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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HESAI TECHNOLOGY CO. LTD., HESAI GROUP,
AND HESAI INC.,
Petitioner,

v.

OUSTER, INC.,
Patent Owner.

IPR2023-01458
Patent 11,422,236 B2

Before MEREDITH C. PETRAVICK, KEVIN W. CHERRY, and JON M. JURGOVAN, *Administrative Patent Judges*.

PETRAVICK, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. Background and Summary

Hesai Technology Co., Ltd. ("Petitioner") filed a Petition requesting *inter partes* review of claims 1, 2, and 7–27 of U.S. Patent No. 11,422,236 B2 (Ex. 1001, "the '236 patent"). Paper 2 ("Pet."). Ouster, Inc. ("Patent Owner") file a Preliminary Response. Paper 6 ("Prelim. Resp.").

Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted unless the information presented in the petition "shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition."

After considering the Petition, the Preliminary Response, and the evidence of record, we determine the information presented fails to show a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of at least one of the challenged claims of the '236 patent. Accordingly, we do not institute an *inter partes* review of the '236 patent.

B. Real Parties in Interest

Petitioner identifies Hesai Technology Co., Ltd., Hesai Group, and Hesai, Inc. as the real parties in interest. Pet. 1. Patent Owner identifies Ouster, Inc. as the real parties in interest. Paper 5, 1.

C. Related Matters

The parties identify the following related court proceedings: *Ouster, Inc. v. Hesai Group et al.*, No. 23-cv-00406 (D. Del.); and *Certain LiDAR (Light Detection and Ranging) Systems and Components Thereof*, Inv. No. 337-TA-1363 (USITC). Pet. 1. The parties also identify the following related *inter partes* reviews: IPR2023-01421

(Patent 11,175,405); IPR2023-01422 (Patent 11,287,515); IPR2023-01456 (Patent 11,178,381); IPR2023-01457 (Patent 11,190,750).

D. The '236 Patent (Ex. 1001).

The '236 Patent is titled "Optical System for Collecting Distance Information Within a Field." *Id.* at code (54). The "invention relates generally to the field of optical sensors and more specifically to . . . collecting distance information in the field of optical sensors." *Id.* at 1:19–22.

Figure 1 of the '236 patent is reproduced below.

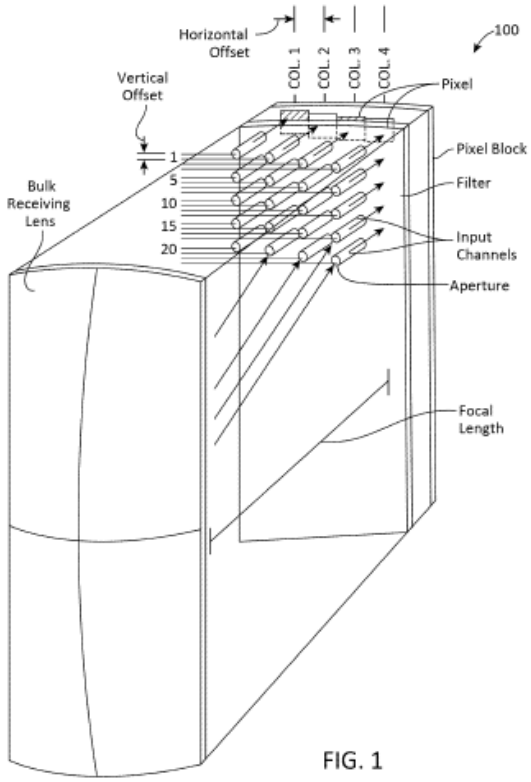


FIG. 1

Figure 1 shows a system that includes: a bulk receiving optic; a pixel block; a first set of input channels; and a second set of input channels. *Id.* at 4:22–25. The system is an image sensor that, when rotated about an

axis parallel to a column of pixels, collects three-dimensional distance data of a volume occupied by the system. *Id.* at 4:47–50.

The pixel block includes first and second columns of pixels. *Id.* at 4:25–32. Each pixel in the first column is vertically offset from an adjacent pixel in the first column by a pixel pitch. *Id.* at 4:26–28. The second column of pixels horizontally offset from the first column by the pixel pitch and vertically offset from the first column by a vertical pitch. *Id.* at 4:28–30. Each pixel in the second column is vertically offset from an adjacent pixel in the second column by the pixel pitch. *Id.* at 4:30–32. The vertical pitch is a fraction of the pixel pitch. *Id.* at 4:32–33. Thus, "the pixel block can include multiple columns of pixels laterally and vertically offset compared to a single column of pixels—to enable each pixel to be taller and wider-thereby enabling each pixel to include a greater number of detectors and increasing the dynamic range of the system—without necessitating a taller pixel block to accommodate such greater vertical pitch between pixels." *Id.* at 6:33–40.

Each pixel detects incident light, e.g., outputs a count of incident photons, a time duration between incident photons, a time duration of incident photons. *Id.* at 5:52–56. The system transforms these data into distances from the system to the external surfaces for the fields of view displayed by the pixels. *Id.* at 5:57–59.

Figure 2 of the '236 patent is reproduced below.

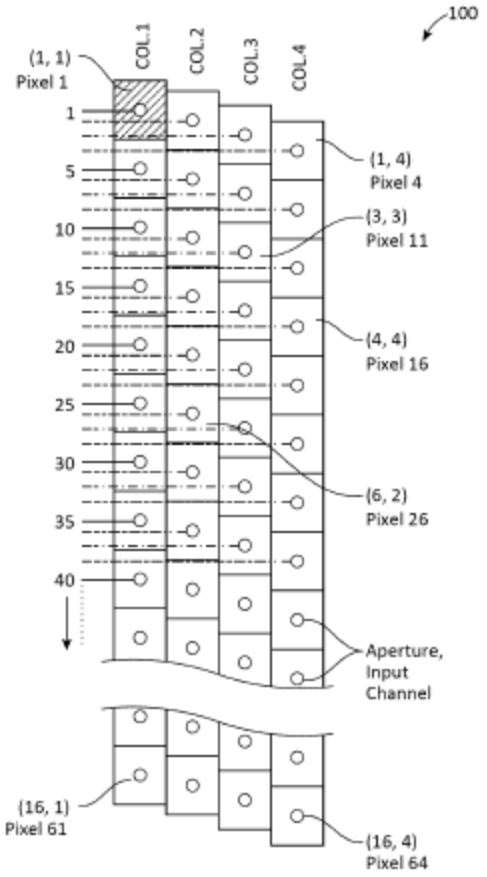


FIG. 2

Figure 2 shows an embodiment of the system implemented as "a 16x4 array of pixels and a corresponding 16x4 array of input channels that share a common bulk receiving optic." *Id.* at 7:45–47. "[P]ixels in each column of the four-column system [are] offset vertically by a fourth vertical pitch half the second vertical pitch of the two-column system (e.g., 400 microns versus 200 microns)." *Id.* at 7:53–57.

> [E]ach column of pixels in the four-column system [is] offset vertically from an adjacent column of pixels by one-quarter of the fourth virtual pitch, thereby providing space in the four-column system for pixels twice the height of pixels in the

two-column system given the same number of pixels arranged on a pixel block of approximately the same height.

Id. at 7:57–63.

E. Illustrative Claim

Petitioner challenges claims 1, 2, and 7–27 of the '236 patent. Claims 1, 10, 16, and 23 are independent. Claims 2 and 7–9 depend from claim 1. Claims 11–15 depend directly or indirectly from claim 10. Claims 17–22 depend directly or indirectly from claim 16. Claims 24–27 depend directly or indirectly from claim 23.

Claim 1 is illustrative and reproduced below.

1. An optical system for collecting distance information, the optical system comprising:

an optical imaging transmit module comprising a bulk transmitting optic and an illumination source comprising a plurality of optical emitters arranged behind the bulk transmitting optic, wherein each optical emitter in the plurality of optical emitters can project light at a nominal wavelength through the bulk transmitting optic and into a field ahead of the optical system;

an optical imaging receive module comprising a bulk receiving optic and a plurality of pixels arranged behind the bulk receiving optic, wherein each pixel in the plurality of pixels comprises a plurality of single photon avalanche diodes (SPADs) and wherein the plurality of pixels includes a first set of pixels arranged in a first column and a second set of pixels arranged in a second column horizontally and vertically offset from the first column; and

an actuator operable to rotate the optical imaging receive module about a vertical axis over a plurality of scan cycles in which, during each scan cycle, the optical imaging receive module is rotated 360 degrees such that each pixel in the plurality of pixels traverses a unique circular path

> parallel to and vertically offset from a unique circular path traversed by every other pixel in the optical system;
>
> wherein the optical system generates, for each of a plurality of arcuate sampling positions within one scan cycle, data that represents distances from the optical system to external surfaces in the field 360 degrees around the optical system.

Ex. 1001, 18:13–43.

F. Evidence

Name	Reference	Date	Exhibit No.
Hall	US 7,969,558	June 28, 2011	1004
Borowski	US 2013/0300840	Nov. 14, 2013	1005
Lipson	US 9,831,630	Nov. 28, 2017	1006
Hipp	US 7,787,105	Aug. 31, 2010	1007
Tan	US 7,544,945	June 9, 2009	1008
Weimer	US 8,736,818	May 27, 2014	1029
Matsui	WO 2017/110573	June 29, 2017	1031 (as translated)
Imai	US 10,114,110	Oct. 30, 2018	1033
Higashi	JP 631441	Apr. 25, 2018	1043 (as translated)

Petitioner also relies on the Declaration of Prof. Lambertus Hesselink, Ph.D. (Ex. 1003).

G. Asserted Grounds

Petitioner asserts the challenged claims would have been unpatentable on the following grounds:

Ground	Claim(s) Challenged	35 U.S.C. §	Basis
1A	1, 7, 9, 10, 23	103[1]	Hall, Borowski
1B	2, 15, 24	103	Hall, Borowski, Lipson
1C	8, 25	103	Hall, Borowski, Hipp

[1] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, 125 Stat. 284 (Sept. 16, 2011), includes revisions to Sections 102 and 103 that became effective on March 16, 2013. Because the challenged claims issued from an application filed before March 16, 2013, we apply pre-AIA law.

Ground	Claim(s) Challenged	35 U.S.C. §	Basis
1D	26, 27	103	Hall, Borowski, Tan
1E	11–13, 16, 17, 22	103	Hall, Borowski, Weimer
1F	14, 19–21	103	Hall, Borowski, Hipp, Weimer
1G	18	103	Hall, Borowski, Weimer, Lipson
2A	1, 7, 9–13, 16, 17, 22, 23, 26, 27	103	Matsui, Imai
2B	1, 2, 7, 9–13, 15–18, 22–24, 26, 27	103	Matsui, Imai, Higashi
2C	8, 14, 19–21, 25	103	Matsui, Imai, Hipp
2D	8, 14, 19–21, 25	103	Matsui, Imai, Higashi, Hipp

Petitioner also relies upon a Declaration of Lambertus Hesselink, Ph.D. (Ex. 1003).

II. ANALYSIS

A. Legal Standards

"In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")); *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a

person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). "[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result." *KSR*, 550 U.S. at 416 (citing *U.S. v. Adams*, 383 U.S. 39, 50–51 (1966)). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations). *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Here, the present record contains no evidence of objective indicia of non-obviousness.

B. Level of Ordinary Skill in the Art

Petitioner asserts: "A [person of ordinary skill in the art ('POSITA')] as of August 24, 2016 would have had an undergraduate degree in mechanical engineering, electrical engineering, or physics, and two to three years of experience in LiDAR design." Pet. 9 (citing Ex. 1003 ¶¶ 59–64).

Patent Owner does not dispute Petitioner's definition of a POSITA. Prelim. Resp. 9.

For purposes of this Decision, we adopt Petitioner's assessment of the level of ordinary skill in the art, as it is consistent with the '236 patent and the asserted prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

C. Claim Construction

In this *inter partes* review, we apply the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). In applying this standard, we generally give claim terms their ordinary and customary meaning as would be understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *See id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc).

We do not need to construe any terms explicitly to reach our decision. *See Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))); *see also* Pet. 10 ("[N]o formal constructions are necessary."); Prelim. Resp. 10 ("[N]o formal constructions are necessary.").

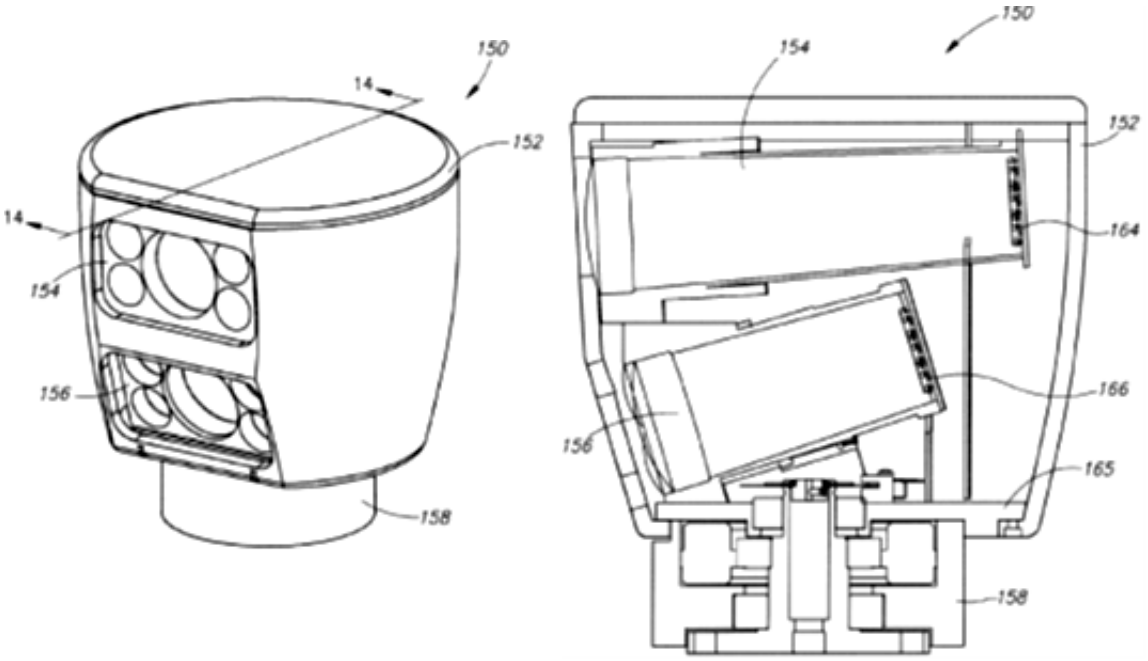
D. Ground 1A: Hall and Borowski—Claims 1, 7, 9, 10, and 23

Petitioner contends that claims 1, 7, 9, 10, and 23 are obvious over Hall and Borowski. Pet. 10–27.

1. Hall (Ex. 1004)

Hall relates to a "lidar-based 3-D point cloud measuring system." *Id.* at Abstract, 3:3–4. Hall explains that lidar uses a pulse of light from a laser to measure distance to an object. *Id.* at 1:11–14, 3:65–66.

Hall's Figures 13 and 14 are reproduced below side-by-side.



Figures 13 and 14 illustrate an embodiment of the "64 emitter/detector pair lidar" system. *Id.* at 6:42–43. The system includes a housing 152 mounted on base 158. *Id.* at 6:42–49. The housing is open on one side for receiving a first lidar system 154 mounted above a second lidar system 156. *Id.* at 6:44–46. Together the first and second lidar systems comprise "a configuration of 2 assemblies of 32 pairs" of pulsed laser emitters and photodiode detectors. *Id.* at 4:59–63. The second lidar system is positioned to have a line of sight at a different angle relative to horizontal than the first lidar system. *Id.* at 6:46–48.

A motor rotates the emitter/detector pairs about the base so that the system has "a 360-degree horizontal field of view (FOV)." *Id.* at 4:3–5, 5:39–40. The emitter/detector pairs rotate "at a rate of up to 200 Hz, thereby providing a high point cloud refresh rate." *Id.* at 4:5–8. "At this configuration, the system can collect approximately 1 million time of flight (TOF) distance points per second." *Id.* at 4:9–11. The configuration,

according to Hall, provides "the unique combination of 360 degree FOV, high point cloud density, and high refresh rate" all of which are necessary for autonomous navigation. *Id.* at 4:11–13, 6:37–41.

Figure 22 is reproduced below.

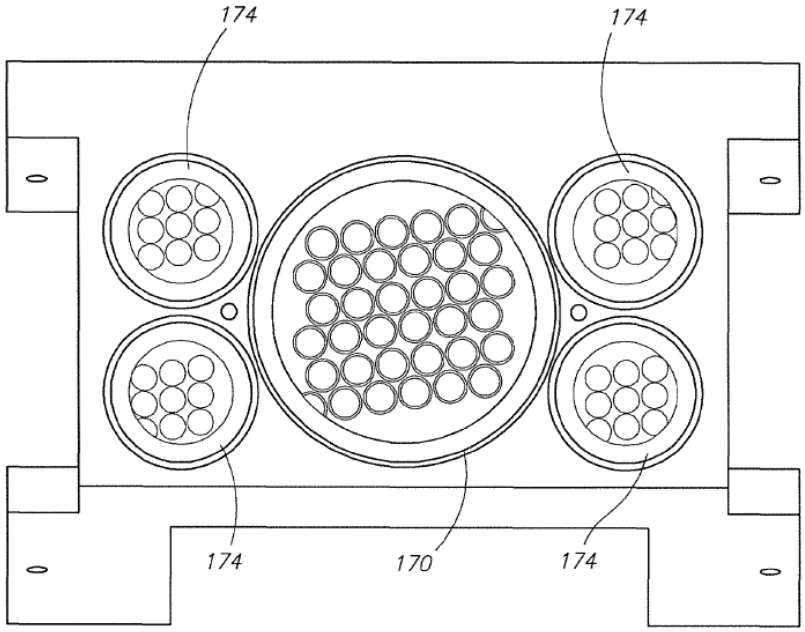


Figure 22 illustrates a "view[] of [the] scanning device." *Id.* at 3:52. With respect to Figure 22, Hall states:

> As shown in FIG. 22, behind each of the lenses in the cavity 174, are 16 laser emitters organized relatively horizontally, thereby combining for 32 total emitters. Behind the lens of the cavity 170 are 32 detectors that are positioned within a tube 176 of the unit 154.

Ex. 1004, 6:67–7:5.

2. Borowski (Ex. 1005)

Borowski is a U.S. patent publication titled "3D Landscape Real-Time Imager and Corresponding Imaging Methods." *Id.* at code (54). The "invention relates to a 3D landscape real-time imager." *Id.* ¶ 1.

Borowski's Figure 2 is reproduced below.

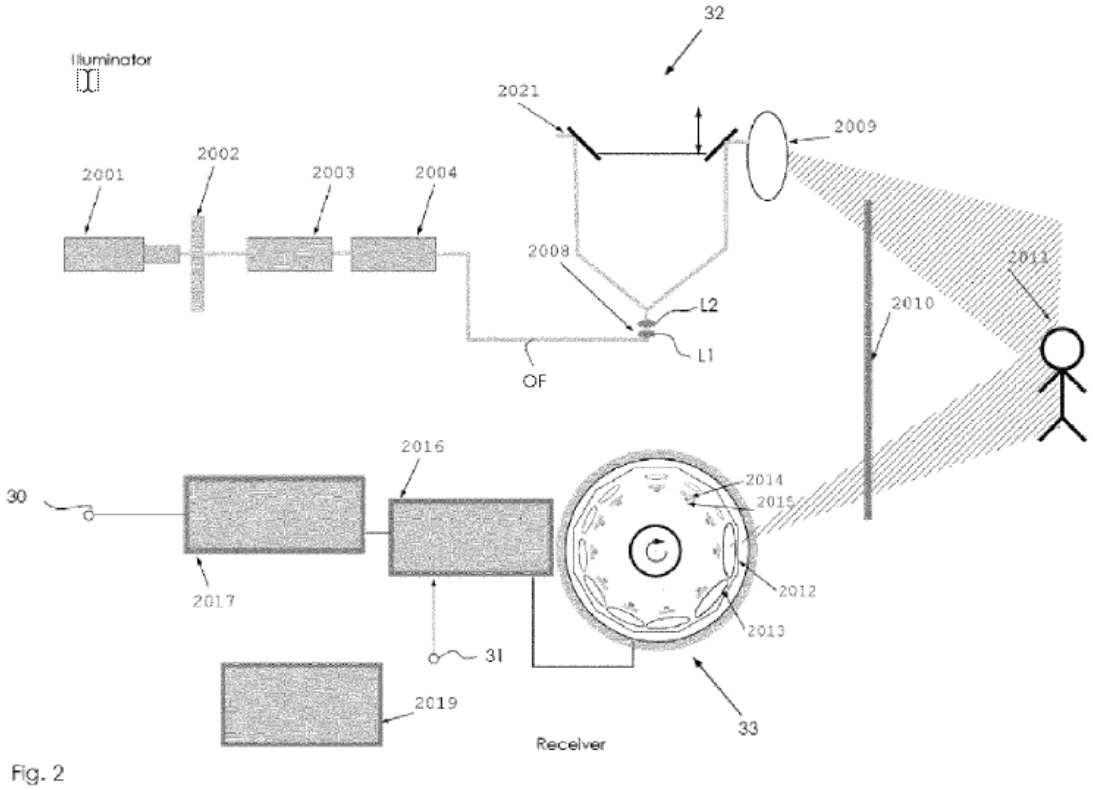


Fig. 2

Figure 2 is a "block diagram of an embodiment of a 3D real-time landscape imager of [the] invention." *Id.* ¶ 26. An illuminating part includes lasers 2001 pulses at varied wavelengths and repetition frequencies. *Id.* ¶ 61 A modulator 2002 suppresses some pulses. *Id.* Amplifiers 2003, 2004 further modulate the pulses. *Id.* ¶¶ 64, 66. A two-lens optical joint 2008 splits the pulses between different emitter groups targeting respective depths of the scene via respective pulse powers. *Id.* ¶ 67. The pulses are reflected by a cone-shaped, fixed mirror 2021. *Id.* Each of multiple rotating lens groups 2009 (e.g., 12) collimates and diverges the pulses so as to measure a respective range of distances. *Id.* ¶ 68. Respective beams of pulses accordingly rotate with the optical rotating device 32. *Id.*

A receiving part includes a rotating block 2012 of multiple lenses 2013 (e.g., 12) that simultaneously receive the pulses reflected by the scene and have respective focuses and sizes. *Id.* ¶ 78. The received pulses are directed from each lens to a plurality of SPAD detector arrays 2014. *Id.* Each or the arrays 2014 generates raw data, which is passed by the link 30 to an external controller. *Id.* ¶ 60.

Each SPAD detector array includes multiple SPAD detector cells. *Id.* ¶ 171. The raw data acquired by a group of cells (i.e., macro-cell) is filtered and averaged. *Id.* Because the quantity of avalanching cells (i.e., activated) can be too low for correct averaging, the imager determines whether a sufficient quantity are avalanching and accordingly (if insufficient) increases the power of the emitted pulses. *Id.*

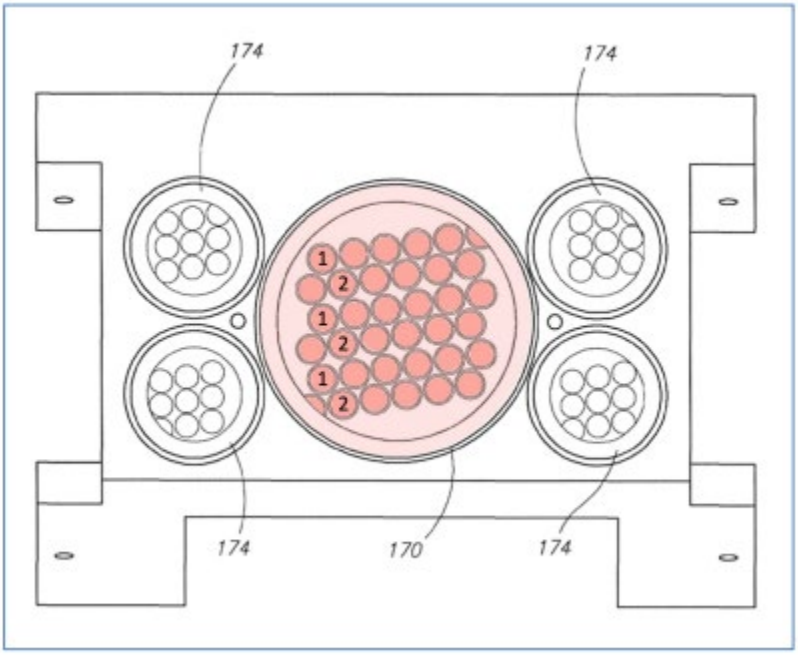
3. Analysis of Claim 1

Claim 1 recites:

> an optical imaging receive module comprising a bulk receiving optic and a plurality of pixels arranged behind the bulk receiving optic, *wherein each pixel in the plurality of pixels comprises a plurality of single photon avalanche diodes (SPADs) and wherein the plurality of pixels includes a first set of pixels arranged in a first column and a second set of pixels arranged in a second column horizontally and vertically offset from the first column.*

Ex. 1001, 18:22–30 (emphasis added).

Petitioner first relies upon Hall as teaching the claimed arrangement of pixel columns recited by this limitation. Pet. 19–20. Petitioner provides an annotated version of Figure 22 of Hall (*id.* at 20), which is reproduced below.



Annotated Figure 22 depicts the scanning device with cavity 170 shaded light red and the circles within the cavity shaded dark red. *Id.*; Ex. 1004, 3:52. One column of circles is labeled with the number 1 and another is labeled with the number 2. Pet. 20.

Relying upon annotated Figure 22, Petitioner asserts:

> Hall further teaches the pixels are arranged in columns, including a first set defining a first column and a second set defining a second column that is horizontally and vertically offset from the first column. . . . The arrangement is shown in Figure 22, with the second set of pixels (annotated as "2") horizontally and vertically offset from the first set of pixels (annotated as "1").

Pet. 20 (citations omitted); *see also id.* at 11. Petitioner's declarant, Dr. Hesselink, testifies likewise. Ex. 1003, 65–66 (claim chart).

Patent Owner contends that "Petitioner incorrectly assumes that each dark red circle in Figure 22 represents a detector." Prelim. Resp. 37. According to Patent Owner, Hall's specification directly contradicts

Petitioner's assumption and note that Petitioner only cites Hall's Figure 22 for support. *Id.* at 37–38.

On this record, we agree with Patent Owner. With respect to Figure 22, Hall states:

> As shown in FIG. 22, behind each of the lenses in the cavity 174, are 16 laser emitters organized relatively horizontally, thereby combining for 32 total emitters. Behind the lens of the cavity 170 are 32 detectors that are positioned within a tube 176 of the unit 154.

Ex. 1004, 6:67–7:5. Thus, Hall's specification describes 32 detectors as being behind the lens of cavity 170. But, Annotated Figure 22 depicts 36 dark red circles, which does not match the 32 detectors described in Hall's specification. Petitioner does not explain this discrepancy in the Petition.

Petitioner cites to Dr. Hesselink's testimony to support its assumption that Annotated Figure 22 shows the claimed arrangement of pixel columns. Pet. 20. Dr. Hesselink's testimony is conclusory and deficient because it does not sufficiently explain why a POSITA would know the dark red circles in Annotated Figure 22 were the detectors. Ex. 1003, 65–66 (claim chart); *see also id.* ¶¶ 72–73.

Petitioner next argues: "To the extent [Patent Owner] contends Hall does not disclose horizontal and vertical offset pixels, a POSITA would have found it obvious to arrange the pixels in this manner." Pet. 21 (citing Ex. 1003 ¶¶ 30–36, 66–17). Petitioner's only support for this argument is the testimony of Dr. Hesselink. Pet. 21. Petitioner, thus, attempts to substitute the testimony of Dr. Hesselink to teach the claimed arrangement of pixels.

But, as explained in our Consolidated Trial Practice Guide[2] (November 2019) at 36:

> Expert testimony, however, cannot take the place of a disclosure in a prior art reference, when that disclosure is required as part of the unpatentability analysis . . . . [I]n an obviousness analysis, conclusory assertions from a third party about general knowledge in the art cannot, without supporting evidence of record, supply a limitation that is not evidently and indisputably within the common knowledge of those skilled in the art. *K/S Himpp v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1365 (Fed. Cir. 2014). Furthermore, because an *inter partes* review may only be requested "on the basis of prior art consisting of patents or printed publications," 35 U.S.C. § 311(b), expert testimony cannot take the place of disclosure from patents or printed publications. In other words, expert testimony may explain "patents and printed publications," but is not a substitute for disclosure in a prior art reference itself.

Petitioner does not rely upon Borowski to teach the claimed arrangement of pixels. *See generally* Pet. 20–21.

Because Petitioner fails to show sufficiently that the combination of Hall and Borowski teaches the arrangement of pixels recited by claim 1, we determine that Petitioner has not met its burden to show that claim 1 would have been obvious over Hall and Borowski.

4. Claims 7 and 9

Claims 7 and 9 depend from claim 1. We determine that Petitioner has not met its burden to show a reasonable likelihood that claims 7 and 9 would have been obvious over Hall and Borowski. *In re Fritch*, 972 F.2d

[2] *Available at* https://www.uspto.gov/sites/default/files/documents/tpgnov.pdf.

1260, 1266 (Fed. Cir. 1992) ("[D]ependent claims are nonobvious if the independent claims from which they depend are nonobvious.").

5. Claims 10 and 23

Independent claims 10 and 23 recite substantially the same arrangement of pixel columns as claim 1. Ex. 1001, 19:34–37, 22:47–51. We determine that Petitioner has not met its burden to show a reasonable likelihood that claims 10 and 23 would have been obvious over Hall and Borowski.

E. Grounds 1B–1G

1. Independent Claim 16

Petitioner contends that claim 16 would have been obvious over Hall, Borowski, and Weimer. Pet. 40–48. Claim 16 recites substantially the same arrangement of pixel columns as claim 1. Ex. 1001, 20:57–61. Petitioner does not rely upon Weimer to cure the deficiency of Hall and Borowski discussed with respect to Ground 1A. *See* Pet. 40–48. We determine that Petitioner has not met its burden to show a reasonable likelihood that claim 16 would have been obvious over Hall, Borowski, and Weimer.

2. Dependent Claims 2, 8, 11–15, 17–22, and 24–27

Claims 2 and 8 depend from claim 1. Claims 11–15 depend from claim 10. Claims 17–22 depend from claim 16. Claims 24–25 depend from claim 23. We determine that Petitioner has not met its burden to show a reasonable likelihood that claims 2, 8, 11–15, 17–22, and 24–25 would have been obvious over the relied upon prior art. *In re Fritch*, 972 F.2d at 1266.

F. Ground 2A: Matsui and Imai—Claims 1, 7, 9–13, 16, 17, 22, 23, 26, and 27

Petitioner contends that claims 1, 7, 9–13, 16, 17, 22, 23, 26, and 27 are obvious over Matsui and Imai. Pet. 50–71.

1. Matsui (Ex. 1031)

Matsui is a Patent Cooperation Treaty (PCT) published patent application titled "Light Protection/Reception Unit and Radar." *Id.* at code (54). The "invention relates to a radar, and to a light projection/reception unit used in a radar, for detecting an object by irradiating it with a light beam from a light source." *Id.* ¶ 1.

Matsui's Figure 2 is reproduced below

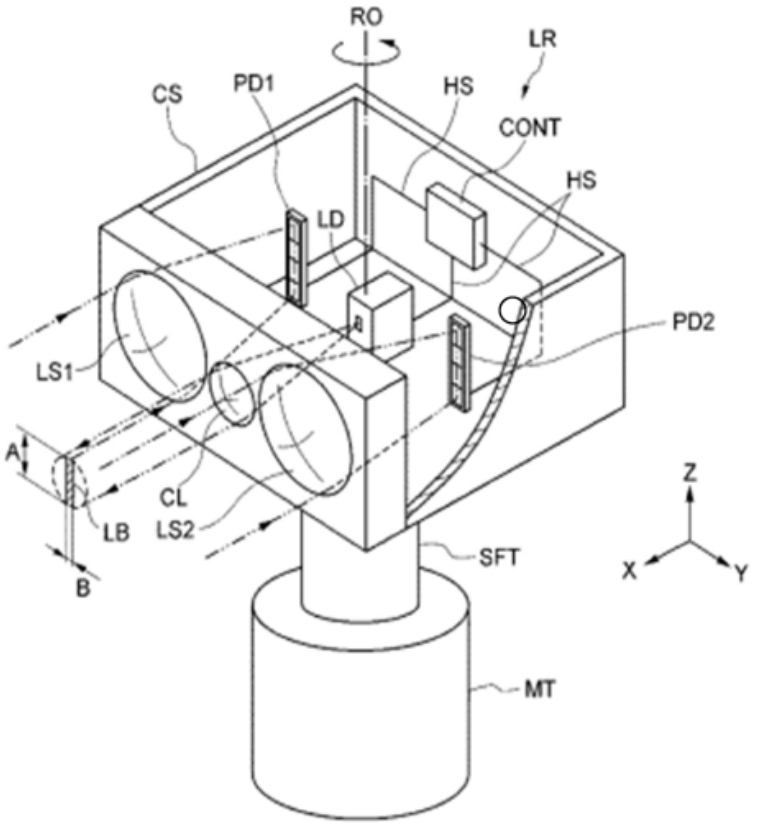


Figure 2 shows "a schematic diagram of the laser radar LR according to [an] embodiment." *Id.* ¶ 14. The laser radar LR has a motor MT attached

to the vehicle body and a casing CS attached to the distal end of a rotary shaft SFT of the motor MT. *Id.* ¶ 16. The casing CS rotates around the vertical axis of rotation RO along with the rotary shaft SFT. *Id.*

In the casing CS, as a light projection/reception unit, there is arranged: a semiconductor laser (light source) LD that emits a pulsed laser light beam; a collimating lens (light projection optical system) CL that converts divergent light from the semiconductor laser LD into a collimated light beam; a first lens (first light reception optical system) LS1 that focuses the reflected light beam (first reflected light beam) from the object OBJ onto which light was projected and scanned; a first light receiving part PD1 that receives the light focused by the first lens LS1; a second lens (second light reception optical system) LS2 that is arranged on the side opposite to the first lens LS1 across the collimating lens CL and focuses another reflected light beam (second reflected light beam) from the object OBJ; a second light receiving part PD2 that receives the light focused by the second lens LS2; and a control circuit CONT serving as a processing device. *Id.* ¶ 17. These components rotate about the axis of rotation RO along with the casing CS. *Id.*

The laser light beam emitted from the semiconductor laser LD passes through unillustrated components to form a cross-section of the collimated light beam LB incident on the object OBJ; the dimension A in the direction perpendicular to the central axis of the collimated light beam (the scanning orthogonal direction) being longer than the dimension B in the horizontal direction orthogonal thereto. *Id.* ¶ 18. The direction in which the collimated light beam LB rotates and moves is the "scanning direction" (i.e., second

direction). *Id.* The direction orthogonal to the scanning direction (i.e., the Z direction: the first direction) is the "scanning orthogonal direction." *Id.*

Matusi's Figure 3 is reproduced below.

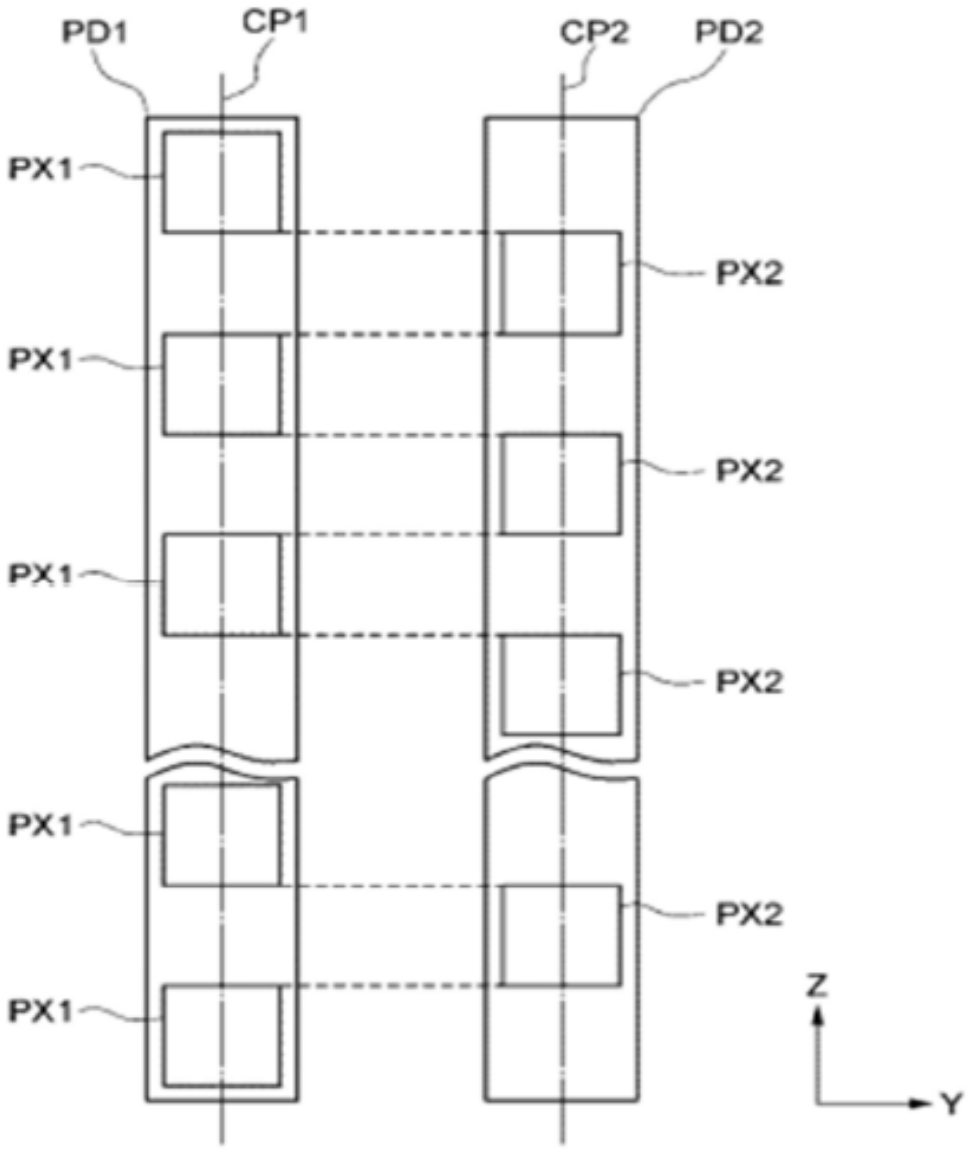


Figure 3 "is a schematic drawing showing the light receiving surfaces of the first light receiving part PD1 and the second light receiving part PD2." *Id.* ¶ 14. The first light receiving part PD1 has a plurality of first light receiving elements PX1 arranged in a single row at equal intervals in the Z

direction on its light receiving surface facing the first lens LS1. *Id.* ¶ 19. The second light receiving part PD2 also has a plurality of second light receiving elements PX2 arranged in a single row at equal intervals in the Z direction. *Id.*

The first light receiving elements PX1 and the second light receiving elements PX2 have the same rectangular shape, are arranged at the same Z-direction interval, and are arranged in a staggered manner. *Id.* ¶ 20. That is, the position of the lower edge of a first light receiving element PX1 in the Z direction coincides with the position of the upper edge of the nearest second light receiving element PX2 (and so forth). *Id.* Thus, if the first light receiving elements PX1 were to be shifted in the Y direction (second direction) relative to the second light receiving elements PX2, these elements PX1, PX2 would contact each other. *Id.* "[I]t is sufficient if at least some of the first light receiving elements PX1 and second light receiving elements PX2 satisfy this relationship." *Id.*

2. Imai (Ex. 1033)

Imai is a U.S. patent titled "Object Detecting Device, Sensing Device, and Mobile Object Device." *Id.* at code (54). The "invention relates to . . . detect[ing] whether there is an object and detects a distance and the like to the object." *Id.* at 1:17–19.

Imai's Figure 4 is reproduced below.

FIG.4

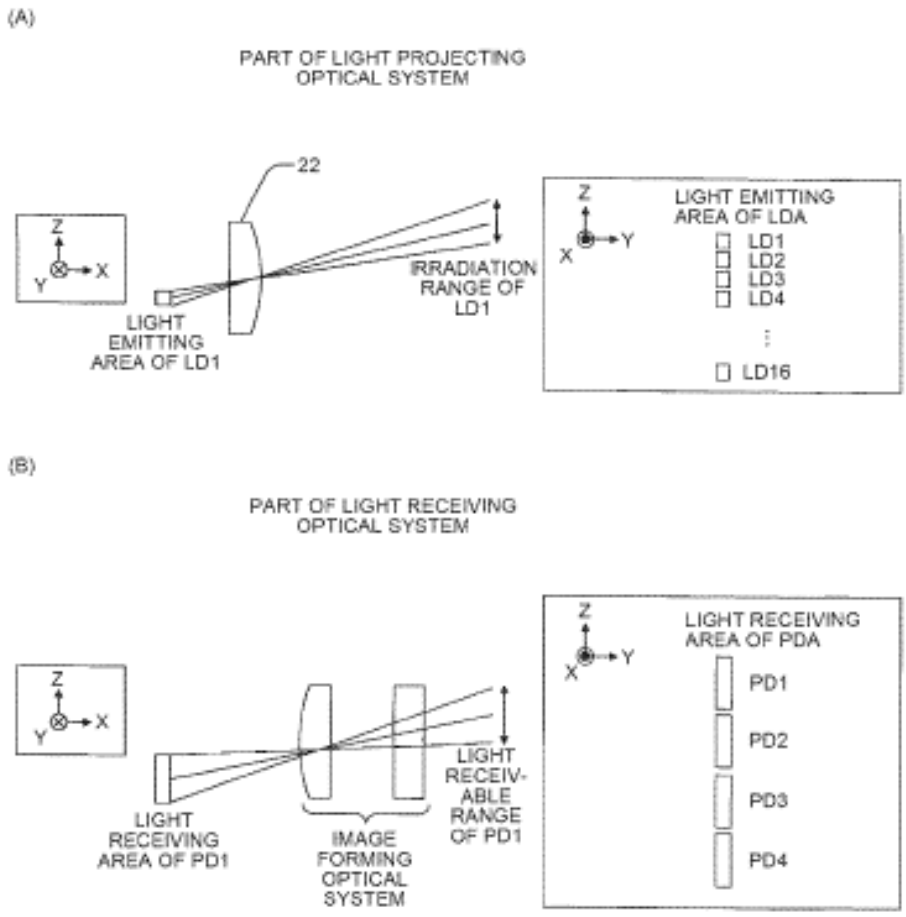


Figure 4 illustrates "[a first laser diode] LD1 (one light emitting area) of [a laser diode array] LDA and an irradiation range of the LD1 at [top illustration] (A) and illustrating a [first photodiode] PD1 (one light receiving area) of [a photodiode array] PDA and a light receivable range of the PD1 at [bottom illustration] (B)." *Id.* at 2:1–4.

The LDA is a vertically stacked laser array in which a plurality of (for example, 16) LDs of LD1 to LD16 is arranged in the Z-axis direction (subscanning direction). *Id.* at 6:15–18. The light receiving area of each PD

of the PDA, and the light receivable range of the reflected light from the object of a PD1, is one PD of the PDA at (B). *Id.* at 6:21–23. The PDA is a vertically stacked photo diode array in which a plurality of (for example, four) PDs of PD1 to PD4 is arranged in the Z-axis direction (sub-scanning direction). *Id.* at 6:24–26.

Imai's Figure 10 is reproduced below.

FIG.10

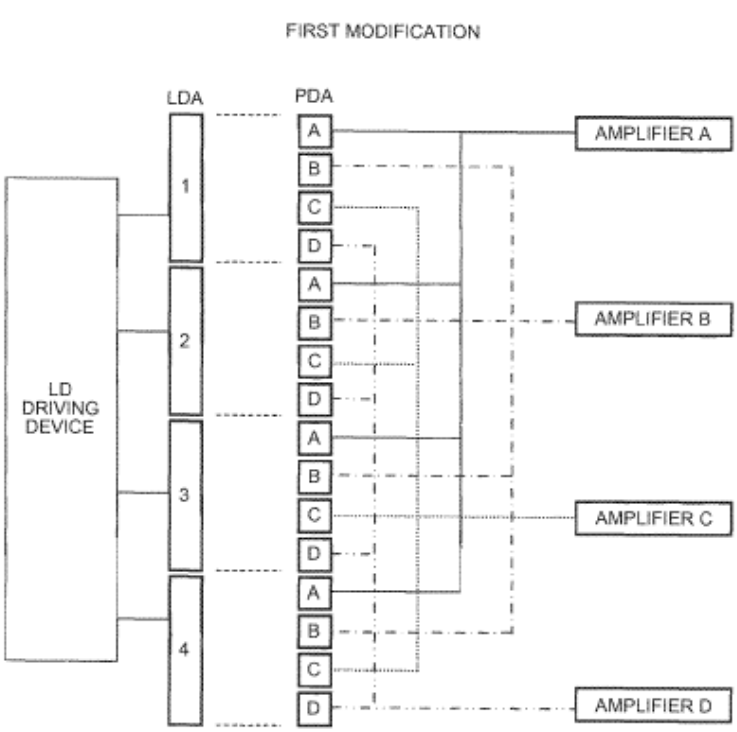


Figure 10 is a diagram illustrating a "correspondence relationship among each LD of an LDA, each PD of a PDA, and four amplifiers of a first modification." *Id.* at 2:18–20. Four PDs of a group A are electrically connected to one another to be connected to an amplifier A. *Id.* at 10:31–34. Similarly, four PDs for each of groups B–D are respectively associated with amplifiers B–D. *Id.* at 10:35–43. "Though it is possible to provide one

amplifier for each of a plurality of PDs, it is preferable to connect a plurality of PDs to one amplifier as described above because the quantity of amplifiers may be decreased." *Id.* at 11:19–22.

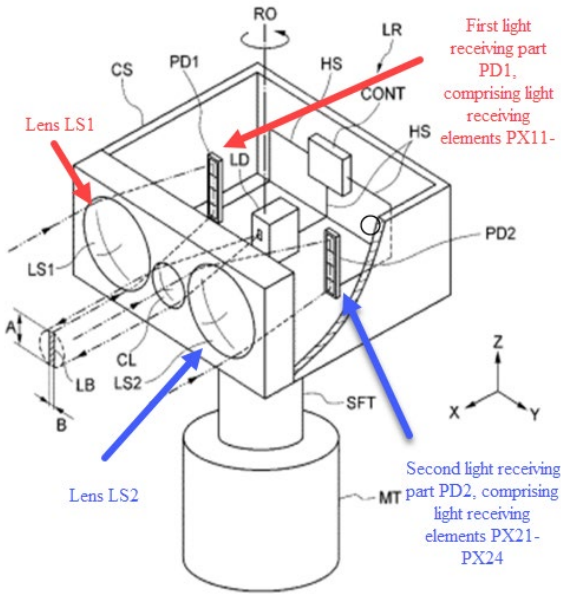
3. Analysis of Claim 1

Claim 1 recites:

> *an optical imaging receive module comprising a bulk receiving optic and a plurality of pixels arranged behind the bulk receiving optic,* wherein each pixel in the plurality of pixels comprises a plurality of single photon avalanche diodes (SPADs) and *wherein the plurality of pixels includes a first set of pixels arranged in a first column and a second set of pixels arranged in a second column horizontally and vertically offset from the first column.*

Ex. 1001, 18:22–30 (emphases added).

Matsui's Figure 2 is reproduced below, with annotations added.



Annotated Figure 2 shows first light receiving part PD1, comprising light receiving elements PX11–PX14, behind lens LS1 and second light receiving part PD2, comprising light receiving elements PX21–PX24,

arranged behind lens LS2. Lens LS1 is separated from lens LS2 by collimating lens CL. First light receiving part PD1 is separate from second light receiving part PD2.

Petitioner combines lenses LS1 and LS2 to teach the claimed bulk receiving optic. Pet. 59 ("The laser-radar device in Matsui includes lenses (LS1, LS2) which comprise a bulk receiving optic . . . ."); *see also id.* at 18 n.6. Petitioner relies upon Matsui's light receiving elements PX11–PX14 to teach the claimed first column (i.e., PD1) and light receiving elements PX21–PX24 to teach the claimed second column (i.e., PD2). *Id.* at 51, 59.

Patent Owner contends that "Matusi teaches a one-dimensional vertical array of pixels behind ***each*** bulk optic LS1 and LS2, not two sets of pixels behind each bulk optic as taught by the '236 Patent." Prelim. Resp. 49–50.

On this record and under the circumstances here, we agree with Patent Owner. Claim 1 requires "a bulk receiving optic and a plurality of pixels arranged behind the bulk receiving optic" and that "the plurality of pixels includes a first set of pixels arranged in a first column and a second set of pixels arranged in a second column horizontally and vertically offset from the first column." Ex. 1001, 18:22–30. Although the '236 patent discloses that the bulk receiving optic can be formed of multiple lenses, such as bi-convex lenses, those lenses cooperate to form a converging lens with all columns of pixels behind the converging lens. *See, e.g.*, *id.* at 9:56–65, Figs. 1, 3A. The '236 patent does not disclose any embodiment where the columns of pixels are each behind a separate non-cooperating lenses. *See generally id.*

Like Patent Owner (Prelim. Resp. 50–51), we note that in a footnote in connection with its analysis of Ground 1A, Petitioner asserts: "A bulk transmitting optic" encompasses one or more optics due to use of the indefinite article "a." Pet. 18 n.6 (citing *KCJ Corp. v. Kinetic Concepts, Inc.*, 223 F. 3d 1351, 1356 (Fed. Cir. 2000)). But, does not sufficiently explain why under the circumstances here, claim 1's bulk receiving optic encompasses two separated lens each having a single column of pixels, not two columns of pixels in the claimed arrangement. *See* 37 C.F.R. § 42.104(b)(4) (requiring the Petition to identify how the challenged claims is to be construed).

Petitioner does not rely upon Imai to teach the claimed arrangement of pixels behind the bulk receiving optic. *See generally* Pet.

On this record, we determine that Petitioner has not met its burden to show a reasonable likelihood that claim 1 is unpatentable over Matsui and Imai.

G. Ground 2B

1. Independent Claims 1, 10, 16, and 23

Petitioner contends that claims 1, 10, 15, and 23 would have been obvious over Matsui, Imai, and Higashi. Pet. 71–78. Petitioner does not rely upon Higashi to cure the deficiency of Matsui and Imai, discussed with respect to Ground 2A. *See id.* We determine that Petitioner has not met its burden to show a reasonable likelihood that claims 1, 10, 16, and 23 would have been obvious over Matsui, Imai, and Higashi.

2. Dependent Claims 2, 7, 9, 11–13, 15, 17–18, 22–24, and 26–27

Claims 2, 7, and 9 depend directly or indirectly from claim 1. Claims 11–13 and 15 depend directly or indirectly from claim 10. Claims 17, 18,

22, and 23 depend directly or indirectly from claim 16. Claims 24, 26, and 27 depend directly or indirectly from claim 23. We determine that Petitioner has not met its burden to show a reasonable likelihood that claims 2, 8, 11–15, 17–22, and 24–25 would have been obvious over the relied upon prior art. *In re Fritch*, 972 F.2d at 1266.

H. Grounds 2C and 2D

Claims 8 depends from claim 1. Claim 14 depends from claim 10. Claims 19–21 depend from claim 16. Claim 25 depends from claim 23. We determine that Petitioner has not met its burden to show a reasonable likelihood that claims 8, 14, 19–21, and 25 would have been obvious over the relied upon prior art. *In re Fritch*, 972 F.2d at 1266.

III. CONCLUSION

After considering the evidence and arguments presented in the Petition and Preliminary Response, we determine that the information presented fails to show reasonable likelihood that Petitioner would prevail in establishing that any one of claims 1, 2, and 7–27 are unpatentable.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that the Petition is *denied*.

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