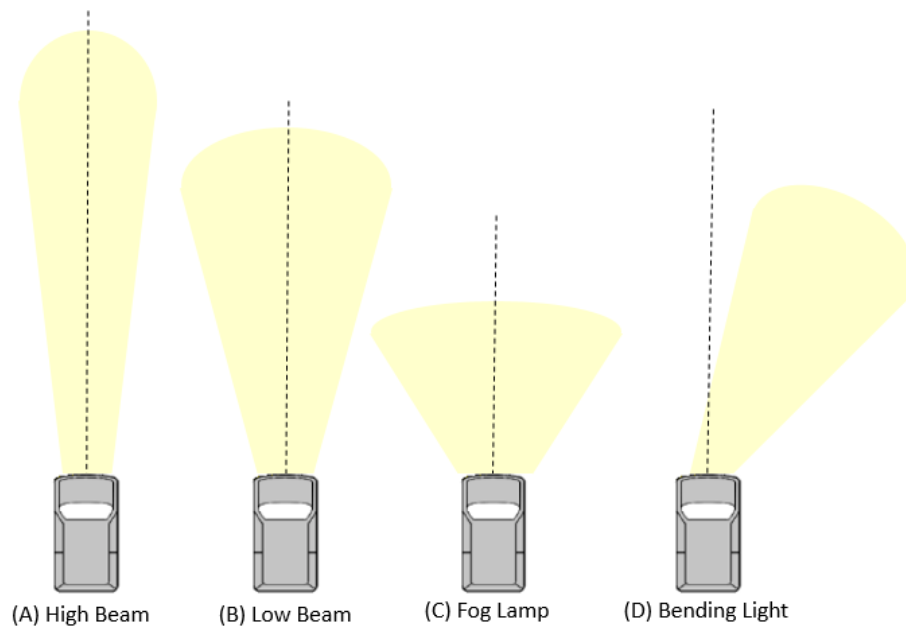
I included the below annotated figure in the same paragraph:



EX1010, FIG. 14 (annotated).

173. Simply put, in direct contradiction to Dr. Turk’s mischaracterization

above and his misstatement at paragraph 210 of the Second Turk Declaration that “[t]here is nothing in Karlsson to suggest that window 50 is the actual beam that would be used for driving,” Karlsson expressly states that “[t]he *emitted light beam 50 is represented as a window* which can *shift* in the plane of the drawings *from the left to the right* and *from the top to the bottom*, if desired, and vice versa, and which may *vary as regards its shape and dimension* in dependence on the *desired pattern and direction of the beam*.” EX1010, 19:29-33; EX1003, ¶91. A POSA would not find anything unclear about this statement in Karlsson. Below, I illustrate several beam patterns that Karlsson would create via its emitted light beam based in part on the section quoted above from Karlsson’s beam (supporting that Karlsson discloses an adaptable beam):



Examples of Karlsson’s “Desired Beam Pattern”.

174. The left-most figure shows a schematic of a high-beam pattern, which is long with a narrower angle of beam spread. The figure next to that shows a low beam pattern—still relatively long and wider spread. The third-from-left figure illustrates a fog lamp beam pattern—low and wider still, ideal to increase short-range visibility and safety. Finally, the right-most figure shows a beam aimed towards the right, for example, towards a right-handed curve when using Gotou’s control strategy to aim light in the direction towards a curve prior to entering the curve. EX1003, ¶¶335, 337; EX1012, 6:40-44, 3:24-47, 3:52-62. I note that Dr. Turk acknowledged that Karlsson can control the pattern and direction of its beam pattern during his deposition, which supports my position here and in my First Declaration, and contradicts his position in the Second Turk Declaration. EX1003, ¶¶335, 337; EX1012, 6:40-44, 3:24-47, 3:52-62; EX1053, 34:19-25 (acknowledging that Karlsson discloses variations of pattern and direction of its light beam).

175. Karlsson’s “spotlight beams 34 can be obtained, for example, by using a light source 2 which is composed of a grid of separate light sources, such as LEDs, which can preferably be *controlled either individually or in groups*.” EX1010, 14:1-4. Dr. Turk acknowledged that Karlsson uses LEDs for headlamps, and that those LEDs can be controlled individually or in groups. EX1054, 129:19-130:1. Even Dr. Turk notes (EX2006, ¶84) that Karlsson discloses multiple beam

patterns “‘spotlight sources indicated at D provide the dipped light [low-beam] function in accordance with existing vehicle headlights,’ and ‘sources indicated at I provide the main-beam light function of existing vehicle headlights.’” (EX1010, 19:22-28). He also acknowledges that Karlsson discloses that the “‘spotlight sources indicated at D/I are both operative as dipped and main beam lights.’” EX2006, ¶84. Thus, Karlsson has the capability of independently controlling its LEDs.

176. And, when asked during deposition, Dr. Turk ultimately correctly acknowledged that Karlsson discloses that its beam 50 can (1) vary as regards to its shape and dimension, (2) vary depending on the desired pattern and direction of the beam, and (3) its dimension can vary depending on the desired pattern and direction of the beam. EX1054, 132:15-25, 133:6-7, 134:2-7, 134:13-15.

177. Dr. Turk even acknowledges that Karlsson expressly discloses that its average intensity of the light emitted by the lighting means is controlled to provide a light beam, the intensity of which is *optimally* adapted to the road and to the ambient light, thereby increasing the driving comfort and road safety. EX1054, 130:7-131:7. And Dr. Turk agrees that “there could be differences in what is considered optimal” depending on road conditions and headlamp location. EX1053, 56:7-15. And nothing suggests to a POSA that Karlsson operates with all of its LED spotlight beams at full intensity (per Dr. Turk) except for situations

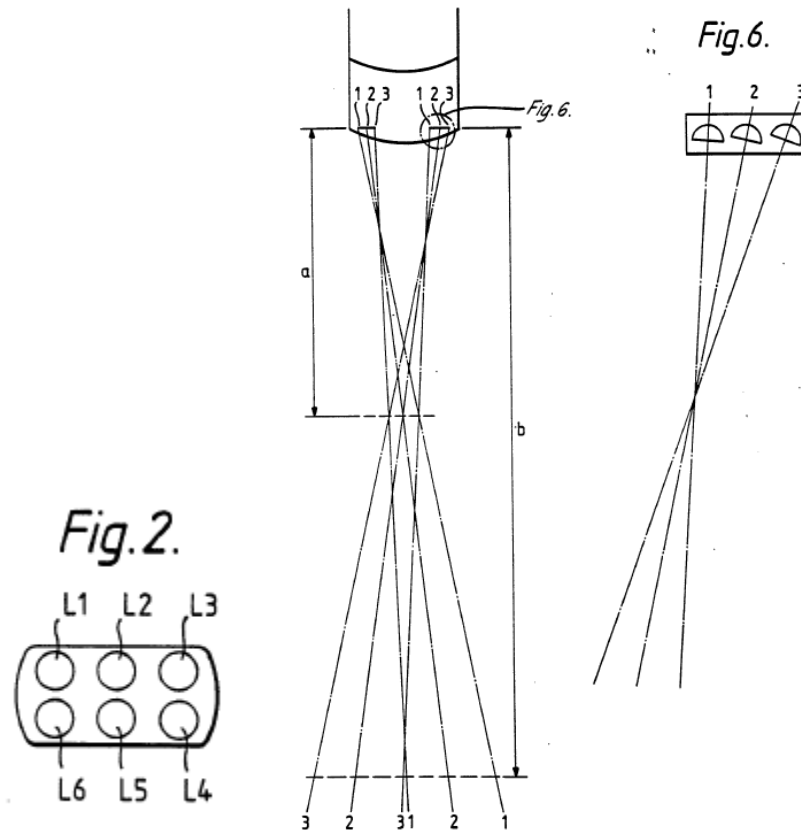
where it implements its glare control function. Such an incorrect reading ignores Karlsson's optimally adapted system with individually and group controllable LEDs resulting in emitted light beam 50 represented as a window that shifts in the plane from left to right and from top to bottom, based on the data from inputs to Karlsson's controller. EX1010, 19:18-20:3.

178. I note that Dr. Turk also characterizes Flaaten's disclosure, in that it aims for an "*optimum* lighting effect." EX2006, ¶209 (citing EX2017 at 1); *see also* EX2006, ¶95 (stating that Flaaten provides an "optimum lighting effect for the driver of the vehicle," citing EX1010, 2:2-9). Indeed, Flaaten describes controlling "the light distribution pattern of the headlights," with "intersecting directions of the axes of light beams," to efficiently dim the light "selectively in the areas where there are other vehicles, persons, or sources of light, whereas a maximum *satisfactory* illumination is maintained of the roadway in front of the vehicle." EX2017, Abstract. Maximum *satisfactory illumination* does not mean *all of Flaaten's light sources are on at all times*. Nor does Flaaten's statement that removing only the portion of the light that would inconvenience the driver of meeting cars support Dr. Turk's conclusion that there should be "full illumination to the 'greatest extent possible,'" (EX2006, ¶96). Rather, a POSA would understand that Flaaten expressly acknowledges that "satisfactory illumination is maintained of the roadway in front of the vehicle," for example, including ahead in

curves. EX2017, Abstract.

179. A POSA would have readily understood that Karlsson-Nakamura-Gotou beam patterns—like known adaptive beam patterns at the time—would include variation in direction, length, and width (angular distribution) from a bird’s eye view, or driver’s view with variation in intensity points along a projected distance. Known patterns shown above include large dispersion, curved-road light (bending light, increased lateral illuminance for curves), and high speed long reaching beams as shown above.

180. Further, to the extent that Dr. Turk thinks Karlsson is an evolution of Flaaten, I have explained above that Flaaten shows an array of bulbs in Figures 1 and 2, and gives an example of directional light sources in its arrays in Figures 5 and 6, also including intersecting, combined, optical axes, that together provide light sources “in each headlight [that] have directions of light that provide the *best possible illumination* in a *desired predetermined area* in front of the vehicle” EX2017, 3:8-14. Flaaten’s Figures 2, 5, and 6 are shown for reference:



EX2017, FIGs. 2, 5, and 6.

181. Flaaten's sources L1-L6 are described to be turned off and on, or "dimmed gradually, one at a time." EX2017, 3:34-36. And Flaaten's sources may include an angular setting that is adjustable *automatically*. EX2017, 5:27-31.

182. Thus, to the extent that Dr. Turk considers Karlsson to be an improvement of a type of device of Flaaten (EX2006, ¶89) or "Karlsson's base device," he appears to acknowledge Karlsson's directionality and aiming of its spotlight beams from its LEDs—indeed Flaaten itself provides that the roadway, the edges of the road, *curves*, etc. are *satisfactorily* illuminated (EX2017, 2:2-6) and that its system of "intersecting head light beams will also be advantageous

when driving in *curves*, since the light beam from left head light will not inconvenience oncoming vehicles, and total dimming of both headlights can be avoided,” (EX2017, 2:22-26) by way of “several directional separate headlights in groups,” that are “individually dim[m]able” (EX2017, claim 3).

183. Again, such a system implemented in Karlsson would not result in Dr. Turk’s created diagrams, rather, Flaaten would suggest that Karlsson’s LED spotlight beams may be aimed to light the *side of the curved road* with more accurate or precise beam pattern control as Karlsson’s spotlight beams are smaller headlamp beam contributors and can be controlled individually or in groups in comparison to Flaaten’s conventional light bulbs.

B. Karlsson-Nakamura-Gotou teaches the sensor data of claim 29.

184. Dr. Turk argues that the Petition does not teach “where the adaptation of the light pattern is based at least in part on sensor data” as recited in claim 29. Here, again, Dr. Turk ignores what I actually said in my First Declaration. As I previously stated, “Gotou discloses several sensors that are used as part of the road curvature prediction process. For example, a “GPS receiver 34,” a “gyro-sensor 33,” and a “vehicle speed sensor 13” are all used as input into the road prediction process. EX1003, ¶350 (citing EX1012, 4:1-11). I concluded that “modified Karlsson would include various sensors and map data as part of its inputs to predict the upcoming road curvatures.” EX1003, ¶350. I note that the Petition provides the

same sensor examples from Gotou and, with cites to my First Declaration as support, also concludes that “modified Karlsson would include various sensors and map data as part of its inputs to predict the upcoming road curvatures.” Pet., 83-84; EX1003, ¶¶350-351. Dr. Turk therefore ignores my explanation of the various sensors that would be used to create the map data. I also note that Dr. Turk does not dispute my explanation for claims 37, 45, and 53, which has the same sensor data term. EX1003, ¶¶350-351. Thus, claim 29 is taught by Karlsson-Nakamura-Gotou.

185. In summary, Dr. Turk’s argument regarding the Karlsson-Nakamura-Gotou combination as allegedly not disclosing the headlamp illumination of road curvature in claims 26–29, 34–37, 42–45, and 50–53 is fundamentally flawed due to his misunderstanding of the art, which indicates he is not an expert in lighting or lighting control, nor a POSA in the field.

XI. THE ALLEGED SECONDARY CONSIDERATIONS EVIDENCE DOES NOT SHOW NONOBVIOUSNESS.

186. I previously addressed the secondary considerations evidence presented during the reexamination of the ’551 patent and concluded that it did not show any nexus. EX1003, ¶¶353-356. Dr. Turk included a section in the Second Turk Declaration where he argues that the secondary considerations evidence submitted in the reexamination shows nonobviousness. I have reviewed Dr. Turk’s commentary on this issue and maintain my position from my First Declaration.

Below I explain why Dr. Turk is wrong regarding secondary considerations.

A. There is no nexus between the evidence and the claims of the '551 patent.

187. I understand from counsel that when a patent owner asserts secondary considerations evidence that does not involve a product that practices the claims, the patent owner must show that the evidence is the direct results of the unique characteristics of the claimed invention. Here, Dr. Turk identifies three features that are supposed unique characteristics:

[1] As explained in paragraphs 39-45 above, the '551 Patent claims include multiple unique characteristics such as “Predictive Curve Illumination” the subject of claims 26-29, 34-37, 42-45 and 50-53,

[2] “*adapting light emission based on the classification of objects*,” the subject of claim 48, and

[3] adapting light emission to provide at least two dark zones with “*light in-between*,” the subject of claim 40.

EX2006, ¶217.

188. At the outset, I note that these unique characteristics only address a subset of the challenged claims. Dr. Turk therefore does not show a nexus for any of the remaining claims to the evidence. EX2006, ¶217.

189. I also note that I do not agree with Dr. Turk’s paraphrasing of these features because he is not summarizing the claim language correctly, as I will

explain below. Further, the three characteristics above are not unique or novel, as both of my declarations explain in detail. EX1003, ¶¶353-356 (“Technically, the various pieces of evidence seem to only involve applications of adaptive headlight technology that were known before the critical priority date of the ’551 patent.”).

190. Regarding the first alleged unique characteristic, “Predictive Curve Illumination,” I note that Dr. Turk never disputes that Kobayashi and Gotou teach this basic concept. Indeed, Dr. Turk links this concept to the claim language “accommodate the upcoming road curvature by adaptation of a light pattern” in EX2006, paragraph 44, but he never alleges that this limitation is missing from the prior art I discussed. EX2006, Sections IX.B.2, IX.D.1. Instead, Dr. Turk’s only argument involving this claim element is a motivation to combine argument, which as I explained above is a flawed argument. Sections VII, X. Specifically, I note that the disclosure of map data used in Gotou’s illumination control is clearly this alleged characteristic. Thus, “Predictive Curvature Illumination” is not a unique characteristic. And, the predictive curve illumination claims, even when considered as a whole, do not disclose a unique characteristic as required to show nexus.

191. Turning to the second alleged unique characteristic, the classification element of claim 48, Dr. Turk’s argument that this element is unique is directly contradicted by the ’551 patent, which states:

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, Chis Bishop, Oxford University Press; (January 1996) included herein by reference.

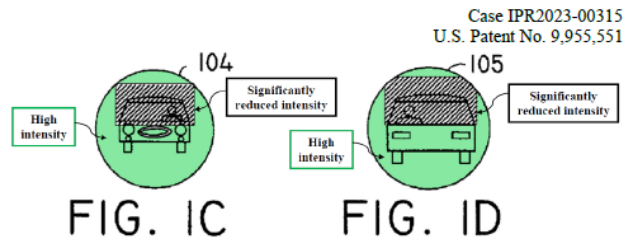
EX1001, 44:67-45:9

192. Thus, even the '551 patent admits that classification as recited in claim 48 was known in the art. My analysis above and in the First Declaration also shows that the classifying element is otherwise well-known in the art. Section VI.F; EX1003, ¶¶353-356. Considering claim 48 as a whole does not change my analysis. Thus, "Classification of Objects" has been disclosed in the art, and it is not a unique characteristic.

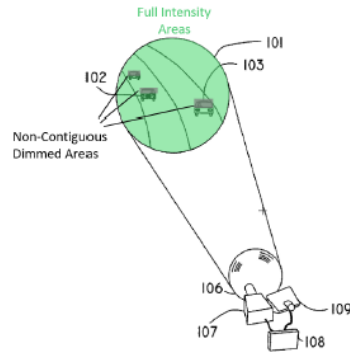
193. Finally, as to the third alleged unique characteristic, the light in-between concept of claim 40, the Second Turk Declaration does not specify the claim language that relates to this characteristic, or even describe this characteristic in detail. EX2006, ¶217. When asked to explain this concept, Dr. Turk said that "I believe it's describing areas of the field of view looking ahead with a dark zone and, adjacent to that, a light zone, and adjacent to that, a darker zone." EX1053,

133:17-20. But, adjacent dark and light zones are not recited in claim 40. The closest language to this concept is the final wherein clause of claim 40, which specifies in part that “wherein the first and second changes decrease intensity of first emission from the first cluster and second emission from the second cluster relative to a third emission.” EX1035, 5:1-5. But this language does not say anything about where this third emission must be located spatially, and certainly does not reflect Dr. Turk’s description of the light in-between concept. Thus, there is no evidence that claim 40 is directed to this alleged unique characteristic.

194. However, the prior art does operate in the manner described by Dr. Turk with respect to this alleged light in-between characteristic. Indeed, this is how Beam works. I annotated this configuration of a light beam in my First Declaration, as shown below, and Dr. Turk does not dispute this annotation or my analysis of the relevant part of claim 40. My annotation below shows light (in green) between the dimmed areas (in dark gray).



EX1005, FIGS. 1C-1D (annotated).



EX1005, FIG. 1 (annotated, excerpt).

EX1003, 92 (citing EX1005, FIG. 1).

195. In fact, Dr. Turk's only challenge specific to claim 40 in the Second Turk Declaration involves the reduced intensity language in Ground 1 and the second cluster/second vehicle in Ground 3, not the light in-between language. EX2006 ¶¶109-111, 176-177. He otherwise challenges claim 40 in the Karlsson grounds as part of a general challenge to the camera elements, but he never even addresses the light in-between language specifically. Taken as whole, claim 40 does not recite any unique characteristics, much less any involving the light in-between concept. EX1003, ¶¶166-179, 259-309. Therefore, "Light in-between" is not a unique characteristic.

B. The alleged unique characteristics are not linked to the evidence.

196. I understand from counsel that in addition to being unique, the unique characteristics—as claimed—must actually be the subject of the secondary considerations evidence. That is not the case here because the secondary considerations evidence only discusses general adaptive lighting concepts, not the alleged unique characteristics here. For example, regarding the alleged Predictive Curve Illumination, Dr. Turk points to evidence that mentions “provid[ing] visibility for upcoming curves.” EX2006, ¶218 (citing EX2023, 727). But the evidence is much broader than the alleged unique characteristic, which is apparently 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. Regarding the alleged light in-between concept, I am not certain what claim language supports this concept, making it impossible to determine if the evidence actually is linked to this alleged characteristic as claimed. Finally, regarding the alleged classifying concept, Dr. Turk argues that this element corresponds to “‘intelligent lighting’ technology to recognize cars that are being followed as well as oncoming traffic. (Ex. 2023 at 729-734.)” EX2006, ¶218. But, again, the claim language in claim 48 is “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, 6:62-65. Thus, even if

these alleged characteristics were unique (they are not), it would not resolve the issues with Dr. Turk's nexus analysis.

C. The underlying secondary considerations evidence does not support Dr. Turk's conclusions.

197. Even if there was a nexus, the underlying evidence that Dr. Turk cites does not support his conclusions that there was a long-felt unmet need and industry praise for the claimed systems in the '551 patent.

198. Regarding the long-felt but unmet need, Dr. Turk appears not to appreciate that the evidence he cites stems from a regulatory ban on the types of advanced adaptive headlight systems at issue here. Indeed, this point is explained by the Stam Declaration, which explains that the Alliance filing Dr. Turk cites advocates for a change in this regulation. EX2023, 735, ¶122; EX2006, ¶216. The Stam Declaration admits that this technology "has been employed outside the US for years." EX2023, 735, ¶122. Thus, this evidence is not the type of long-felt but unmet need that I understand secondary considerations to typically require, which is to say a need for a technological improvement to address an issue.

199. The so-called industry praise evidence Dr. Turk discusses in paragraph 218 of the Second Turk Declaration suffers from similar issues because the evidence is praising non-U.S. technology that would otherwise be available and in-use but for the regulatory barrier. Absent the barriers, the praise would not have existed because the technology would be in widespread use in the U.S. Thus, even

considering the evidence, in my opinion it is insufficient to show that the claims are nonobvious, especially in view of the strength of the prior art I discussed in my two declarations.

XII. CONCLUSION

200. For at least these reasons, I reach the same conclusions as in my First Declaration—each of the Grounds of unpatentability render all challenged claims of the '551 patent unpatentable as obvious.

201. In signing this declaration, I recognize that the declaration will be filed as evidence in an *inter partes* review before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required, I will appear for cross-examination within the United States during the time allotted.

I hereby declare that all 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 or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on this 5th day of December 2023, in Arlington, Virginia.



Dr. Jianzhong Jiao