Hesai Technology Co., Ltd.(Petitioner)
v.
Ouster, LLC. (Patent Owner)

Petitioner's Demonstratives

Case Nos. IPR2023-01456, IPR2023-01457
U.S. Patent Nos. 11,178,381, 11,190,750
Before Hon. Meredith C. Petravick, Kevin W. Cherry, and Jon M. Jurgovan
Administrative Patent Judges

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

EX1048
Hesai v. Ouster
IPR2023-01456

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Issue 1

"coincident with" elements

('381 claims 1, 14 and '750 claim 44)

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Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

'381 Patent, Claim 1

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

a bulk transmitting optic;

a plurality of optical emitters arranged behind the bulk transmitting optic and configured to output electromagnetic radiation of an operating wavelength through the bulk transmitting optic into a field external to the optical system according to an illumination pattern that comprises a plurality of non-overlapping emission regions;

a bulk imaging optic disposed adjacent to the bulk transmitting optic;

a plurality of pixels arranged behind the bulk imaging optic, wherein each pixel in the plurality of pixels has a field of view coincident with an emission region of a corresponding optical emitter in the plurality of optical emitters and each pixel comprises a plurality of single photon avalanche diodes (SPADs) operable to detect photons emitted from its corresponding optical emitter and received through the bulk imaging optic after being reflected from surfaces within the field; and

an optical filter disposed in an optical path of the plurality of pixels, the optical filter configured to allow a set of wavelengths of electromagnetic radiation, including the operating wavelength, to pass through the optical filter while blocking electromagnetic radiation outside the set of wavelengths from reaching the plurality of pixels.

'381 Patent, Claim 14

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

a bulk transmitting optic;

a plurality of optical emitters arranged behind the bulk transmitting optic and configured to output electromagnetic radiation of an operating wavelength into a plurality of non-overlapping emission regions, each emission region representing a spot in a field ahead of the optical system;

a bulk imaging optic;

a plurality of pixels arranged behind the bulk imaging optic and corresponding in number to the plurality of optical emitters, wherein each pixel in the plurality of pixels is paired with a different optical emitter in the plurality of optical emitters and has a field of view coincident with an emission region of its paired optical emitter and wherein each pixel comprises a plurality of single photon avalanche diodes (SPADs) operable to detect photons emitted from its paired optical emitter and received through the bulk imaging optic after being reflected from surfaces within the field; and

an optical filter disposed in an optical path of the plurality of pixels, the optical filter configured to allow a set of wavelengths of electromagnetic radiation, including the operating wavelength, to pass through the optical filter while blocking electromagnetic radiation outside the set of wavelengths from reaching the plurality of pixels;

wherein, the optical system is configured to collect distance data based on times between transmission of beams of electromagnetic radiation from the plurality of optical emitters and detection of photons from the beams by the plurality of pixels.

'750 Patent, Claim 44

44. An optical imaging system comprising:

a bulk imaging optic;

a plurality of pixels arranged behind the bulk imaging optic, wherein each pixel in the plurality of pixels comprises a plurality of single photon avalanche diodes (SPADs) and has a field of view that is non-overlapping beyond a threshold distance in a field external to the optical imaging system with fields of view of all other pixels in the plurality of pixels, and wherein the plurality of pixels includes at least a first pixel and a second pixel;

an aperture layer disposed between the bulk imaging optic and the plurality of pixels, the aperture layer comprising a plurality of apertures separated from each other by a stop region, the plurality of apertures including a first aperture disposed in a first optical path extending between the bulk imaging optic and the first pixel and a second aperture disposed in a second optical path extending between the bulk imaging optic and the second pixel;

a bulk transmitting optic disposed adjacent to the bulk imaging optic; and

a plurality of emitters arranged to project electromagnetic radiation through the bulk transmitting optic and into the field according to an illumination pattern where electromagnetic radiation output from each emitter in the illumination pattern is coincident with a field of view of a corresponding pixel in the plurality of pixels.

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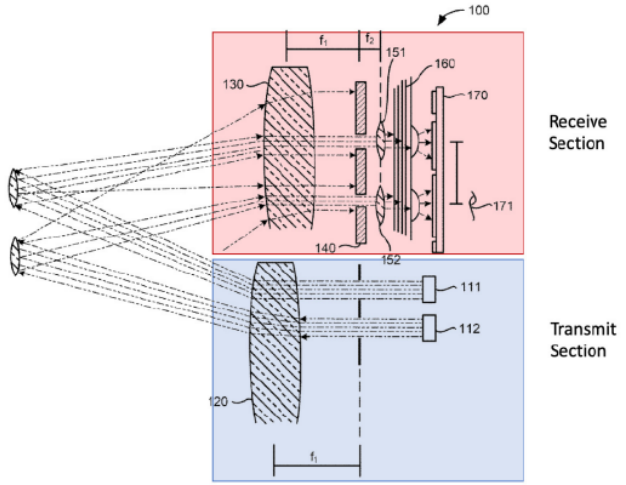
Examples in the ’750 Patent (similarly in the ’381 Patent)

In this implementation, a first aperture **141** in the aperture layer **140** defines a field of view that is distinct and that does not intersect a field of view defined by another aperture in the aperture layer **140**, as shown in FIG. **2**. The set of illumination sources **110** includes a first illumination source **111** paired with the first aperture **141** and configured to project an illuminating beam substantially aligned with (i.e., overlapping) the field of view of the first aperture **141** in the field ahead of the bulk imaging optic **130**. Furthermore, the first illumination source **111** and a bulk transmitting optic **120** can cooperate to project an illuminating beam of a cross-section substantially similar to (and slightly larger than) the cross section of the field of view of the first aperture **141** as various distances from the bulk imaging optic **130**. Therefore light output by the first illumination

EX1001, 5:17-31 (cited at -01457 POR, 28)

Because the first illumination source **111** projects an illuminating beam that is substantially coincident (and substantially the same size as or minimally larger than) the field of view defined by the first aperture **141** (as shown in FIG. **4**), a signal passed into the first lens **151** by the first aperture **141** in the aperture layer **140** can exhibit a relatively high ratio of light rays originating from the first illumination source **111** to light rays originating from other illumination sources in the system. Generally, because various illumination

EX1001, 6:3-11 (cited at -01457 POR, 28)



-01457 Pet., 7; EX1001, FIG. 2

shown in FIG. **2**. In this second example, each emitter is characterized by an illuminating active area (or aperture) of diameter approximately (or slightly greater than) twice the diameter of a corresponding aperture in the apertures layer, and the column of emitters is offset behind the bulk transmitter optic by twice the focal length of the bulk transmitter optic such that each illuminating beam projected from the bulk transmitter optic into the field intersects and is of substantially the same size and geometry as the field of view of the corresponding sense channel, as described above.

EX1001, 11:28-37 (cited at -01457 POR, 28)

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Issue 1A

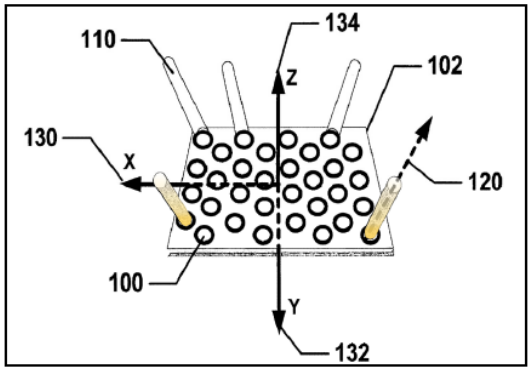
The Retterath Grounds Disclose the "Fields of View Coincident with" Element

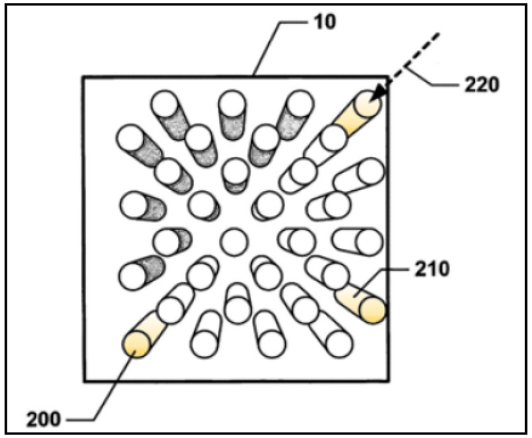
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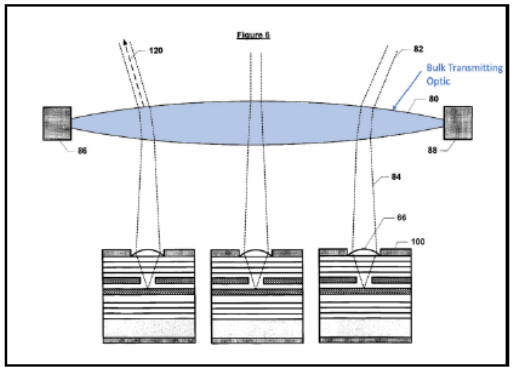
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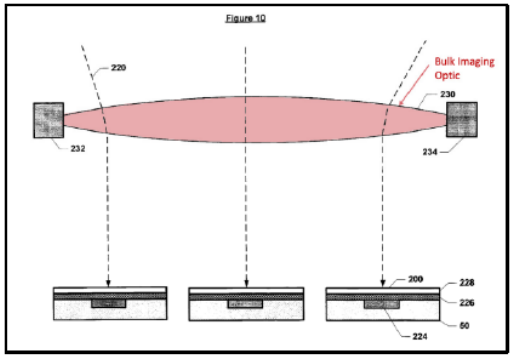
The Retterath Grounds Disclose the "Coincident with" Elements

Retterath









Pet., 26-27; EX1005, FIGS. 4, 6, 8, 10; EX1003, ¶151

the device normal to a plane of the array **10**. For each emitter/detector set of elements **100/200**, the emitter and detector vectors are coincident and form a common on-coincident axis that is at an angle relative to a vector normal to the plane of the array that is unique for that emitter/detector set.

Pet., 28; EX1005, 6:23-28

For a device where the angular spacing of successive emitter elements **100** is equivalent across the horizontal and vertical fields of view, each emitter of emitter elements **100** projection angle beam of light **110** is expressed as a emitter vector **120** utilizing uvw nomenclature, where u corresponds to the x-axis **130**, v corresponds to the y-axis **132**, and w corresponds to a z-axis **134**:

Pet., 22, 27; EX1005, 7:61-67

Referring to FIG. **7**, a beam profile for multiple emitters according to an embodiment is shown. The top diagram shows a perfectly collimated beam **92** that produces a round spot **94** on the surface of the reflecting object. The beam

Pet. 22, EX1005, 9:29-32

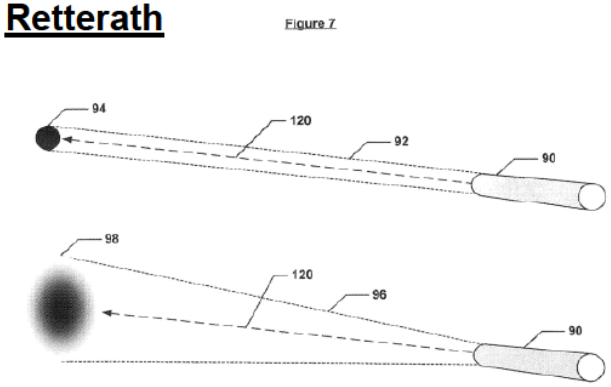
Referring to FIG. **8**, a top view of detector elements **200** geometry on the emitter/detector array **10** surface is shown according to an embodiment. Light **210** is received at each detector of detector elements **200**. Each detector of detector elements **200** has an optimal receive detector vector (coincident axis) **220** along which the maximum optical energy will be transferred. Inbound optical energy that is slightly

Pet. 26-27; EX1005, 9:53-59

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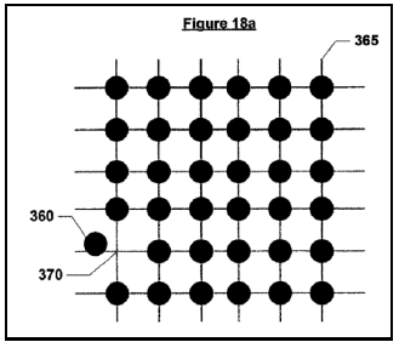
The Retterath Grounds Disclose the "Coincident with" Elements

Retterath



collimated beam **92** has advantages. First, a smaller round spot **94** size will result in fewer locations within the device field of view being illuminated. Since the goal of LiDAR is to measure the distance to a point at a known coincident angle, reducing the number of points that generate a return signal will increase the device's precision. Second, a smaller round spot **94** will generally reduce or remove crosstalk with detectors that are near the on-coincident axis matched detector for this emitter **90**. The bottom diagram in FIG. **7** shows

Pet., 22-23; EX1005, 9:34-44, FIG. 7, 18a



In various embodiments of the present invention the emitters are constructed using 650 nanometer lasers. One skilled in the art can utilize other wavelengths for emitter and detector construction as long as the emitted radiation maintains its directionality while transmitting though the medium and as long as the selected wavelength is not highly absorptive by the objects contained in the medium. In some embodiments, the light energy is emitted and received as collimated or coherent electromagnetic energy, such as common laser wavelengths of 650 nm, 905 nm or 1550 nm.

Pet., 15, 22; EX1005, 19:33-44

'381 Patent

As shown in FIG. **1**, a one-dimensional optical system **100** for collecting distance information within a field includes: a set of illumination sources **110** arranged along a first axis, each illumination source in the set of illumination sources **110** configured to output an illuminating beam of an operating wavelength toward a discrete spot in the field ahead of the illumination source; a bulk imaging optic **130**

Pet., 24; EX1001, 2:7-11

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The Retterath Grounds Disclose the "Coincident with" Elements

'381 Patent

in the system. Generally, because various illumination sources in the system may output illuminating beams at different frequencies, duty cycles, and/or power levels, etc. at a particular time during operation, light rays passed from the bulk imaging optic **130** into a first pixel **171** in the set of pixels **170** but originating from an illumination source other than the first illumination source **111** paired with the first pixel **171** constitute noise at the first pixel **171**. Though the

EX1001, 6:20-27; Reply, 11; EX1040, ¶20

Retterath

through 37. Since the vectors are similar, emitted energy from one emitter will possibly be received at a detector that is not its pair. To accommodate detection of pulse sequences

EX1005, 11:33-35; Reply, 11

Dr. Shanley

not its pair. *See* EX1001, 6:15-27. For example, the '381 Patent discloses that rays from an emitter are sometimes detected by a non-paired pixel and are "noise." *See* EX1001, 6:20-27. Retterath describes a similar situation where emitters are paired with pixels and the extent that energy from one emitter is "possibly" detected by a non-paired pixel.

Reply, 11; EX1040, ¶30

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

Petition

lenged claims obvious under the constructions advanced by both parties. Accordingly, no formal claim constructions are necessary in this proceeding because "claim terms need only be construed to the extent necessary to resolve the controversy." *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011).

Pet., 3-4

Dr. Shanley

that meaning in the context of the patent and its prosecution history. Based upon my review of the '381 Patent and my knowledge and experience in this field, the claim language does not include specialized terms that require further explanation or elaborative definitions. The ordinary and customary meaning would have recognized and understood by a POSITA.

9. For example, I believe that "a field of view coincident with an emission region" as recited by claims 1 and 14 is a phrase that a POSITA would have understood without needing any substituted terminology. This is confirmed by the '381 Patent's description and the plain usage by others at the time. I note that Patent Owner mischaracterizes my analysis of the "field of view coincident with an emission region" elements. For example, Patent Owner states that the analysis in my first declaration "only take[s] into account the *direction* of the emission regions and fields of view—not the *area* of these regions." POR, 2. This is not correct.

Reply, 2, EX1040, ¶¶9-10

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

Patent Owner's Response

Based on the specification of the '381 patent and the extrinsic evidence, the term "**each pixel in the plurality of pixels has a field of view coincident with an emission region of [a corresponding/its paired] optical emitter**" should be construed to mean that the field of view of each pixel and the emission region of a corresponding [or paired] optical emitter cover substantially the same area in the field. (EX2009, ¶¶108-22.) Petitioner's construction is consistent with the intrinsic evidence.

source." (EX1001, 3:61-4:1 (emphasis added).) Accordingly, the specification uses the term "coincident" to mean that one area (the field of view of an aperture) matches another (the "discrete spot" of an illumination source). (EX2009, ¶111.)

The extrinsic evidence further supports Patent Owner's construction. For example, the term "coincident" is defined as "[o]ccupying the same place or portion of space." (EX2011 (Oxford English Dictionary (1989)) at 8.) This definition

POR, 23-25, 28

'381 Patent, claim 1

a plurality of pixels arranged behind the bulk imaging optic, wherein each pixel in the plurality of pixels has a field of view coincident with an emission region of a corresponding optical emitter in the plurality of optical emitters and each pixel comprises a plurality of single photon avalanche diodes (SPADs) operable to detect photons emitted from its corresponding optical emitter and received through the bulk imaging optic after being reflected from surfaces within the field; and

'381 Patent

Because the first illumination source **111** projects an illuminating beam that is substantially coincident (and substantially the same size as or minimally larger than) the field of view defined by the first aperture **141** (as shown in FIG. **4**), a signal passed into the first lens **151** by the first aperture **141** in the aperture layer **140** can exhibit a relatively high ratio of light rays originating from the first illumination source **111** to light rays originating from other illumination sources in the system. Generally, because various illumination

EX1001, 6:12-20; Reply, 3

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

'381 Patent, FIG. 1

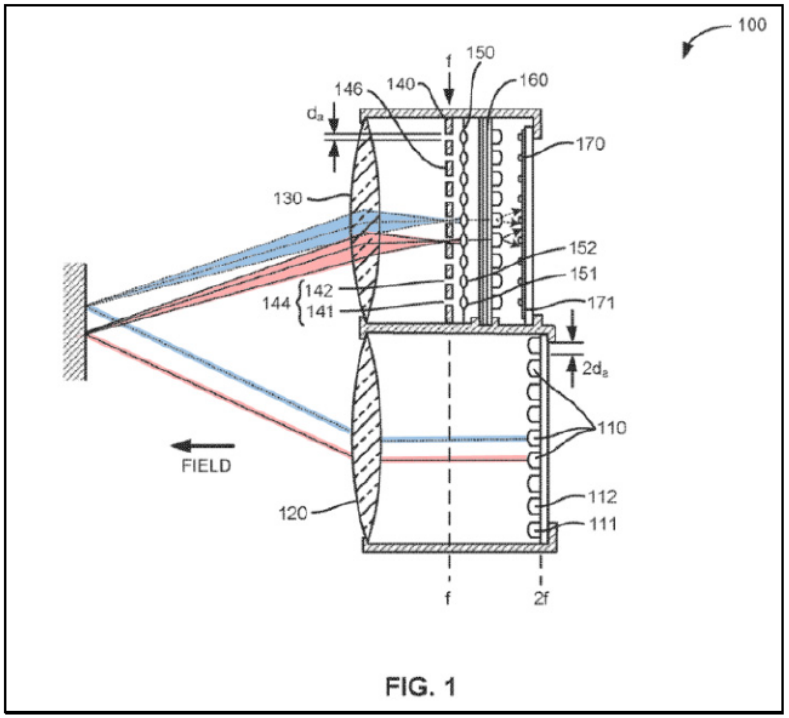


FIG. 1

Dr. Shanley:

sources 110."). Although FIG. 1 indicates there is an overlapping relationship sufficient for the beam to be detected, FIG. 1 does not indicate a size of the field of view relative to a size of the corresponding emission region. *Id.* Dr. Janét relies on FIG. 1, despite its lack of indication of the extent of the fields of view. EX1041, 29 ("My opinion about the field of view of 111 would be any reference I have to Figure 1.").

Dr. Janét:

THE WITNESS: My opinion about the field of view of 111 would be any reference I have to Figure 1. Figure 1 -- again, if I'm wrong, point it to me. But 111 in Figure 1 does not have any lines drawn from it passing through bulk optics and the like.

EX1040, ¶14; EX1041, 29; Reply, 4

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

'381 Patent:

> Because the first illumination source **111** projects an illuminating beam that is substantially coincident (and substantially the same size as or minimally larger than) the field of view defined by the first aperture **141** (as shown in FIG. **4**),

EX1001, 6:12-15; FIG. 2; Reply, 3, 7

> pitch distance. In this first example, each emitter outputs an illuminating beam of diameter substantially identical to or slightly greater than the diameter of a corresponding aperture in the apertures layer, and the column of emitters is

EX1001, 11:17-20; Pet. 67; Reply, 6

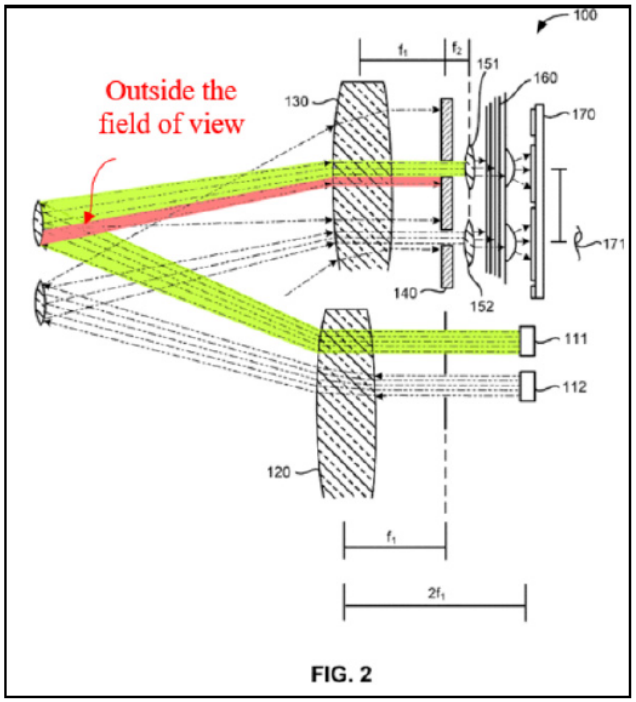


FIG. 2

A "claim interpretation that excludes a preferred embodiment from the scope of the claim is rarely, if ever, correct." *Accent Packaging, Inc. v. Leggett & Platt, Inc.*, 707 F.3d 1318, 1326 (Fed. Cir. 2013).

EX1040, ¶14; EX1041, 29; Reply, 4

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

Patent Owner Response (-01456)

The '381 patent specification indicates that each aperture **144** in Figure 1 "defines a **field of view in the field coincident a discrete spot** by a corresponding illumination source." (EX1001, 3:61-4:1 (emphasis added).) Accordingly, the specification uses the term "coincident" to mean that one area (the field of view of an aperture) matches another (the "discrete spot" of an illumination source). (EX2009, ¶111.)

As shown in FIGS. **1** and **2**, the system includes an aperture layer **140** coincident the focal plane, defining a set of apertures **144** in a line array parallel to the axes of the illumination sources, and defining a stop region **146** around . . .

which the pixels are blind." (EX1001, 3:4-12.) Further, matching emission and detection regions between pairs of corresponding or paired emitters and detectors leads to "a relatively high ratio of light rays originating from the first illumination source **111** to light rays originating from other illumination sources in the system." (*Id.*, 6:12-37.)

POR, 27 (citing EX1001, 6:12-37)

Patent Owner Sur-Reply (-01456)

Petitioner and its expert focus on Figure 2 of the '381 patent, which shows the impact curvature in an object in the external field can have on the path of certain light emitted by an optical system. Reply at 4, 6-7. But an aberration caused by the curvature of the external field does not invalidate the '381 patent's clear and extensive disclosures regarding *matching* emission and detection regions and thereby minimizing wasted light and wasted detector area "across a range of distances from the system[.]"[3] EX1001, 2:67-3:12, 2:53-3:20, 3:25-30; EX1041,

Patent Owner Sur-Reply, 8

Platt, Inc., 707 F.3d 1318, 1326 (Fed. Cir. 2013)). But none of the specification excerpts Petitioner points to relate to a preferred embodiment.[5] In fact, there is no indication that these specification excerpts relate to an embodiment having pixels with fields of view "coincident with" corresponding optical emitters at all. EX1001, 11:4-25 (discussing "one implementation"), 6:12-20 (discussing unclaimed "substantially coincident" fields of view).

Patent Owner Sur-Reply, 9-10

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

Patent Owner Response (-01457)

The '750 patent specification indicates that this matching between radiation outputs and detector fields of view is "substantial[]" matching. (EX2009, ¶109.) For example, the '750 patent discloses that the system "selectively project[s] illuminating beams into a field ahead of the system according to an illumination pattern that **substantially matches**—in size and geometry across a range of distances from the system—the fields of view of the apertures." (EX1001, 2:58-62; *see also id.*, 5:5-58, 6:3-11, 11:28-37.)

as shown in FIG. **2**.

shown in FIG. **2**

Because the first illumination source **111** projects an illuminating beam that is substantially coincident (and substantially the same size as or minimally larger than) the field of view defined by the first aperture **141** (as shown in FIG. **4**), a signal passed into the first lens **151** by the first aperture **141** in the aperture layer **140** can exhibit a relatively high ratio of light rays originating from the first illumination source **111** to light rays originating from other illumination sources in the system. Generally, because various illumination

-01457 POR, 28 (citing EX1001, 6:3-11 (750 patent))

Patent Owner Sur-Reply (-01457)

Petitioner and its expert focus on Figure 2 of the '750 patent, which shows the impact curvature in an object in the external field can have on the path of certain light emitted by an optical system. Reply at 4-7. But an aberration caused by the curvature of the external field does not invalidate the '750 patent's clear and extensive disclosures regarding *matching* emission and detection regions and thereby minimizing wasted light and wasted detector area "across a range of distances from the system[.]"[2] EX1001, 2:58-3:3, 2:44-3:11, 3:16-20; EX1041,

Patent Owner Sur-Reply, 8

Platt, Inc., 707 F.3d 1318, 1326 (Fed. Cir. 2013)). But none of the specification excerpts Petitioner points to relate to a preferred embodiment.[4] In fact, there is no indication that these specification excerpts relate to an embodiment having pixels with fields of view "coincident with" corresponding optical emitters at all. EX1001, 10:65-11:19 (discussing "one implementation"), 6:3-11 (discussing unclaimed "substantially coincident" fields of view).

Patent Owner Sur-Reply, 9-10

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Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

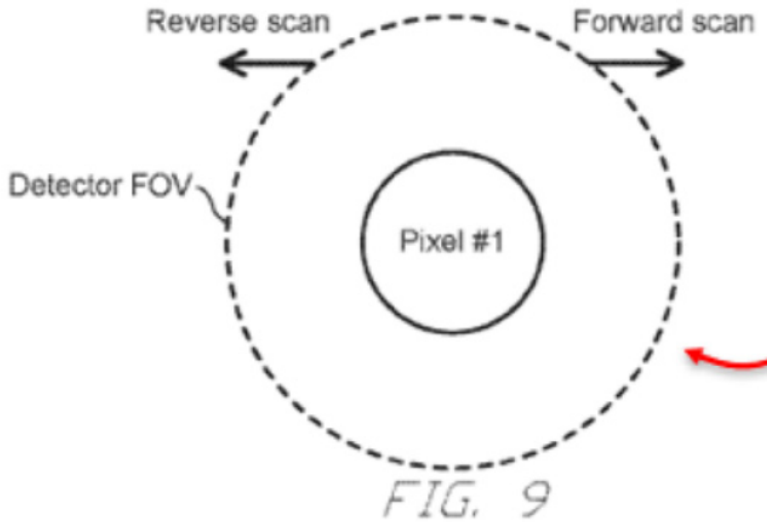


FIG. 9

ordinary example of "substantially coincident" fields of view

In some embodiments, a lidar system **100** may be configured so that the detector FOV is larger than the light-source FOV, and the detector and light-source FOVs are substantially coincident or overlapped. The light source **110**

EX1040, ¶16; EX1043, FIG. 9, 10:13-16; Reply, 5

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

Dr. Janét:

Q. What is the difference between substantially matches and just matches? In other words, when you say "substantially matches," what does that add versus just saying matches? What are you trying to convey?

THE WITNESS: Let me see if I can provide some support.

As I previously articulated, substantially matches within the context of the '381, from my understanding, includes minimizing wasted power and maximizing the signal integrity discrimination or signal-to-noise ratio.

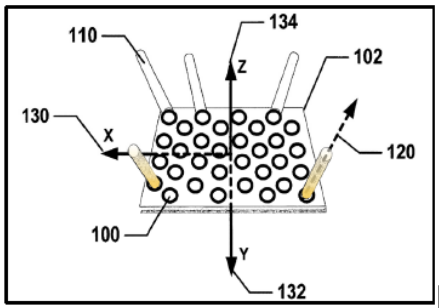
So that would shape a person with ordinary skill's definition of substantially in interpreting this. So if it delivers on those, then -- on both of those, then a person with ordinary skill would understand that the illumination pattern substantially matches the field of view.

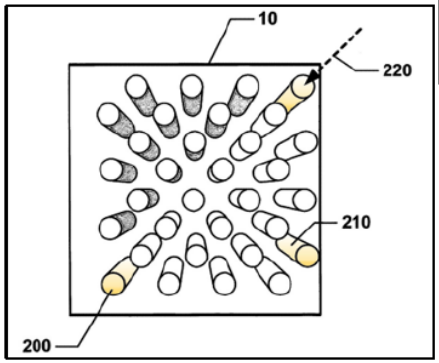
EX1041, 49-50; Reply, 8

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose the "Coincident with" Elements

Now … Return to Retterath's teaching:





Pet., 26-27; EX1005, FIGS. 4, 8; EX1003, ¶151

the device normal to a plane of the array **10**. For each emitter/detector set of elements **100**/**200**, the emitter and detector vectors are coincident and form a common on-coincident axis that is at an angle relative to a vector normal to the plane of the array that is unique for that emitter/detector set.

Pet., 28; EX1005, 6:23-28

absorptive by the objects contained in the medium. In some embodiments, the light energy is emitted and received as collimated or coherent electromagnetic energy, such as common laser wavelengths of 650 nm, 905 nm or 1550 nm.

Pet., 15, 22; EX1005, 19:33-44

For a device where the angular spacing of successive emitter elements **100** is equivalent across the horizontal and vertical fields of view, each emitter of emitter elements **100** projection angle beam of light **110** is expressed as a emitter vector **120** utilizing uvw nomenclature, where u corresponds to the x-axis **130**, v corresponds to the y-axis **132**, and w corresponds to a z-axis **134**:

Pet. 22, 27; EX1005, 7:61-67

Referring to FIG. **7**, a beam profile for multiple emitters according to an embodiment is shown. The top diagram shows a perfectly collimated beam **92** that produces a round spot **94** on the surface of the reflecting object. The beam

Pet. 22; EX1005, 9:29-32

Referring to FIG. **8**, a top view of detector elements **200** geometry on the emitter/detector array **10** surface is shown according to an embodiment. Light **210** is received at each detector of detector elements **200**. Each detector of detector elements **200** has an optimal receive detector vector (coincident axis) **220** along which the maximum optical energy will be transferred. Inbound optical energy that is slightly

Pet. 26-27; EX1005, 9:53-59

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Retterath-Borowski-Weimer Additionally Discloses the "Fields of View Coincident with" Element

And … Return to the Petition's alternative Retterath-Borowski-Weimer combinations:

Petition:

1. Weimer

Similar to Retterath, Weimer is directed to vehicle-based LiDAR devices. *Id.*, FIGS. 1A-D, 4:4-6. Weimer notes that "the goal for good daytime performance has been to have the laser spot size only slightly smaller than the receivers instantaneous field of view." *Id.*, 1:56-59. To achieve that goal, Weimer teaches controlling the emission pattern of individual laser beams to match the field-of-view of a corresponding detector. *Id.*, 4:56-58; EX1003, ¶¶100-101. An example embodiment is

Pet., 49-51; EX1003, ¶¶100-101

Second, a POSITA would have been prompted to implement Weimer's suggestions in the Retterath-Borowski combination to facilitate a high-resolution point cloud with reduced interference. EX1003, ¶238. By controlling the emission pattern of individual lasers to match the field of view of a corresponding pixel, Weimer's suggested improvement would have predictably avoided background light and facilitates improved SNR. *Id.*, 1:56-61, 4:56-58.

Pet., 51; EX1003, ¶ ¶ 236-238

Pet., 51; EX1003, 237-238, 246

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Retterath-Borowski-Weimer Additionally Discloses the "Fields of View Coincident with" Element

Weimer

the LIDAR system's **104** detector. In addition, individual beams **208** can be directed to cover an area corresponding to a single pixel of the detector, or multiple pixels of the detector.

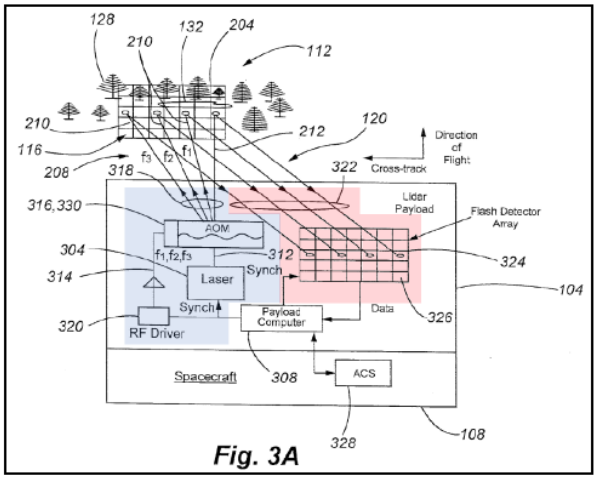


Fig. 3A

EX1008, FIG. 3A, 4:56-58; Pet., 50-52; EX1003, ¶¶100-101

Dr. Shanley

237. As a first reason, a POSITA would have been prompted to match the field-of-view of each pixel to the emission region of an emitter, based on Weimer's suggestions, to improve signal to noise (SNR) in the pixel array in the Retterath-Borowski combination. Retterath describes an objective to reduce interference

238. As a second reason, a POSITA would have been prompted to facilitate a high-resolution point cloud with reduced interference by implementing Weimer's suggestions in the Retterath-Borowski combination. Based on my knowledge and experience in the field and my review of Retterath, Borowski, and Weimer, a POSITA would have recognized that Weimer's suggested improvement would have predictably avoided background light and facilitated improved SNR, by controlling the emission pattern of individual lasers to match the field of view of a corresponding pixel, for example. *Id.*, 1:56-61, 4:56-58. Moreover, a POSITA would have

Pet., 51; EX1003, 237-238, 246

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Retterath-Borowski-Weimer Additionally Discloses the "Coincident with" Elements

Weimer, FIG. 3A

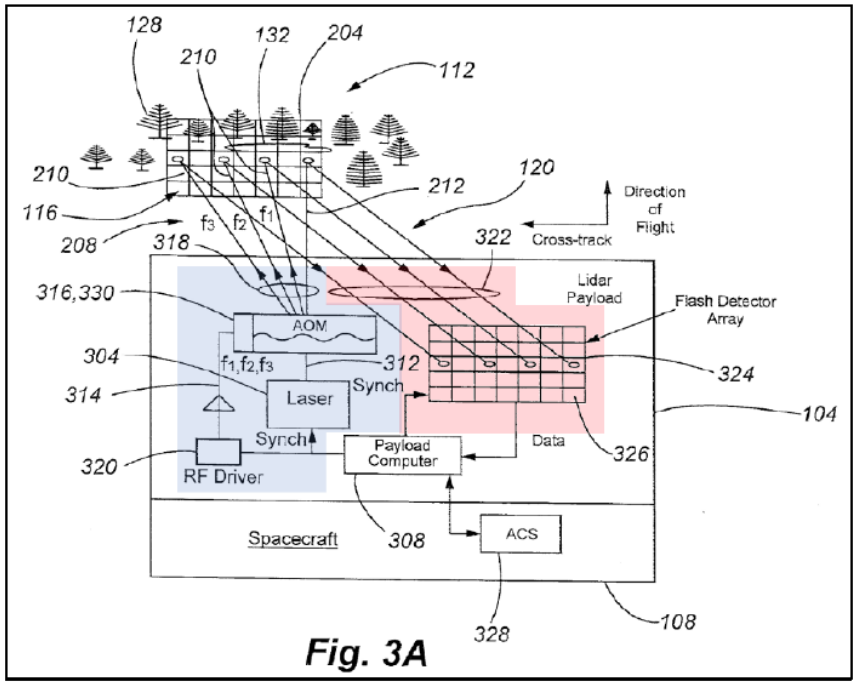


Fig. 3A

EX1008, FIG. 3A, Pet., 50

'381 Patent

Because the first illumination source **111** projects an illuminating beam that is substantially coincident (and substantially the same size as or minimally larger than) the field of view defined by the first aperture **141** (as shown in FIG. **4**),

pitch distance. In this first example, each emitter outputs an illuminating beam of diameter substantially identical to or slightly greater than the diameter of a corresponding aperture in the apertures layer, and the column of emitters is

EX1001, 6:12-15, 11:16-20; Pet. 67; Reply, 3, 6, 7

Dr. Shanley

33. For example, Weimer teaches that "[i]ndividual beams 208 can be directed to cover *an area corresponding to a single pixel* of the detector." EX1008, 4:56-58. Weimer also describes other similar examples, including a "laser spot size *only slightly smaller* than the receiver's instantaneous field of view". *Id.*, 1:56-60. Based on my review of Retterath, Borowski, Weimer, and the '381 Patent, these teachings are indistinguishable from the '381 Patent's examples. As I noted above,

EX1040, ¶33

FISH.
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Retterath-Borowski-Weimer Additionally Discloses the "Coincident with" Elements

Rebuttal to: *"… On reply, Petitioner points to Weimer's disclosure that emitted light can "correspond[] to a single pixel…But this excerpt in Weimer relates to Figure 2A, which (as discussed in the Patent Owner Response) shows that this "correspond[ence]" entails emission regions that are significantly smaller and differently shaped than the detection regions of corresponding pixels" Sur-Reply at 13*

Dr. Shanley

Weimer's configuration. Patent Owner provides an annotated figure including pink squares and green circles, where pink squares correspond to areas that the Patent Owner construes as a "field of view" of a detector and green circles correspond to areas that the Patent Owner construes as "emission regions." POR, 33. Patent Owner did not provide any support in Weimer for its assertion that the green circles and pink squares accurately represent emission regions and fields of view of detectors.

EX1040, ¶35

'381 Patent, FIG. 2A

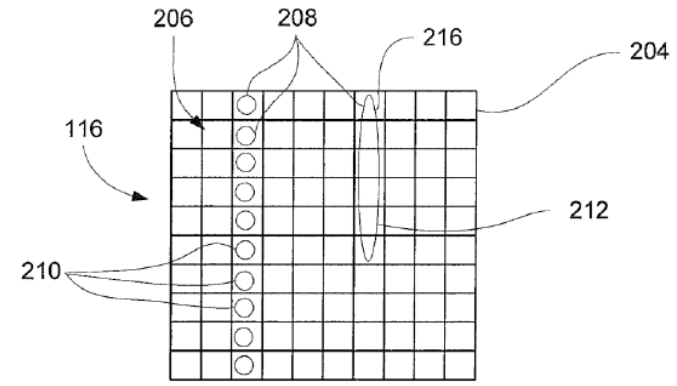


Fig. 2A

EX1008, FIG. 2A

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 1B

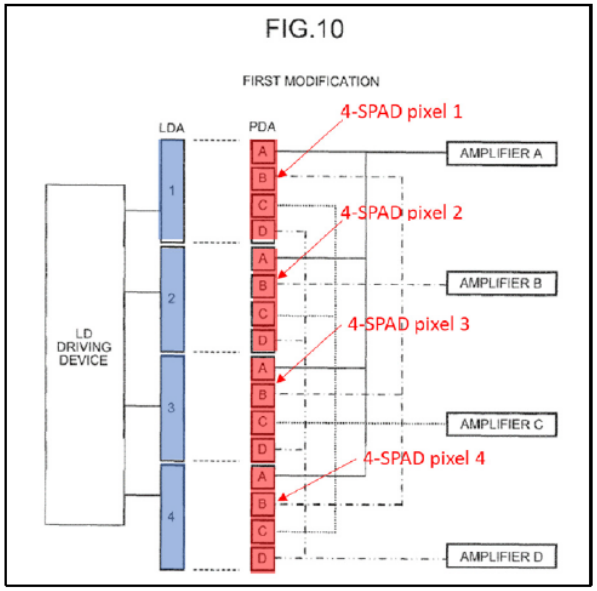
The Imai Grounds Disclose the "Coincident with" Element

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose the "Fields of View Coincident with" Element

Imai

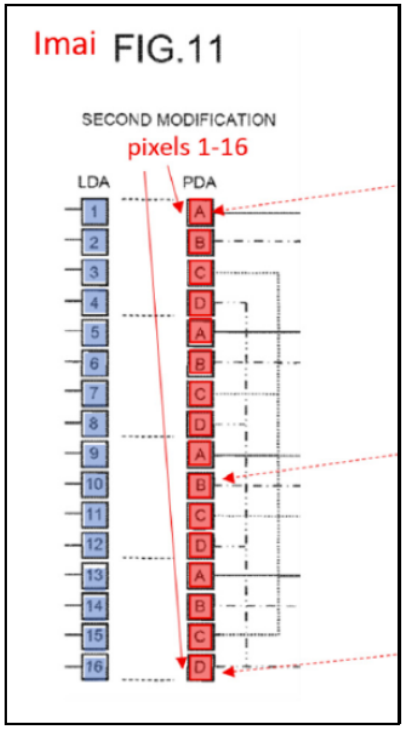


[0099] An irradiation range of the LD1 corresponds to light receivable ranges of the PD1 to PD4, the irradiation range of the LD2 corresponds to the light receivable ranges of the PD5 to PD8, the irradiation range of the LD3 corresponds to the light receivable ranges of the PD9 to PD12, and the irradiation range of the LD4 corresponds to the light receivable ranges of the PD13 to PD16.

Pet., 66-67; EX1009, [0099], FIG. 10

different timings. Herein, the number of LDs and that of PDs are the same and the LDs and PDs one-to-one correspond to each other. Meanwhile, in the second modification, connec-

Pet., 68-69; EX1009, [0125], FIG. 11



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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose the "Fields of View Coincident with" Element

Petition (p. 69)

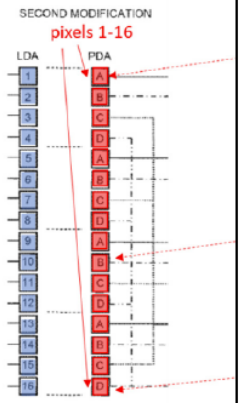
Moreover, beyond Imai's explicit description for the one-to-one correspondence, a POSITA would have been motivated to implement the 16 pixels to each have a field of view coincident with an emission region of a corresponding LD. Regarding "relationship between the irradiation range of each LD on the LDA and the light receivable range of each PD of the PDA," Imai describes examples of the correspondence between the light receivable range of a pixel and the emission region of a corresponding emitter. *See e.g.*, EX1009, [0062-64] (discussing "light receivable range of each PD" and "the corresponding irradiation ranges of [emitters]") in FIG. 5), [0067-70] (discussing FIGS. 7A and 7B depict "irradiation areas of [emitters] correspond to a light receivable range of [a corresponding PD]")). A POSITA would have been motivated to implement the LDs and the pixels 1-16 to achieve a one-to-one correspondence (such that each of pixels 1-16 was coincident with a corresponding one of the LDs) in order to provide a balanced tradeoff of detection time and detection distance. EX1009, [0067-70]; EX1003, ¶¶274-276. Ultimately, a POSITA would have recognized each of pixels 1-16, as provided by the resulting combination, has a light receivable range matched with the irradiation area of a corresponding LD so that light emitted by the corresponding LD is received by the matching pixel. EX1003, ¶276.

Dr. Shanley

corresponding PD]")). For example, with reference to FIGS. 7A and 7B, Imai discusses potential tradeoffs between different ranges of the LDs and PDs, noting considerations of detection time versus detection distance. *See e.g.*, EX1009, [0067-70]. A POSITA would have found it obvious to implement the LDs and PDs to have a one-to-one correspondence such that each of pixels 1-16 was coincident with a corresponding LDs in order to provide a balanced tradeoff of detection time and detection distance. *Id.* A POSITA would have recognized each of pixels 1-16 in the Imai-Higashi system has a light receivable range matched with the irradiation area of a corresponding LD so that light emitted by the corresponding LD is received by the matching pixel.

Pet., 69; EX1003, ¶276; Reply, 22

Imai FIG.11



Pet., 66, 68; EX1009, FIGS. 10-11

Patent Owner contended this position is "improper new reply argument" (sur-reply, 20), but it was presented in the original petition and furthermore responsive to the POR. *See Apple, Inc., v. Andrea Elec. Corp.*, 949 F.3d 697 (Fed. Cir. 2020); *Axonics Inc. v. Medtronic*, 75 F.4th 1374 (Fed. Cir. 2023).

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose the "Fields of View Coincident with" Element

Patent Owner's Response

In fact, Imai makes clear that using irradiation regions that are significantly *larger* than receiving ranges for its system is important to the proper functioning of its system. (EX2009, ¶223.) For example, Imai discloses:

> **The irradiation range of each LD is set to be slightly larger than corresponding light receiving ranges of the four PDs.** According to this, it is possible to efficiently irradiate the light receivable range, so that a light reception quantity in the light receivable range may be increased and detection accuracy and a detection distance may be improved. **It is possible to inhibit deterioration in detection accuracy and detection distance even when the irradiation range and the light receivable range are slightly displaced with each other within a manufacturing range.**

(EX1009, [0101] (emphasis added).) Accordingly, a POSITA would have understood that using irradiation ranges that are significantly *larger* than the detector

Imai

[0101] The irradiation range of each LD is set to be slightly larger than corresponding light receiving ranges of the four PDs. According to this, it is possible to efficiently irradiate the light receivable range, so that a light reception quantity in the light receivable range may be increased and detection accuracy and a detection distance may be improved. It is possible

Pet., 66-67; EX1009, [0101]

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose the "Fields of View Coincident with" Element

Patent Owner's Construction

Based on the specification of the '381 patent and the extrinsic evidence, the term "**each pixel in the plurality of pixels has a field of view coincident with an emission region of [a corresponding/its paired] optical emitter**" should be construed to mean that the field of view of each pixel and the emission region of a corresponding [or paired] optical emitter cover substantially the same area in the field. (EX2009, ¶¶108-22.) Petitioner's construction is consistent with the intrinsic evidence.

Patent Specification (Cols. 5-6)

In this implementation, a first aperture **141** in the aperture layer **140** defines a field of view that is distinct and that does not intersect a field of view defined by another aperture in the aperture layer **140**, as shown in FIG. **2**. The set of illumination sources **110** includes a first illumination source **111** paired with the first aperture **141** and configured to project an illuminating beam substantially aligned with (i.e., overlapping) the field of view of the first aperture **141** in the field ahead of the bulk imaging optic **130**. Furthermore, the first illumination source **111** and a bulk transmitting optic **120** can cooperate to project an illuminating beam of a cross-section substantially similar to (and slightly larger than) the cross section of the field of view of the first aperture **141** as various distances from the bulk imaging optic **130**. Therefore light output by the first illumination

EX1001, 5:17-31 (cited at -01457 POR, 28)

Imai

[0101] The irradiation range of each LD is set to be slightly larger than corresponding light receiving ranges of the four PDs. According to this, it is possible to efficiently irradiate the light receivable range, so that a light reception quantity in the light receivable range may be increased and detection accuracy and a detection distance may be improved. It is possible

Pet., 66-67; EX1009, [0101]

Because the first illumination source **111** projects an illuminating beam that is substantially coincident (and substantially the same size as or minimally larger than) the field of view defined by the first aperture **141** (as shown in FIG. **4**), a signal passed into the first lens **151** by the first aperture **141** in the aperture layer **140** can exhibit a relatively high ratio of light rays originating from the first illumination source **111** to light rays originating from other illumination sources in the system. Generally, because various illumination

EX1001, 6:3-11 (cited at -01457 POR, 28 and Reply, 22)

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 2C

The Weimer Grounds Disclose the “Coincident with” Element (‘750 Patent)

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Weimer Ground Discloses the "Coincident with" Element ('750 Patent)

Weimer

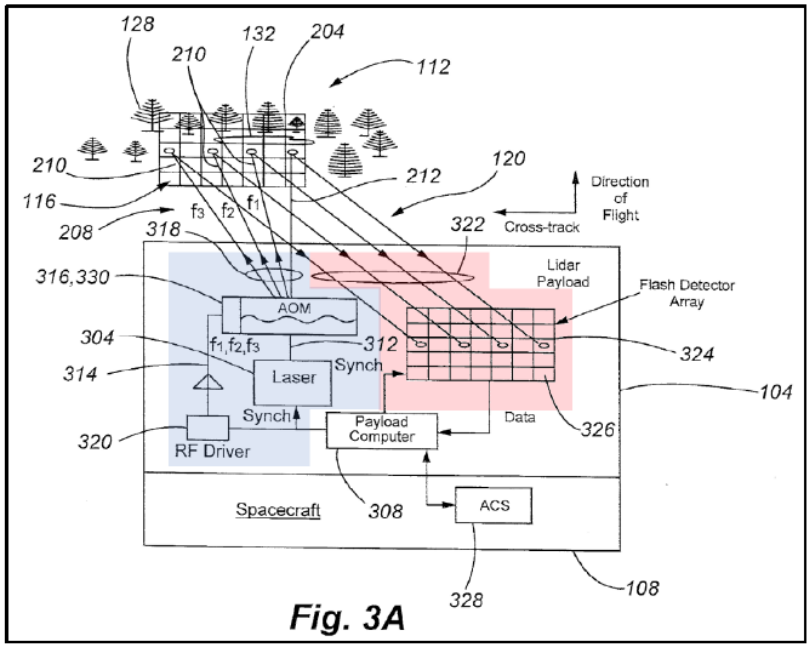


Fig. 3A

the LIDAR system's **104** detector. In addition, individual beams **208** can be directed to cover an area corresponding to a single pixel of the detector, or multiple pixels of the detector.

EX1008, FIG. 3A, 4:56-58; -01457 Pet, 74-75, 77-78;

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Weimer Ground Discloses the "Coincident with" Element ('750 Patent)

Even if Patent Owner's narrow construction was considered …

Patent Owner's Construction

Based on the specification of the '381 patent and the extrinsic evidence, the term "**each pixel in the plurality of pixels has a field of view coincident with an emission region of [a corresponding/its paired] optical emitter**" should be construed to mean that the field of view of each pixel and the emission region of a corresponding [or paired] optical emitter cover substantially the same area in the field. (EX2009, ¶¶108-22.) Petitioner's construction is consistent with the intrinsic evidence.

-01457 POR, 25-26

Weimer

the LIDAR system's **104** detector. In addition, individual beams **208** can be directed to cover an area corresponding to a single pixel of the detector, or multiple pixels of the detector.

EX1008, 4:56-58; -01457 Pet, 74-75, 77-78;

reducing the signal to noise ratio. Within the field of view, the goal for good daytime performance has been to have the laser spot size only slightly smaller than the receiver's instantaneous field of view. This requires accurate boresighting of the

EX1008, 1:56-60; -01457 Reply, 13 and 24.

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 2A

The Retterath Grounds Disclose the Bulk Transmitting Optic “Adjacent To” the Bulk Imaging Optic

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Claim Construction Analysis of the "coincident with" Limitations Is Incorrect

'381 Patent, Claim 1

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

a bulk transmitting optic;

a plurality of optical emitters arranged behind the bulk transmitting optic and configured to output electromagnetic radiation of an operating wavelength through the bulk transmitting optic into a field external to the optical system according to an illumination pattern that comprises a plurality of non-overlapping emission regions;

a bulk imaging optic disposed adjacent to the bulk transmitting optic;

a plurality of pixels arranged behind the bulk imaging optic, wherein each pixel in the plurality of pixels has a field of view coincident with an emission region of a corresponding optical emitter in the plurality of optical emitters and each pixel comprises a plurality of single photon avalanche diodes (SPADs) operable to detect photons emitted from its corresponding optical emitter and received through the bulk imaging optic after being reflected from surfaces within the field; and

an optical filter disposed in an optical path of the plurality of pixels, the optical filter configured to allow a set of wavelengths of electromagnetic radiation, including the operating wavelength, to pass through the optical filter while blocking electromagnetic radiation outside the set of wavelengths from reaching the plurality of pixels.

'750 Patent, Claim 44

44. An optical imaging system comprising:

a bulk imaging optic;

a plurality of pixels arranged behind the bulk imaging optic, wherein each pixel in the plurality of pixels comprises a plurality of single photon avalanche diodes (SPADs) and has a field of view that is non-overlapping beyond a threshold distance in a field external to the optical imaging system with fields of view of all other pixels in the plurality of pixels, and wherein the plurality of pixels includes at least a first pixel and a second pixel;

an aperture layer disposed between the bulk imaging optic and the plurality of pixels, the aperture layer comprising a plurality of apertures separated from each other by a stop region, the plurality of apertures including a first aperture disposed in a first optical path extending between the bulk imaging optic and the first pixel and a second aperture disposed in a second optical path extending between the bulk imaging optic and the second pixel;

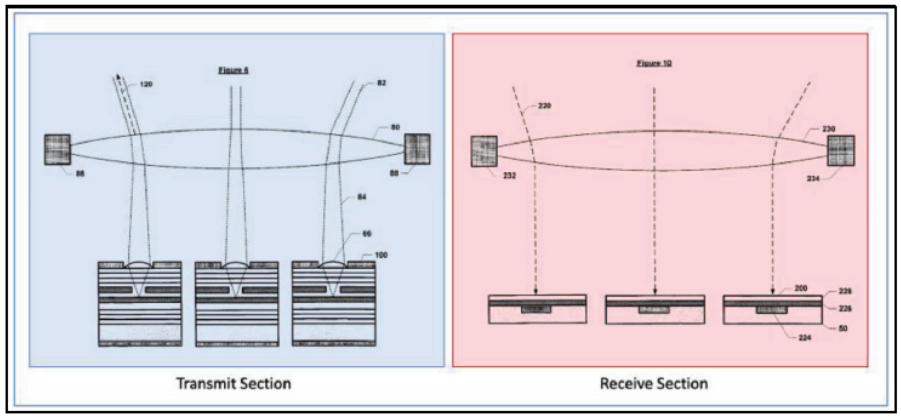
a bulk transmitting optic disposed adjacent to the bulk imaging optic; and

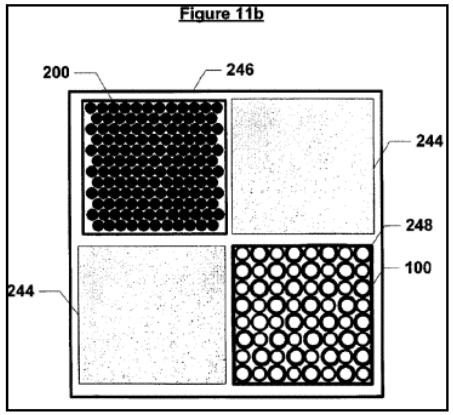
a plurality of emitters arranged to project electromagnetic radiation through the bulk transmitting optic and into the field according to an illumination pattern where electromagnetic radiation output from each emitter in the illumination pattern is coincident with a field of view of a corresponding pixel in the plurality of pixels.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

32

The Retterath Grounds Disclose the Bulk Transmitting Optic "Adjacent" To the Bulk Imaging Optic





Pet. 11, 25; EX1005, FIGS. 6, 10, 11b

Retterath

Referring to FIG. **6**, a cross section side view of emitter elements **100** with a macro lens **80** according to an embodiment is shown. In embodiments, each emitter of emitter elements **100** and emitter lens **66** produces a converging beam **84**. The macro lens **80** is configured to diverge to produce a plurality of beams **82** along a multitude of emitter vectors (coincident axes) **120** throughout the device's field of view.

Referring to FIG. **10** a cross section side view of a detector element with a macro detector lens **230** is shown according to an embodiment. In embodiments, detector elements **200** comprise a substrate **50**, a photoreceptor **224**, a bandpass filter layer **226** and a protective layer **228**. In other embodiments, light can be received from a diverging field of view at a macro detector lens **230** that directs in-bound light to the surface of detector elements **200**.

Referring to FIG. **11***b* a physical device layout according to an embodiment is shown. In embodiments, emitter elements **100** can be arranged in an emitter electro-optical section **248** and detector elements **200** can be arranged in a detector electro-optical section **246** of device **240**. The

EX1005, 9:12-20, 10:23-30, 10:62-66; Pet. 19-20, 24, 26

FISH.
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose the Bulk Transmitting Optic "Adjacent" To the Bulk Imaging Optic

Rebuttal to: *"… As discussed in the Patent Owner Response, Petitioner's theory for what allegedly constitutes "adjacent" bulk transmitting and bulk imaging optics in Retterath requires combining different embodiments of Retterath shown in Figures 6, 10, and 11b…Nothing in Figure 11b or the corresponding excerpt of the Retterath specification discusses multiple optics or how they are arranged." Sur-reply at 15*

Dr. Shanley

39. For example, the structure of the Retterath-Borowski combination includes bulk transmitting and imaging optics, and these optics are arranged "adjacent" to one another. Retterath and numerous corroborating references provide straightforward teachings of adjacent bulk and imaging optics, which was conventional at the time. I note that, in describing the combined system, the Petition highlighted Retterath's teachings of a "macro lens 230" positioned over the "emitter array 100" and a "macro lens 80" positioned over "detector array 200." These configurations involve the arrays and lenses being positioned adjacent (e.g., diagonally) to one another. *See, e.g.*, Pet., 11-14, 20-22, 24-26 (citing EX1005, FIGS.

EX1040, Shanley Second Declaration, ¶39

Intel Corp. v. PACT XPP Schweiz AG, 61 F.4th 1373, 1379-80 (Fed. Cir. 2023) ("a person of ordinary creativity, not an automaton"). (Cited at Pet., 15; Reply, 16)

Retterath

Referring to FIG. **6**, a cross section side view of emitter elements **100** with a macro lens **80** according to an embodiment is shown. In embodiments, each emitter of emitter elements **100** and emitter lens **66** produces a converging beam **84**. The macro lens **80** is configured to diverge to produce a plurality of beams **82** along a multitude of emitter vectors (coincident axes) **120** throughout the device's field of view.

EX1005, 9:12-20; Pet., 24-26; Reply, 14-15

Referring to FIG. **10** a cross section side view of a detector element with a macro detector lens **230** is shown according to an embodiment. In embodiments, detector elements **200** comprise a substrate **50**, a photoreceptor **224**, a bandpass filter layer **226** and a protective layer **228**. In other embodiments, light can be received from a diverging field of view at a macro detector lens **230** that directs in-bound light to the surface of detector elements **200**.

EX1005, 10:23-30; Pet., 24-26; Reply, 14-15

Referring to FIG. **11***b* a physical device layout according to an embodiment is shown. In embodiments, emitter elements **100** can be arranged in an emitter electro-optical section **248** and detector elements **200** can be arranged in a detector electro-optical section **246** of device **240**. The

EX1005, 10:62-66; Pet., 24-26; Reply, 14-15

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose the Bulk Transmitting Optic "Adjacent" To the Bulk Imaging Optic

Retterath

Figure 11a

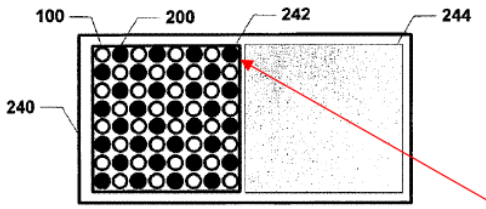
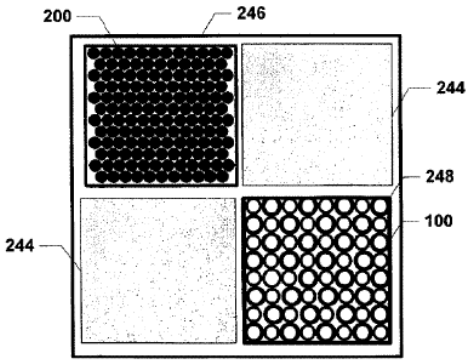


Figure 11b



Reply, 15-16; EX1005, FIGS. 11a-b

Referring to FIG. **11***a*, a physical device layout according to an embodiment is shown. In an embodiment, emitter elements **100** and detector elements **200** can be symmetrically arranged in an electro-optical section **242** of the device **240**. The number of emitter elements **100** can be equal to the number of detector elements **200**, and each detector of detector elements **200** is "paired" with a designated emitter of emitter elements **100**. The pulse sequence transmitted by an emitter of emitter elements **100** will be sensed and detected only by its paired detector of detector elements **200**. In embodiments, a single global lens can be utilized for both emitter elements **100** and detector elements **200**. When single global lens are used for emitter elements **100** and detector elements **200** optics, the distance between the emitter/detector pair must be minimal. In other embodiments, for example, where micro lens are used for emitter elements **100**, the distance between each emitter/detector is not as important and can vary according to embodiments. Larger distances between micro-lens emitter elements and waveguide detector elements will require slightly larger diverging waveguides according to FIG. **9**. Device circuitry is located in an electronic section **244** of the device **240**.

Referring to FIG. **11***b*, a physical device layout according to an embodiment is shown. In embodiments, emitter elements **100** can be arranged in an emitter electro-optical section **248** and detector elements **200** can be arranged in a detector electro-optical section **246** of device **240**. The number of detector elements **200** can be equal to or greater than the number of emitter elements **100**. In embodiments, for example, each emitter/detector array will comprise K detector elements **200** for each emitter of emitter elements **100**, where K is an integer value from 1 to 25.

EX1005, 10:40-11:4; Reply, 15-16

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Retterath-Borowski-Pacala Additionally Discloses the "Adjacent" Elements

Pacala

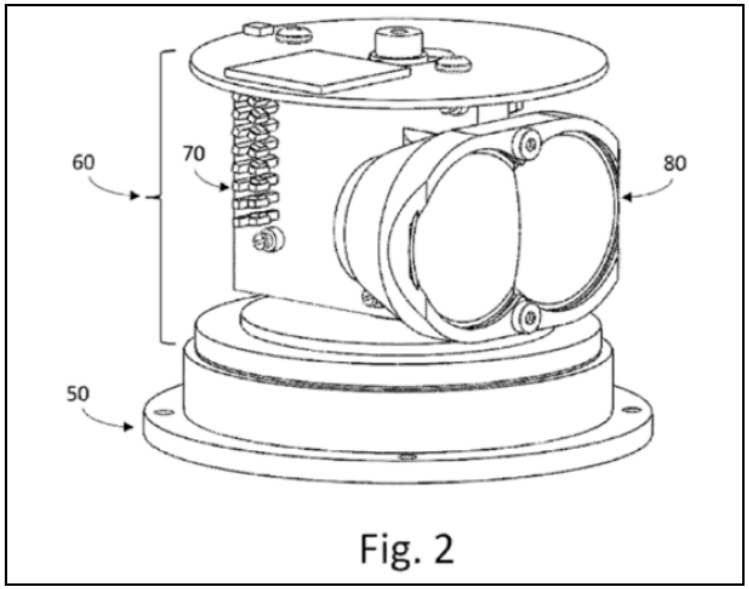


Fig. 2

EX1013, FIG. 2, Pet., 43-47

Dr. Shanley

223. As a first reason, a POSITA would have been motivated to position the bulk optics (e.g., 80, 230) in the Retterath-Borowski combination immediately next to one another, based on Pacala's suggestion, in order to provide a more compact and low-cost LiDAR device. *See e.g.*, EX1013, FIG. 2. Pacala suggests a commonly

Pet., 43-47; EX1003, ¶223

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 2B

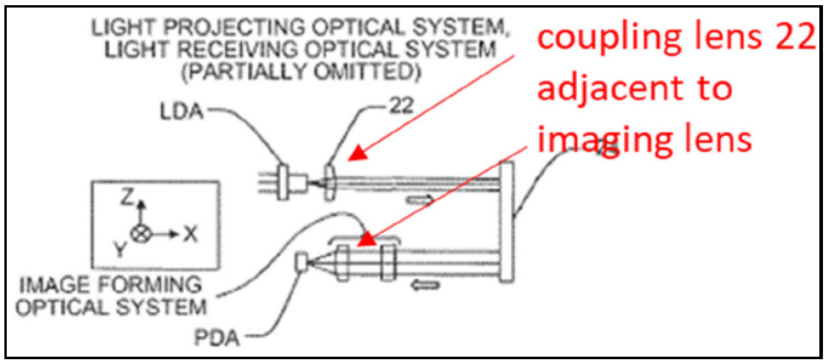
The Imai Grounds Disclose the Bulk Transmitting Optic "Adjacent To" the Bulk Imaging Optic

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose the Bulk Transmitting Optic "Adjacent" To the Bulk Imaging Optic

Imai



Pet., 65-66; EX1009, FIG. 2C

Petition

(d) ***Element 1(d):***

The Imai-Higashi combination provides this Element. EX1003, ¶267. Imai describes a bulk imaging optic provided by an imaging lens. *Id.* As depicted in FIG. 2C (reproduced below), coupling lens 22 of the projection optical system 20 and imaging lens on the light receiving optical system 30 are adjacent to each other along the "Z-axis" direction, similar to the embodiment of the '381 patent. *Compare*,

Pet., 65-66

'381 Patent

of discrete emitters. In this implementation, the bulk transmitter optic can be substantially identical to the bulk imaging optic **130** in material, geometry (e.g., focal length), thermal isolation, etc., and the bulk transmitter optic is adjacent and offset laterally and/or vertically from the bulk imaging optic **130**. In a first example, set of illumination

EX1001, 11:11-13

Patent Owner contended this position is "improper new reply argument" (sur-reply, 20-21), but it was presented in the original petition and furthermore responsive to the POR. *See Apple, Inc., v. Andrea Elec. Corp.*, 949 F.3d 697 (Fed. Cir. 2020); *Axonics Inc. v. Medtronic*, 75 F.4th 1374 (Fed. Cir. 2023).

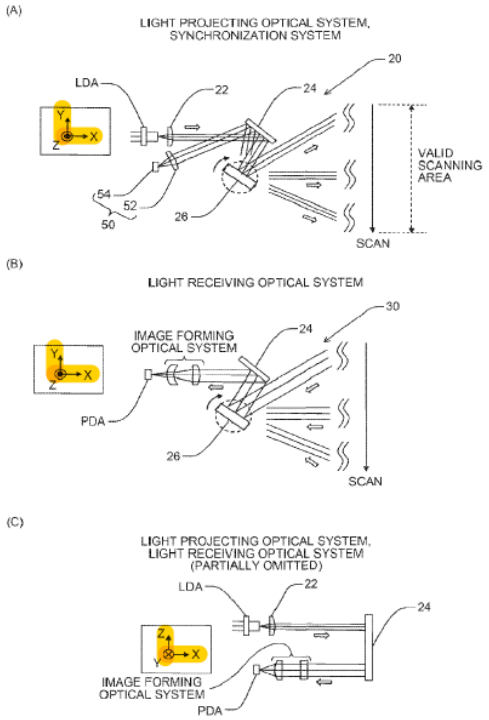
FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose the Bulk Transmitting Optic "Adjacent" To the Bulk Imaging Optic

Imai

FIG.2



Pet., 56, 63, 65-66; EX1009, FIGS. 2A-2C

[0031] FIG. **2** schematically illustrates the light projecting optical system **20** and the synchronization system **50** at (A). FIG. **2** schematically illustrates the light receiving optical system **30** at (B). It is hereinafter described with appropriate reference to an XYZ three-dimensional orthogonal coordinate system in which a Z-axis direction is a vertical direction illustrated at (A) in FIG. **2** and the like.

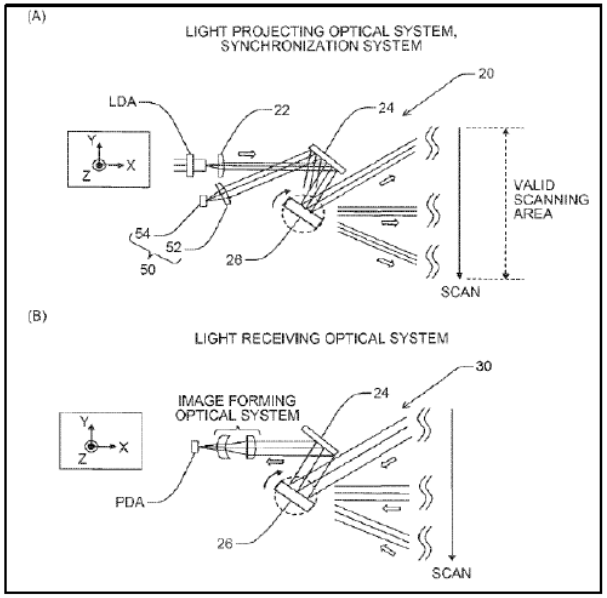
[0039] As is understood from (C) in FIG. **2**, the light projecting optical system **20** and the light receiving optical system **30** are arranged so as to be overlapped in the Z-axis direction and the rotary mirror **26** and the reflecting mirror **24** are shared by the light projecting optical system **20** and the light receiving optical system **30**. According to this, it is

FISH.

Reply, 23

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

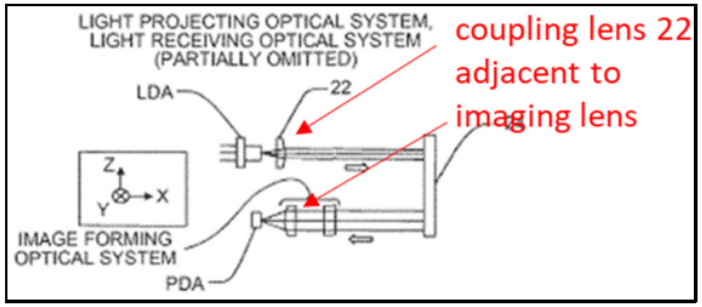
The Imai Grounds Disclose the Bulk Transmitting Optic "Adjacent" To the Bulk Imaging Optic



description, FIGS. 2A-2B illustrate transmitting and receiving paths of the top view (along the z-axis) and FIG. 2C illustrates the side view (along the y-axis). EX1009, FIGS. 2A-2C. Figure 2C thus shows a perspective that is rotated relative to FIGS. 2A-2B. Both when FIG. 2C is viewed independently, and certainly when viewed

Reply, 23-24; EX1040, 57; EX1009, 2A-2C

[0038] At (C) in FIG. **2**, the optical path from the LDA to the reflecting mirror **24** and the optical path from the reflecting mirror **24** to the PDA are illustrated in a partially omitted manner.



Pet., 65-66; Reply, 23-24; EX1009, [0038], 2C

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 2C

The Weimer Grounds Disclose the "Adjacent to" Element ('750 Patent)

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Weimer Ground Discloses the "Adjacent to" Element ('750 Patent)

Claim 44 (750 patent)

Claim 44	
44(a)	An optical imaging system comprising:
44(b)	a bulk imaging optic;
44(c)	a plurality of pixels arranged behind the bulk imaging optic, wherein each pixel in the plurality of pixels comprises a plurality of single photon avalanche diodes (SPADs) and has a field of view that is non-overlapping beyond a threshold distance in a field external to the optical imaging system with fields of view of all other pixels in the plurality of pixels, and wherein the plurality of pixels includes at least a first pixel and a second pixel;
44(d)	an aperture layer disposed between the bulk imaging optic and the plurality of pixels, the aperture layer comprising a plurality of apertures separated from each other by a stop region, the plurality of apertures including a first aperture disposed in a first optical path extending between the bulk imaging optic and the first pixel and a second aperture disposed in a second optical path extending between the bulk imaging optic and the second pixel;
44(e)	a bulk transmitting optic disposed adjacent to the bulk imaging optic; and
44(f)	a plurality of emitters arranged to project electromagnetic radiation through the bulk transmitting optic and into the field according to an illumination pattern where electromagnetic radiation output from each emitter in the illumination pattern is coincident with a field of view of a corresponding pixel in the plurality of pixels.

Pet., p. vi

The LIDAR system **104** may additionally include transmit optics **318** and/or receive optics **322**. For example, transmit optics **318** may include optics for controlling or shaping one or more of the beams **208** output by the LIDAR system **104**.

EX1008, FIG. 3A, 10:3-16; -01457 Pet, 76-77

(b) ***Element 44(b):***

Weimer discloses a receive optic 322 that is positioned in front of the pixel array 324 and configured to receive photons reflected from objects in the target scene:

(e) ***Element 44(e)***

The Weimer-Borowski-Hipp combination provides a bulk transmitting optic (e.g., transmit optic 318) that transmits light beams 208 to the surrounding environment and disposed adjacent to the bulk transmit optic 31:

Pet., p. 73 and 76

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Weimer Ground Discloses the "Adjacent to" Element ('750 Patent)

Weimer

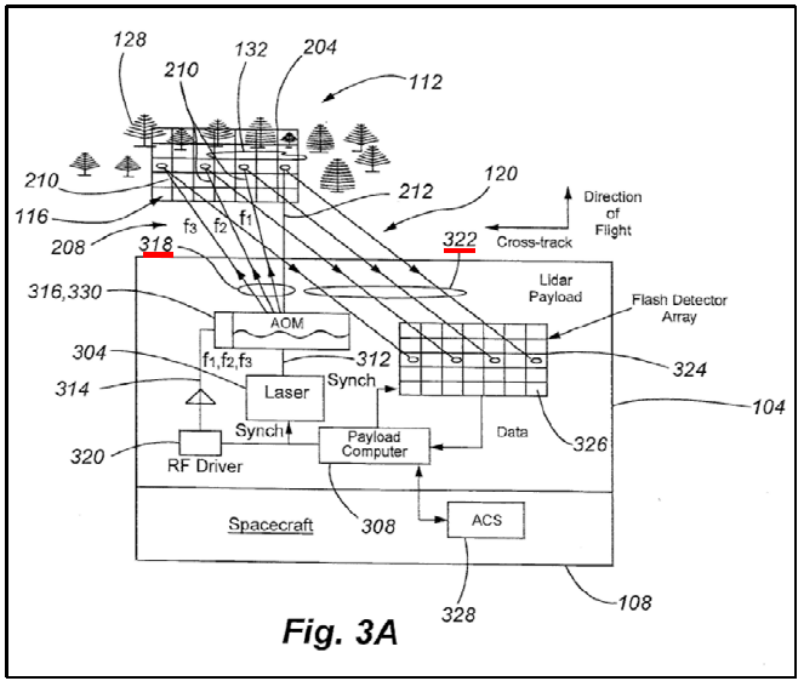


Fig. 3A

EX1008, FIG. 3A, 10:3-16; -01457 Pet, 76-77

> The LIDAR system **104** may additionally include transmit optics **318** and/or receive optics **322**. For example, transmit optics **318** may include optics for controlling or shaping one or more of the beams **208** output by the LIDAR system **104**.

EX1008, FIG. 3A, 10:3-16; -01457 Pet, 76-77

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Weimer Ground Discloses the "Adjacent to" Element ('750 Patent)

Weimer

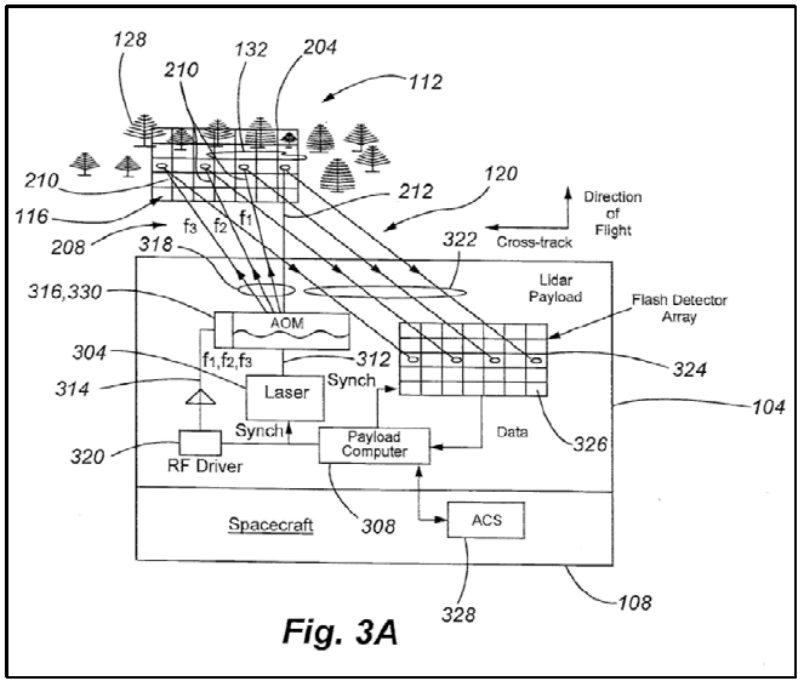


Fig. 3A

EX1008, FIG. 3A, 10:3-16; -01457 Pet, 76-77

Dr. Shanley

adjacent optics relies on an assertion that FIG. 3A is not drawn to scale. POR, 51. A drawing that conveys the physical layout of a system is useful whether or not the entirety of the drawing is "to scale." This is especially the case in FIG. 3A, which provides horizontal ("Cross-track") and vertical ("Direction of Flight") axes, and illustrates the respective lenses 318 and 322 are aligned on the vertical-axis, and spaced adjacently along the horizontal-axis. This arrangement of lenses is indistinguishable from the '750 Patent's description that "the bulk transmitting optic is adjacent and offset laterally and/or vertically from the bulk imaging optic." EX1001, 11:11-13.

-01457 Reply, 23; -01457, EX1040, ¶62

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 3A

The Retterath Grounds Disclose the "Proportional" Element – '381 Patent Claim 3

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose Dependent Claim 3

'381 Patent, Claim 3:

3. The optical system according to claim 1 wherein the plurality of optical emitters are arranged in a first arrangement and the plurality of pixels are arranged in a second arrangement, proportional to the first arrangement.

Retterath:

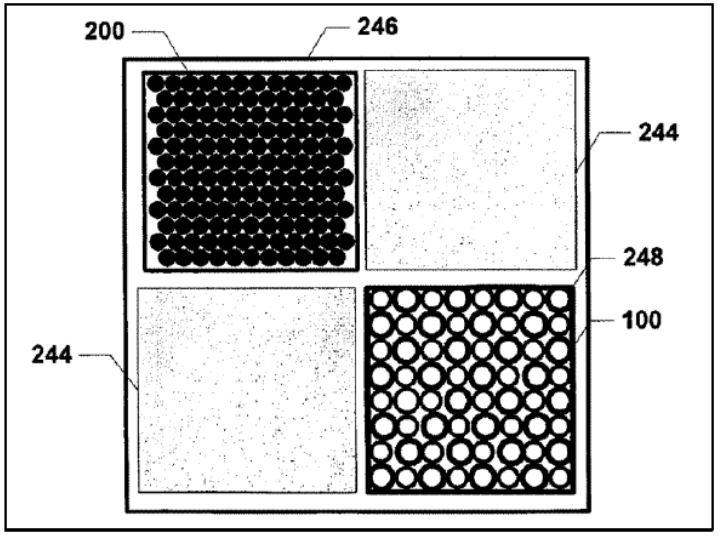
than the number of emitter elements **100**. In embodiments, for example, each emitter/detector array will comprise K detector elements **200** for each emitter of emitter elements **100**, where K is an integer value from 1 to 25.

EX1005, 11:1-4; Pet., 37; EX1040, ¶43

Dr. Shanley

170. In the Retterath-Borowski combination, Retterath describes the emitters 100 are in a first grid arrangement (electro-optical section 248). EX1005, FIGS. 4, 11b. Retterath also teaches the detectors 200 and the pixels 224 are in a second grid arrangement (electro-optical section 246). Retterath describes an equal number of detector and emitter elements, indicating the first and second arrangements proportional in number. *Id.*, 10:44-47 ("The number of emitter elements 100 can be equal to the number of detector elements 200, and each detector of detector elements 200 is 'paired' with a designated emitter of emitter elements 100.").

EX1003, ¶170



EX1005, FIG. 11b

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Implicit Claim Construction of Claim 3 Is Unsupported by the '381 Patent

'381 Patent, Claim 3:

> 3. The optical system according to claim 1 wherein the plurality of optical emitters are arranged in a first arrangement and the plurality of pixels are arranged in a second arrangement, proportional to the first arrangement.

Patent Owner:

> A POSITA would have considered proportional arrangements to be arrangements that are related by a scaling factor. (EX2009, ¶142.) For example, a

POR, 41

47

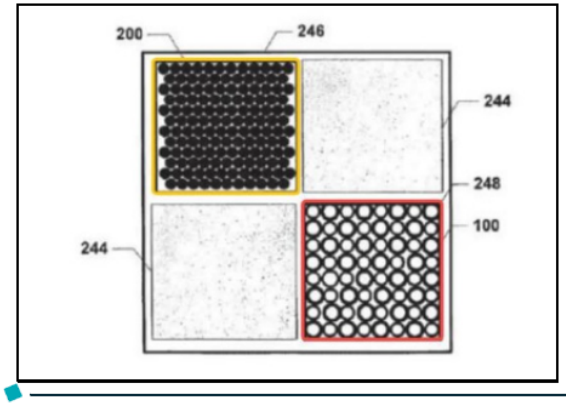
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose Dependent Claim 3

Rebuttal to: *"… all Petitioner can point to for the 'proportional to the first arrangement' limitation is that Retterath discloses using the same number of emitters and pixels. (Pet at 30.) However, nothing in Retterath indicates that the emitters and pixels have a proportional arrangement." POR, 40*

Retterath

Referring to FIG. **11***b* a physical device layout according to an embodiment is shown. In embodiments, emitter elements **100** can be arranged in an emitter electro-optical section **248** and detector elements **200** can be arranged in a detector electro-optical section **246** of device **240**. The number of detector elements **200** can be equal to or greater



EX1001, 10:63-67; Reply, 17

Dr. Shanley:

43. And, consistent with the Petition and my analysis in my first declaration, the specific arrangements of respective emitters and detectors provide a proportional arrangement in a second manner, based on Retterath's express teachings of "K detector elements 200 for each emitter." EX1005, 1-4. For example, when K=1, the system includes a an "equal number" of detector and emitter elements. Likewise, when K=2, the system includes a proportional arrangement (e.g., 2X the number of detectors to emitters). Nothing in the '381 Patent excludes these types of proportional arrangements from the scope of claim 3. *Id.*

Reply, 17; EX1040, ¶43

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose Dependent Claim 3

Rebuttal to: *"…Petitioner provides the new reply argument that the "overall arrangement" of Retterath's emitters and detectors is 'proportional.'…But as the Patent Owner Response showed, a POSITA would not have understood the dissimilar arrangement of Retterath's emitters and detectors in Figure 11B to be 'proportional'… Sur-Reply, 17-18*

Retterath

In various embodiments, the array comprises a non-scanning, solid-state device having a multitude of emitter/detector sets arranged on a generally planer surface. In some embodiments, each emitter/detector set is a single pair of an emitter and a detector. In other embodiments, a single emitter can be optically configured to provide on-coincident axis light energy to multiple different detectors, with each unique on-coincident axis combination of the single emitter and a different detector comprising a different emitter/detector set. In some embodiments, the number of emitter/detector sets can range from a 16×16 array of emitter/detector sets up to an array of 4096×4096 emitter/detector sets. In other embodiments, the number of emitter/detector sets and the configuration arrangement can be more or less, and can be planar or non-planar depending upon the specific application for which the LiDAR system is designed.

Reply, 18; EX1005, 3:22-37

Dr. Shanley

reduced to a scaling factor." Patent Owner's interpretation is inconsistent with the plain and ordinary meaning, but even if Patent Owner's narrow interpretation of claim 3 were applied, Patent Owner ignores Retterath's teachings that address claim 3. For example, it is clear that Retterath discloses the conventional proportional arrays for sets of emitters and detectors. EX1005, 3:24-34 ("a "16x6 array" up to "an array of 4096x4096"). This disclosed option for a proportional array is consistent

Reply, 18; EX1040, 43

Patent Owner contended this position is "improper new reply argument" (sur-reply, 21), but it was "responsive to arguments raised in [the] Patent Owner Response." *Apple, Inc., v. Andrea Elec. Corp.*, 949 F.3d 697 (Fed. Cir. 2020); *Axonics Inc. v. Medtronic*, 75 F.4th 1374 (Fed. Cir. 2023) ("We hold that where a patent owner in an IPR first proposes a claim construction in a patent owner response, a petitioner must be given the opportunity in its reply to argue and present evidence of anticipation or obviousness …").

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

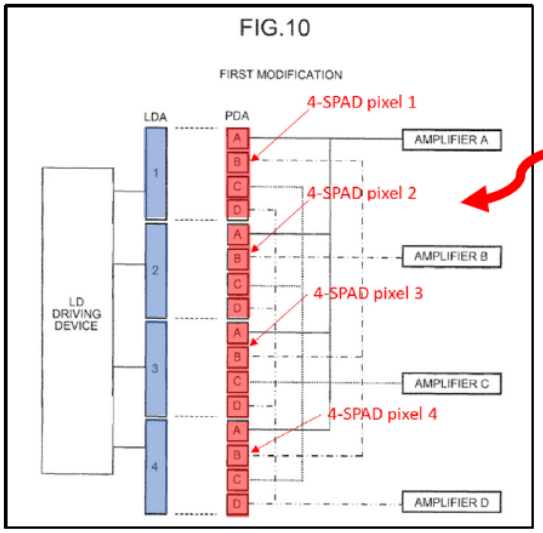
Issue 3B

The Imai Grounds Disclose the “Proportional” Element – ’381 Patent Claim 3

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose Claim 3



[0097] An LDA in the first modification is a vertically stacked laser array in which a plurality of (for example, four) LDs of LD**1** to LD**4** is stacked in a Z-axis direction (vertical direction). Herein, the LD**1** to LD**4** are arranged in ascending order in a negative Z direction.

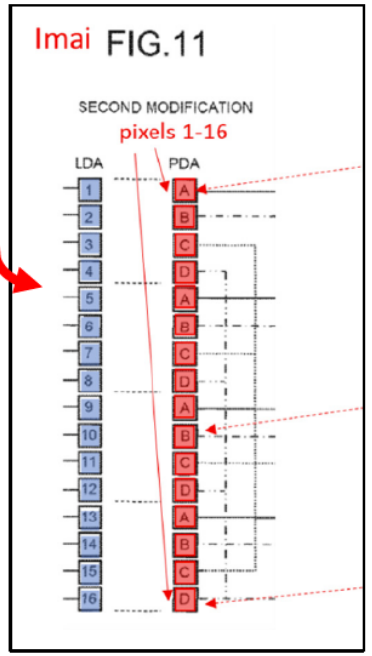
[0098] A PDA in the first modification is a vertically stacked photo diode array in which a plurality of (for example, 16) PDs of PD**1** to PD**16** is stacked in the Z-axis direction (vertical direction). Herein, the PD**1** to PD**16** are arranged in ascending order in the negative Z direction. Meanwhile, the LDs represented by **1** to **4** in the LDA are the LD**1** to LD**4**, respectively, in FIG. **10**.

Pet., 66; EX1009, [0097]-[0098]

Petition (Imai Grounds, Claim 3)

tional to the first arrangement. For example, according to the first predictable manner, Imai provides 4 LDs in a first arrangement and 4 pixels (each including 4 SPADs) in a second arrangement proportional to the first arrangement. EX1009, FIG. 10; *supra*, Ground 2A, Analysis of Element 1(e). According to the second predictable manner, Imai provides 16 LDs in a first arrangement and 16 pixels (each including 4 SPADs) in a second arrangement, proportional to the first arrangement. *Id.*, FIG. 10, *supra*, Ground 2A, Analysis of Element 1(e). EX1003, ¶283.

Pet., 71; EX1009, [0099], FIGS. 10-11; *see also* Pet., 66 ("first manner" for Element 1(e)) and 68 ("second manner" for Element 1(e))



FISH.

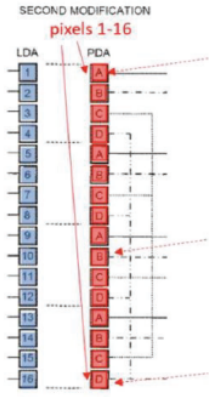
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose Claim 3

Dr. Shanley's Response to Patent Owner's "Scaling Factor" Contentions

used in its analysis of the Retterath Grounds. Even applying Patent Owner's improperly narrow interpretation of "proportional," Imai describes and illustrates configurations in which the LDs and pixels exhibit the same spatial arrangement. One example of this is proportionality is depicted below in FIG. 11.

Imai FIG.11



EX1009, FIG. 11 (partial). I understand Patent Owner does not addresses these

Reply, 25; EX1040, 60

Imai

[0099] An irradiation range of the LD1 corresponds to light receivable ranges of the PD1 to PD4, the irradiation range of the LD2 corresponds to the light receivable ranges of the PD5 to PD8, the irradiation range of the LD3 corresponds to the light receivable ranges of the PD9 to PD12, and the irradiation range of the LD4 corresponds to the light receivable ranges of the PD13 to PD16.

Pet., 66-67; EX1009, [0099], FIG. 10

different timings. Herein, the number of LDs and that of PDs are the same and the LDs and PDs one-to-one correspond to each other. Meanwhile, in the second modification, connec-

Pet., 68-69; EX1009, [0125], FIG. 11

Patent Owner contended this position is "improper new reply argument" (sur-reply, 21-22), but it was "responsive to arguments raised in [the] Patent Owner Response." *Apple, Inc., v. Andrea Elec. Corp.*, 949 F.3d 697 (Fed. Cir. 2020); *Axonics Inc. v. Medtronic*, 75 F.4th 1374 (Fed. Cir. 2023) ("We hold that where a patent owner in an IPR first proposes a claim construction in a patent owner response, a petitioner must be given the opportunity in its reply to argue and present evidence of anticipation or obviousness …").

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 4

The “Stop Region” Elements – Retterath Grounds (Claims 6-7, 17 of the ’381 Patent and Claim 44 of the ’750 Patent)

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose a "stop region" with an "opaque structure"

'381 Patent, Claim 6

6. The optical system according to claim 1 further comprising an aperture layer disposed between the bulk imaging optic and the plurality of pixels and comprising a plurality of apertures separated by a stop region.

'750 Patent, Claim 44 (Element 44(d))

an aperture layer disposed between the bulk imaging optic and the plurality of pixels, the aperture layer comprising a plurality of apertures separated from each other by a stop region, the plurality of apertures including a first aperture disposed in a first optical path extending between the bulk imaging optic and the first pixel and a second aperture disposed in a second optical path extending between the bulk imaging optic and the second pixel;

Patent Owner's Construction: "Opaque"

5. The Retterath-Based Grounds Do Not Satisfy Dependent Claims 6 or 17

Claims 6 and 17 require an "aperture layer . . . comprising a plurality of apertures separated by a stop region." A POSITA would have understood that the "stop region" claim limitation requires an opaque structure. But Petitioner points to

-01456 POR, 49

Patent Owner's Construction: "Opaque"

1. The Retterath-Based Grounds Fail to Disclose the Claimed Aperture Layer Including a Stop Region

The challenged independent claim—claim 44—requires "an aperture layer disposed between the bulk imaging optic and the plurality of pixels, the aperture layer comprising a plurality of apertures separated from each other by a stop region[.]" Petitioner fails to show that the Retterath-based grounds satisfy the "stop region" limitation. The structure of Retterath that Petitioner relies on is semi-transparent—not an opaque "stop region." Apparently recognizing the limitations

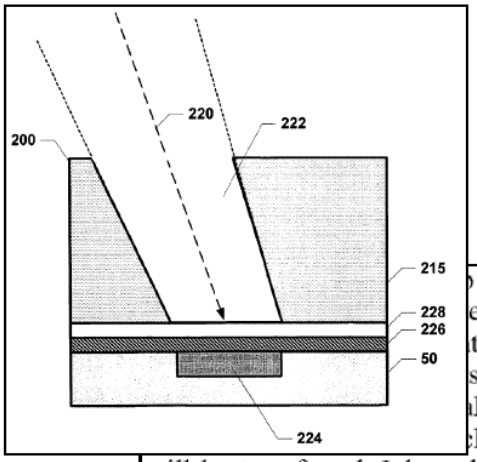
-01457 POR, 19

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose a "stop region" with an "opaque structure"

Retterath



view of detector elements **200** ector array **10** surface is shown t. Light **210** is received at each s **200**. Each detector of detector l receive detector vector (coin- h the maximum optical energy will be transferred. Inbound optical energy that is slightly non-parallel to the detector vector **220** will be partially reduced in intensity due to waveguide blocking or due to the macro lens. Inbound optical energy that is more than slightly-non-parallel to the receive detector vector (coincident axis) **220** will be substantially blocked by the detector waveguide or directed elsewhere by the macro lens. For purposes of the present invention, the coincidence axis of a given detector is defined as the center of the area of the light

EX1008, 9:53-67, FIG. 9; Pet., 34

Dr. Shanley

180. The waveguide 222 that defines the aperture "shall be an air gap or shall consist of a material that is substantially transparent to the wavelength of emitted light" to allow light pass through along detector vector 220. *Id.* 10:12-14. The waveguide material 215, by contrast, is designed to block stray light. *Id.*, 9:62-65 ("Inbound optical energy that is more than slightly-non-parallel to the receive detector vector (coincident axis) 220 will be substantially blocked by the detector waveguide or directed elsewhere by the macro lens."). To achieve that purpose, a POSITA would have recognized from Retterath's description that the waveguide material 215 comprises an optically opaque material that is not transparent to effectuate that purpose. The waveguide material 215 is formed as a layer on

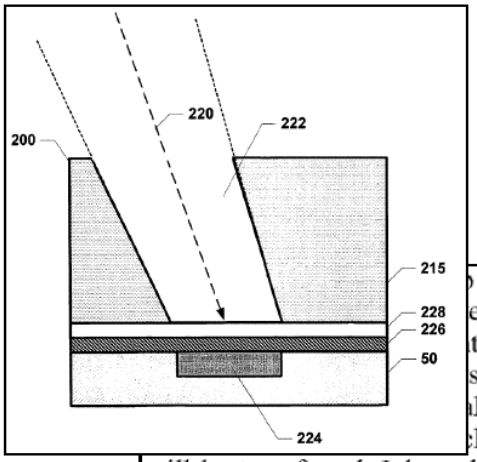
EX1003, ¶180

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose a “stop region” with an “opaque structure”

Retterath



view of detector elements **200** ector array **10** surface is shown t. Light **210** is received at each s **200**. Each detector of detector l receive detector vector (coin- h the maximum optical energy will be transferred. Inbound optical energy that is slightly non-parallel to the detector vector **220** will be partially reduced in intensity due to waveguide blocking or due to the macro lens. Inbound optical energy that is more than slightly-non-parallel to the receive detector vector (coincident axis) **220** will be substantially blocked by the detector waveguide or directed elsewhere by the macro lens. For purposes of the present invention, the coincidence axis of a given detector is defined as the center of the area of the light

EX1008, 9:53-67, FIG. 9; Pet., 34

Dr. Janét:

Q. And is that because you're excluding stray light from the environment from Retterath's description of in-bound optical energy?

MR. LAUPPE: Object to form.

THE WITNESS: Yeah, not really. I'm not -- I think that if you look at the construction even described in Retterath, the optical energy in the environment, in the field, is not only the light that comes from the emitters, that there is a plethora of other types of optical energy, whether the type is differentiated by the source or the type is differentiated by the wavelength

EX1041, 78

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose a "stop region" with an "opaque structure"

POPR (January 2024)

> Petitioner asserts that a POSITA would have been motivated to use both structures to "block[] out extraneous optical energy from background/unintended sources." (Pet. at 32.) But this is *exactly* the purpose that Retterath discloses can be served by either the macro detector lens *or* waveguides. (Ex. 1005, 9:59-65; *see also id.*, Figs. 8-10, 3:58-4:12, 17:46-48.) Petitioner argues that a POSITA would have

'381 POPR, 31

> embodiments); *see also id.*, Figs. 9-10.) Retterath indicates that waveguides and a macro detector lens serve the same purpose—blocking light non-parallel to the "receive detector vector"—so there is no evident reason to include them both in a single system. (Ex. 1005, 9:59-65.)

'750 POPR, 29

POR (July 2024)

> ¶¶154-60.) The structure of Retterath that Petitioner relies on is semi-transparent—not opaque. Apparently recognizing the limitations with Retterath, Petitioner

'381 POR, 43

Patent Owner Sur-Reply

> ¶¶ 47-48.) Furthermore, Retterath provides no basis for Petitioner's argument, instead indicating that "[i]nbound optical energy that is more than slightly-non-parallel to the receive detector vector"—in other words, light that should be blocked by the waveguide material—is only "**substantially** blocked by the detector waveguide." EX1005, 9:62-65 (emphasis added).

'381 Sur-Reply, 19

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose a "stop region" with an "opaque structure"

[1] Note that PO contends "substantially" here has the exact opposite implication from same term "substantially" in its proposed construction for claim 1. According to PO, a teaching for "*substantially* matches" does not exclude *fully* matching (POR, 26), but somehow a teaching for "*substantially* blocked" does exclude *fully* blocking (POR, 44-45). Such inconsistency cannot be reconciled.

Reply, 19 (footnote 1)

Patent Owner Response (p. 45)

wavelengths of light—*e.g.*, stray light from the environment. Indeed, Retterath's disclosure of "partial[]" or "substantial[]" blocking of light suggests that there are wavelengths of light that Retterath's waveguide material **215** does ***not*** block or absorb. (EX2009, ¶157.)

Patent Owner's Response (p. 26)

The '381 patent makes clear that the region ("discrete spot") illuminated by each emitter's light matches the field of view of a corresponding or paired detector. The '381 patent specification indicates that each aperture **144** in Figure 1 "defines a **field of view in the field coincident a discrete spot** by a corresponding illumination source." (EX1001, 3:61-4:1 (emphasis added).) Accordingly, the specification uses the term "coincident" to mean that one area (the field of view of an aperture) matches another (the "discrete spot" of an illumination source). (EX2009, ¶111.)

The '381 patent specification indicates that this matching between emission regions and detector fields of view is "substantial[]" matching. (EX2009, ¶¶111, 113-14.) For example, the '381 patent discloses that the system "selectively project[s] illuminating beams into a field ahead of the system according to an illumination pattern that **substantially matches**—in size and geometry across a

58

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose a "stop region" with an "opaque structure"

'381 Patent, Claim 7:

7. The optical system according to claim **6** wherein the aperture layer comprises a thin opaque structure.

EX1001, 42-43

Retterath:

will be transferred. Inbound optical energy that is slightly non-parallel to the detector vector **220** will be partially reduced in intensity due to waveguide blocking or due to the macro lens. Inbound optical energy that is more than slightly-non-parallel to the receive detector vector (coincident axis) **220** will be substantially blocked by the detector waveguide or directed elsewhere by the macro lens. For purposes of the present invention, the coincidence axis of a given detector is defined as the center of the area of the light

EX1005, 8:59-65

Dr. Janét:

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EX1041, 78

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The “stop region” with an “opaque structure” is additionally rendered obvious based on combination with Hipp

Petition

press goal of Retterath. EX1005, 9:41-59. In the resulting system, a shadow mask in accordance with Hipp would have been utilized together with Retterath's macro detector lens 230, in addition or as an alternative, to a waveguide. EX1003, ¶208.

First, a POSITA would have been prompted to combine Hipp with the Retterath-Borowski combination to further Retterath’s objective of reduced cross-talk among the pixels of the LiDAR system. EX1003, ¶¶209-210. Signal interference was a well-known concern for multi-beam LiDAR devices, and Hipp’s shadow mask was designed specifically to address it. EX1007, 21:46-56. “[I]nterference

Pet., 40-41

Hipp

This effect can be dramatically reduced by a shadow mask (**134**) (cf. FIG. **16**). The shadow mask (**134**) is designed such that only that light is transmitted which would also be incident on the active zones of the APDs. The shadow mask (**134**) is attached directly to the APD array, as FIG. **16** shows. The remaining light can be avoided in that the shadow mask is mirror coated superficially, with it thus being achieved that the unwanted light does not enter into the region of the active zones at all or in that the shadow mask is printed onto the cover plate of the APD array or onto an APD with impermeable material.

Pet., 40-41; EX1007, 21:57-67

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim 7 ("opaque structure") is additionally rendered obvious based on combination with Hipp

Rebuttal to: *"…a POSITA would not have been motivated to combine the Retterath-Borowski combination—based on noise-prone SPADs—with Hipp's shadow mask, which causes noise and interference due to reflections." POR, 43-44*

Petition

First, a POSITA would have been prompted to combine Hipp with the Retterath-Borowski combination to further Retterath's objective of reduced cross-talk among the pixels of the LiDAR system. EX1003, ¶¶209-210. Signal interference was a well-known concern for multi-beam LiDAR devices, and Hipp's shadow mask was designed specifically to address it. EX1007, 21:46-56. "[I]nterference pulses arise which superimpose themselves with the desired signals which is a basic problem of the array technique." *Id.* The shadow mask solves that problem "such that only that light is transmitted which would also be incident on the active zones." *Id.*, 21:57-67 ("remaining light can be avoided" such that "the unwanted light does not enter into the region of the active zones at all….").

Petition, 41

Dr. Shanley

50. I understand that Patent Owner asserts that the combination presents "risk of interference from light scattered by the underside of Hipp's shadow mask." POR, 48-49. A POSITA would not have been dissuaded by this risk, whether or not SPADs were used. Hipp not only acknowledges this potential scenario, but offers the traditional solution in which "the rear side of the carrier glass is provided with a layer of material absorbing signal light." EX1007, 22:7-10; *see also* EX1003, ¶107, 214. This solution would have been recognized as applicable regardless of detector type. Simply put, based on my knowledge and experience in the field and my review

EX1040, ¶50

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim 7 ("opaque structure") is additionally rendered obvious based on combination with Hipp

Rebuttal to: *"…a POSITA would not have been motivated to combine the Retterath-Borowski combination—based on noise-prone SPADs—with Hipp's shadow mask, which causes noise and interference due to reflections." POR, 43-44*

Hipp

This effect can be dramatically reduced by a shadow mask (**134**) (cf. FIG. **16**). The shadow mask (**134**) is designed such that only that light is transmitted which would also be incident on the active zones of the APDs. The shadow mask (**134**) is attached directly to the APD array, as FIG. **16** shows. The remaining light can be avoided in that the shadow mask is mirror coated superficially, with it thus being achieved that the unwanted light does not enter into the region of the active zones at all or in that the shadow mask is printed onto the cover plate of the APD array or onto an APD with impermeable material.

Pet., 41; EX1007, 21:57-67

However, some of the light which passes through the holes of the shadow mask could be reflected by the APD and be reflected back from the lower side of the shadow mask and also still be scattered under certain circumstances. After approximately a two-fold reflection to and fro, this light would be able to reach the adjacent active zones and act as an interference signal there. This effect can be reduced in that the rear side of the carrier glass is provided with a layer of material absorbing signal light when the shadow mask is configured as a mirror layer. In addition, only the marginal

Reply, 20; EX1007, 22:7-10

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 5

The “Threshold Distance” Element – ’750 patent

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose the "Threshold Distance" Element ('750 Patent, 44(c))

Retterath

the device normal to a plane of the array **10**. For each emitter/detector set of elements **100/200**, the emitter and detector vectors are coincident and form a common on-coincident axis that is at an angle relative to a vector normal to the plane of the array that is unique for that emitter/detector set.

750 Pet., 22-23; EX1005, 6:23-28

Dr. Shanley

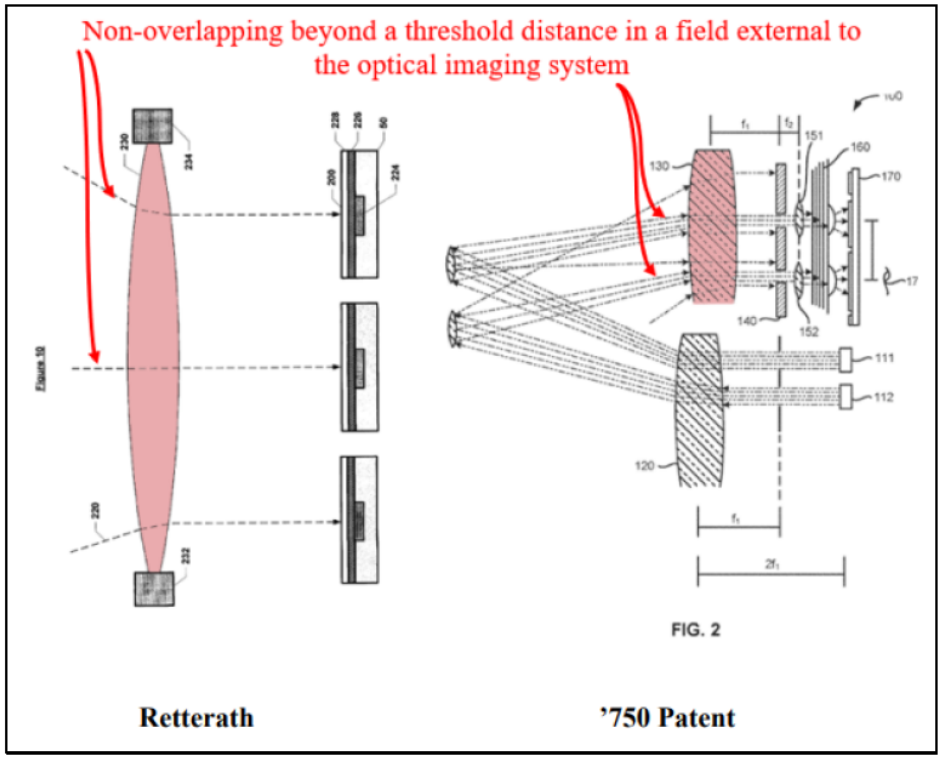
view of all other pixels. EX1005, 6:23-28; 6:29-39; 10:66-11:1. I note additionally that the Retterath-Borowski combination would have been implemented by a POSITA such that each of Retterath's pixels is aligned with Retterath's corresponding waveguide 222, as I discuss in more detail with reference to element 44(d) and Retterath's FIG. 9. Accordingly, in the combined system, the waveguides further ensure that the field-of-view for each pixel is non-overlapping beyond a threshold distance in the field external to the optical imaging system with fields of view of all other pixels.

750 Pet., 22-23; 750 EX1003, ¶151

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Retterath Grounds Disclose the "Threshold Distance" Element ('750 Patent, 44(c))



750 Reply, 18; 750 EX1040, ¶47-48; EX1005, FIG. 10; EX1001, FIG. 2

Dr. Shanley

Q. What is the threshold distance Retterath discloses?

A. I would have to go and look at Retterath. I don't think it's absolutely designed as an absolute number on it. So I can't be certain.

Q. You don't know what the threshold distance is for Retterath; is that correct?

MR. DEUTSCH: Objection. Same objections.

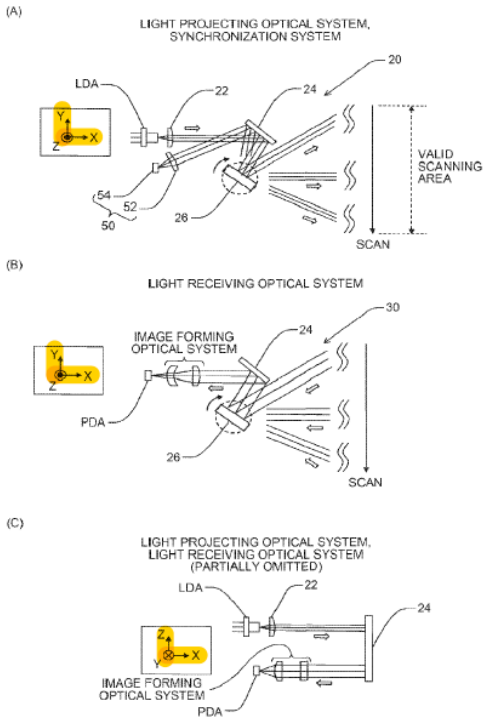
A. Yeah, at this point I'd have to go through and look at the patent. But basically my quick comment here is that it really depends upon the object being detected and how that system is performing. But one schooled in this field knows that there's a distance, you know, that this statement is true.

750 POR, 41; EX2010, 56:6-57:18

FISH.
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Imai Grounds Disclose the "Threshold Distance" Element ('750 Patent, 44(c))

FIG.2



Pet., 56, 63, 65-66; EX1009, FIGS. 2A-2C

Imai

[0099] An irradiation range of the LD**1** corresponds to light receivable ranges of the PD**1** to PD**4**, the irradiation range of the LD**2** corresponds to the light receivable ranges of the PD**5** to PD**8**, the irradiation range of the LD**3** corresponds to the light receivable ranges of the PD**9** to PD**12**, and the irradiation range of the LD**4** corresponds to the light receivable ranges of the PD**13** to PD**16**.

different timings. Herein, the number of LDs and that of PDs are the same and the LDs and PDs one-to-one correspond to each other. Meanwhile, in the second modification, connec-

'750 Pet., 51-52, 55-59; EX1009, [0125]

Dr. Shanley

223. Additionally, as detailed below for Element 44(d), the predictable combination would have been implemented such that each of Imai's pixels is aligned with an corresponding aperture of the aperture layer (as suggested by Grzesik), thereby further isolating each pixel and ensuring that the field-of-view for each pixel in the resulting combination is "non-overlapping" as recited in this claim.

-01457 EX1003, ¶223, 227

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

The Weimer Grounds Disclose the "Threshold Distance" Element ('750 Patent, 44(c))

Weimer

the LIDAR system's **104** detector. In addition, individual beams **208** can be directed to cover an area corresponding to a single pixel of the detector, or multiple pixels of the detector.

-01457 Pet., 74-75; EX1008, 4:56-58

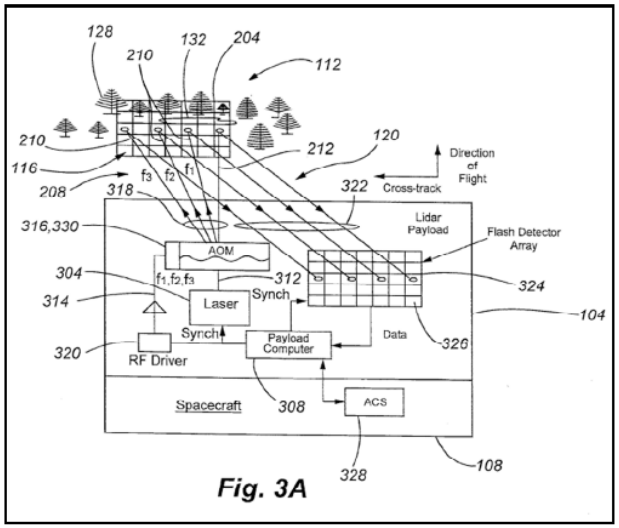


Fig. 3A

Dr. Shanley

EX1008, 8:58-9:6, FIG. 3A-3D, 11:29-48. Each pixel in the plurality of pixels has a field-of-view that is non-overlapping beyond a threshold distance in a field external to the optical imaging system with fields of view of all other pixels in the plurality of pixels. For example, in one embodiment, the individual beams 208 have discrete, non-overlapping emission regions, as shown in FIG. 2A, and each pixel 326 has a field-of-view that matches a corresponding beam 208 from the illumination source. *Id.*, FIG. 3A, 10:17-45; *see also* 4:56-58, 1:56-59.

-01457 Pet., 72-73, 74-76; -01457 EX1003, ¶271

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Issue 6

Patent Owner's Secondary Considerations Are Legally And Factually Deficient

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Secondary Considerations Are Legally And Factually Deficient

'381 Patent, Claim 1

> a plurality of pixels arranged behind the bulk imaging optic, wherein each pixel in the plurality of pixels has a field of view coincident with an emission region of a corresponding optical emitter in the plurality of optical emitters and each pixel comprises a plurality of single photon avalanche diodes (SPADs) operable to detect photons emitted from its corresponding optical emitter and received through the bulk imaging optic after being reflected from surfaces within the field; and

EX1001, 17:6-14

Lectrosonics, Inc. v. Zaxcom, Inc., IPR2018-01129, Paper 33, 33-34 (PTAB Precedential Jan. 24, 2020) ("Where the offered secondary consideration actually results from something other than what is both claimed and novel in the claim, there is no nexus to the merits of the claimed invention.")

Reply, 25-26

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Patent Owner's Secondary Considerations Are Legally And Factually Deficient

ABSTRACT

SPADs (Single Photon Avalanche Diodes) are emerging as most suitable photodetectors for both single-photon counting (Fluorescence Correlation Spectroscopy, Lock-in 3D Ranging) and single-photon timing (Lidar, Fluorescence Lifetime Imaging, Diffuse Optical Imaging) applications. Different complementary metal-oxide semiconductor (CMOS) implementations have been reported in literature. We present some figure of merit able to summarize the typical SPAD

depth imager. In contrast, we have developed a compact LIDAR that has both high resolution and a long distance range by combining a SPAD array with an optical scanning system. By scanning a narrow

i.e., timing resolution. Arrays of single-photon avalanche-diodes (SPADs) are the best candidates because they have no read-out noise, unlike CCDs, no limited sensitivity, differently from CMOS Active Pixel Sensors, and no excess noise, typical of analog avalanche photo diode arrays. SPAD arrays provide true

Reply, 26; EX1045, 2-5; EX1046, 2; EX1047, 1-8

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Issue 7

Dr. Janét Is Not a Person of Ordinary Skill in the Art

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Dr. Janét Is Not a Person of Ordinary Skill in the Art

Dr. Shanley

And the other thing that's ambiguous is how much time he did spend on LiDAR as opposed to doing subcontract work as opposed to looking at financials as opposed to doing all the report writing to the -- and coordinating with the various people working on the team for their inputs to do the monthly and -- reporting on this, how he's reporting the financials, how he's managing the resources in each of these areas.

So the question is how much time is he working on admin. stuff as well as the technical part. And then you're divided into so many different -- into these four different systems. How much time is he spending on each? So does he really have that full year's experience on LiDAR? And it doesn't speak to me that he has an in-depth knowledge of LiDAR that we in our declaration basically said he has to have.

EX2020, 15:18-16:18; Sur-Reply 26

So "interface," I don't know what that means. It's to make play between each of these sensors. Does it say that I need to go in and understand the dynamics of my LiDAR system and design it? No, it says I have to interface it, all I have to know, about input and output.

So that doesn't tell me he has a lot of experience with LiDAR, just the interface between LiDARs, and that's not the experience and requisite you would need to design this system.

EX2020, 19:9-18

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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