

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HESAI TECHNOLOGY CO., LTD.,
Petitioner,

v.

OUSTER, INC.,
Patent Owner.

IPR2023-01421
Patent 11,175,405 B2

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

CHERRY, *Administrative Patent Judge*.

DECISION
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Hesai Technology Co., Ltd. (“Petitioner”) filed a Petition (Paper 2, “Pet.”) to institute an *inter partes* review of claims 21 and 23–34 (“the challenged claims”) of U.S. Patent 11,175,405 B2 (Ex. 1001, “the ’405 patent”). Ouster, Inc. (“Patent Owner”) filed a Preliminary Response (Paper 6, “Prelim. Resp.”). We instituted *inter partes* review under 35 U.S.C. § 314(a). Paper 9 (“Inst. Dec.”).

During the trial, Patent Owner filed a Response (Paper 22, “PO Resp.”), Petitioner filed a Reply (Paper 31, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 39, “PO Sur-Reply”).

Petitioner and Patent Owner (“the parties”) requested oral argument (Papers 36 and 37). A hearing was conducted on December 17, 2024. Paper 44 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). Having reviewed the complete trial record, we determine that Petitioner has shown, by a preponderance of the evidence, that the challenged claims are unpatentable.

II. BACKGROUND

A. *Real Parties in Interest*

Petitioner identifies itself, Hesai Group, and Hesai Inc. as real parties in interest. Pet. 2. Patent Owner identifies itself as the real party in interest. Paper 4, 1.

B. *Related Matters*

Petitioner and Patent Owner identify the following related matters:

- *Ouster, Inc. v. Hesai Group et al.*, No. 23-cv-00406 (D. Del.).

- *Certain LiDAR (Light Detection and Ranging) Systems and Components Thereof*, Inv. No. 337-TA-1363 (USITC).

Pet. 2–3; Paper 4, 1.

C. *The '405 Patent (Ex. 1001)*

The '405 patent is titled “Spinning LIDAR^[1] Unit with Micro-Optics Aligned behind Stationary Window.” Ex. 1001, Code (54). The '405 patent claims priority to Provisional Application Nos. 62/506,449; 62/506,437; and 62/506,445 all filed on May 15, 2017, as well as Provisional Application No. 62/515,291 filed on June 5, 2017. *Id.* at Code (60).

The '405 patent relates to optical imager systems that achieve wide field-of-view, narrowband imaging with micro-optic receiver channel arrays. *Id.* at 2:63–65. In some embodiments described in the '405 patent, the optical imager system “includes a light emission system and a light detection system.” *Id.* at 3:29–31.

The '405 patent explains that narrowband imagers collect “light within a limited wavelength range” using optical filters. *Id.* at 1:34–40. “Optical filters serve to prevent some portion of the electromagnetic spectrum from reaching the photodetectors.” *Id.* at 1:40–42. According to the '405 patent, “[o]ptical filters are sensitive to the angle of incident light making it difficult to achieve a narrow range of wavelengths.” *Id.* at 1:53–55.

¹ “LIDAR” or “LiDAR” stands for light detection and ranging. *See* Pet. 1; Prelim. Resp. 1.

Figure 2 of the '405 patent is shown below.

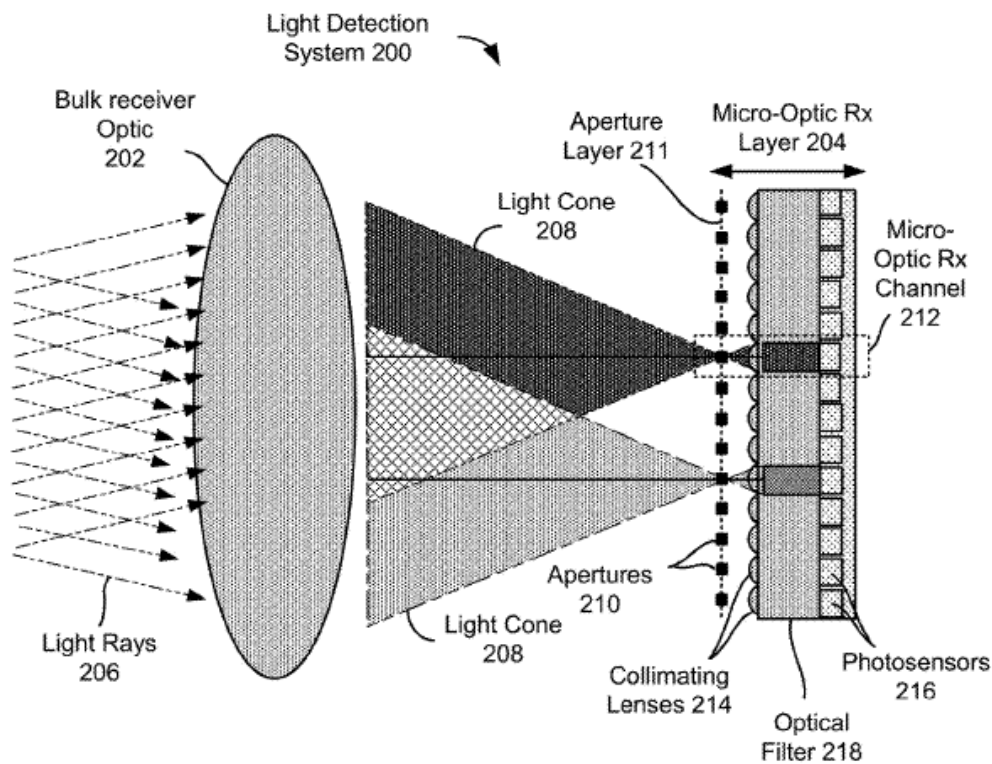


FIG. 2

Figure 2, above, is a diagram illustrating a light detection system. During operation of the light detection system, light rays 206 enter a bulk receiver optic 202 and are focused into light cones 208. *Id.* at 13:39–42. A micro-optic receiver layer “is positioned so that apertures 210 coincide with the focal plane of bulk receiver optic 202.” *Id.* at 13:42–44. The receiver layer “can be a one-dimensional or two-dimensional array of micro-optic receiver channels 212.” *Id.* at 13:44–46. Each receiver channel “is formed of a respective aperture 210, collimating lens 214, and photosensor 216 positioned along the same axis in the direction of light flow.” *Id.* at 13:46–49.

Photosensors “can be pixelated light sensors that employ, for each photosensor, a set of discrete photodetectors such as single photon avalanche diodes (SPADs).” *Id.* at 21:54–58. The photosensors 216 “are positioned on a side opposite of collimating lenses 214 so that light rays 206 first pass through collimating lenses 214 and optical filter 218.” *Id.* at 14:29–32. The optical filters block “unwanted wavelengths of light.” *Id.* at 14:10.

Figure 11 of the '405 patent is shown below.

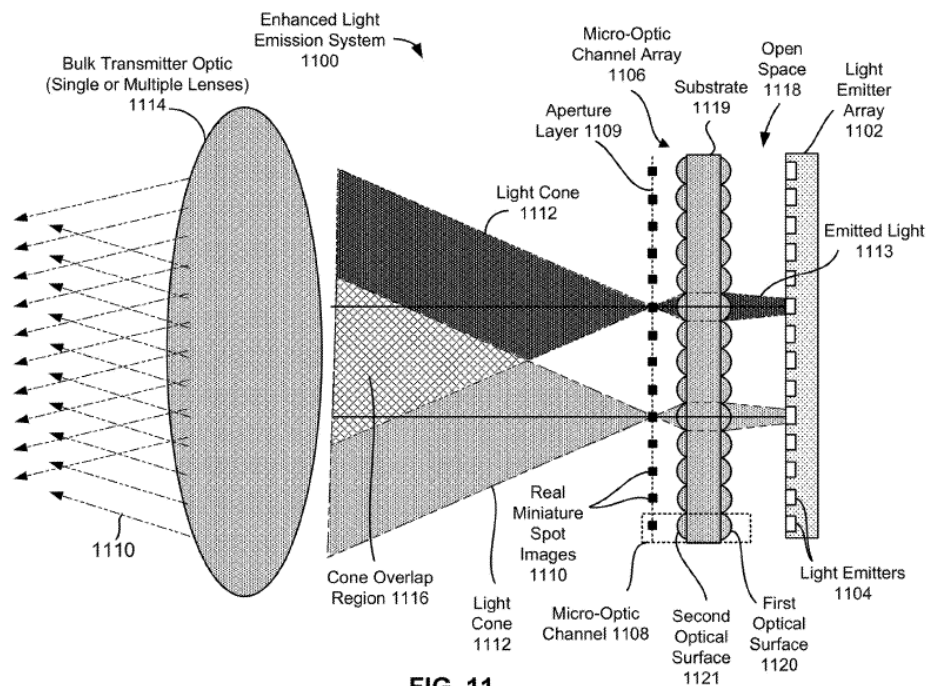


FIG. 11

Figure 11, above, is a diagram of an exemplary light emission system. *Id.* at 28:59–60. The light emission system “can include a light emitter array 1102” and a “micro-optic transmitter channel array 1106 separated from light emitter array 1102 by an open space 1118.” *Id.* at 28:62–65, 29:4–6. “Each micro-optic transmitter channel 1108 is paired with a corresponding receiver channel.” *Id.* at 29:6–8.

D. *Challenged Claims*

Petitioner challenges claims 21 and 23–34. Pet. 1. Of the challenged claims, claims 21 and 26 are independent. Claim 21, reproduced below with Petitioner’s identifiers for the claim limitations, is illustrative of the claimed subject matter.

- [21(a)]** An optical system for performing distance measurements, the optical system comprising:
- [21(b)]** a stationary housing having a base, a top and an optically transparent window disposed between the base and the top and extending fully around a periphery of the stationary housing;
- [21(c)]** a light ranging device disposed within the housing and comprising:
- [21(d)]** a platform;
- [21(e)]** a light transmission module coupled to the platform and comprising a bulk transmitter optic and a plurality of optical emitters, each optical emitter in the plurality of optical emitters configured to generate and transmit pulses of radiation through the bulk transmitter optic and through the optically transparent window into a field external to the optical system; and
- [21(f)]** a light sensing module coupled to the platform and comprising a bulk receiver optic, an aperture layer comprising a plurality of apertures separated by a stop region, a plurality of photosensors operable to detect photons emitted from the plurality of optical emitters and received through the bulk receiver optic after being reflected from surfaces within the field, and an optical filter disposed between the bulk receiver optic and the plurality of photosensors and configured to allow a band of radiation, including an operating wavelength of the plurality of optical emitters, to

pass through the filter to the plurality of photosensors while blocking radiation outside the band from reaching the plurality of photosensors; and

[21(g)] a motor disposed within the housing and operatively coupled to spin the platform and the light ranging device within the housing;

[21(h)] wherein: each photosensor in the plurality of photosensors comprises a plurality of single photon avalanche diodes (SPADs);

[21(i)] the plurality of apertures comprises at least first, second, third and fourth apertures;

[21(j)] the plurality of photosensors comprises at least first, second, third and fourth photosensors; and the light sensing module includes a first optical path to the first photosensor through the first aperture, a second optical path to the second photosensor through the second aperture, a third optical path to the third photosensor through the third aperture, and a fourth optical path to the fourth photosensor through the fourth aperture.

Ex. 1001, 56:40–57:21.

E. *Evidence*

Petitioner submits the following evidence:

Evidence	Exhibit No.
Declaration of James F. Shanley, Ph.D.	1003
Pacala et al., US 2014/0211194 A1 (published July 31, 2014, filed Jan. 27, 2014) (“Pacala”)	1004
Spector, US 10,473,766 B2 (issued Nov. 12, 2019, filed June 27, 2017) (“Spector”)	1005
Droz et al., US 10,605,984 B2 (issued Mar. 31, 2020, filed Dec. 1, 2016) (“Droz”)	1006
Villeneuve et al., US 10,520,602 B2 (issued Dec. 31, 2019, filed Nov. 29, 2016) (“Villeneuve”)	1007
Hall et al., US 9,983,297 B2 (issued May 29, 2018, filed	1008

Evidence	Exhibit No.
Mar. 20, 2017) (“Hall”)	
Borowski, US 2013/0300840 A1 (published Nov. 14, 2013, filed Dec. 21, 2011) (“Borowski”)	1009
Takai, et al., Single-Photon Avalanche Diode with Enhanced NIR-Sensitivity for Automotive LIDAR Systems (2016) (“Takai”)	1032
Reply Declaration of James F. Shanley, Ph.D.	1033
Deposition of Jason A. Janét, Ph.D.	1034

Patent Owner submits the following evidence.

Evidence	Exhibit No.
Corrected Declaration of Jason A. Janét, Ph.D.	2010
Deposition Transcript of James F. Shanley, Ph.D., dated June 6, 2024	2011
Hall, US 7,969,558 B2 (issued June 28, 2011)	2012
Warren J. Smith, Practical Optical System Layout, and Use of Stock Lenses (McGraw-Hill 1997)	2013
Sergey L. Vinogradov, “Evaluation of performance of silicon photomultipliers in LIDAR applications” (2017)	2014
Edoardo Charbon, et al., “SPAD-Based Sensors” (2013)	2015
Cristiano Niclass, et al., “A Single Photon Avalanche Diode Array Fabricated in Deep-Submicron CMOS Technology” (2006)	2016
Deposition Transcript of James F. Shanley, Ph.D., taken Nov. 6, 2024	2017
Deposition Transcript of James F. Shanley, Ph.D., deposition in IPR2023-01421, dated June 6, 2024	2018

F. *Asserted Grounds*

Petitioner asserts the following grounds of unpatentability:

Claim(s) Challenged	35 U.S.C. §²	Reference(s)/Basis
21, 23, 26–31, 34	103	Pacala, Droz
24, 25, 32, 33	103	Pacala, Droz, Villeneuve
21, 23–33	103	Hall, Borowski, Spector
34	103	Hall, Borowski, Spector, Droz

III. ANALYSIS

A. *Legal Standards*

A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the [claimed invention] and the prior art are such that the [claimed invention] as a whole would have been obvious [before the effective filing date of the claimed invention] to a person having ordinary skill in the art to which [the claimed invention] pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

In conducting an obviousness analysis, one must determine whether the claimed elements are present in the prior art. *PAR Pharm., Inc. v. TWI*

² The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. §§ 102, 103. Because the ’405 patent has an effective filing date after the effective date of the applicable AIA amendment, we refer to the AIA version of § 103.

Pharms., Inc., 773 F.3d 1186, 1194–1198 (Fed. Cir. 2014) (citing *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1164 (Fed.Cir.2006)).

However, a patent claim “is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR*, 550 U.S. at 418. An obviousness determination requires finding “both ‘that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.’”

Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd., 821 F.3d 1359, 1367–68 (Fed. Cir. 2016) (citation omitted); *see KSR*, 550 U.S. at 418.

Further, an assertion of obviousness “cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418; *In re NuVasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (a finding of a motivation to combine “must be supported by a ‘reasoned explanation’”).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3)); *see also Intelligent Bio-Sys.*, 821 F.3d at 1369. Therefore, to prevail in an *inter partes* review, Petitioner must explain how the proposed combinations of prior art would have rendered the challenged claims unpatentable.

B. *Level of Ordinary Skill in the Art*

The person of ordinary skill in the art is a hypothetical person who is presumed to know the relevant prior art. *In re GPAC Inc.*, 57 F.3d 1573,

1579 (Fed. Cir. 1995) (citing *Custom Accessories, Inc. v. Jeffrey–Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)). In determining the skill level, the Board may consider various factors including “the type of problems encountered in the prior art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *Id.* In a given case, every factor may not be present, and one or more factors may predominate. *Id.*

Petitioner contends that a person of ordinary skill in the art would have “had an undergraduate degree in mechanical or electrical engineering or physics and two to three years of experience in LiDAR design.” Pet. 12. Petitioner further contends that “[l]ess work experience may be compensated by a higher level of education or vice versa.” *Id.*

Patent Owner argues that

a POSITA would have had an undergraduate degree in mechanical or electrical engineering and two to three years of work experience with electro-optical and electro-mechanical devices or systems, with, at a minimum, at least one year of work experience was with LIDAR designs, where less work experience may be compensated by a higher level of education or vice versa.

PO Resp. 8 (citing Ex. 2010 ¶¶ 60–62).

We agree with and will apply Patent Owner’s statement of the level of ordinary skill in the art. This level of ordinary skill is reflective of the education and experience that would have been required to understand the problems and solutions identified in the ’405 patent and the prior art.

Okajima v. Bourdeau, 261 F.3d 1350 (Fed. Cir. 2001).

C. *Claim Construction*

In an *inter partes* review, claims are construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). This standard includes “construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b). “Any prior claim construction determination concerning a term of the claim in a civil action, or a proceeding before the International Trade Commission, that is timely made of record in the *inter partes* review proceeding will be considered.” *Id.*

“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

1. “*stop region*”

Limitation 21(f) of claim 21 recites, in relevant part, “an aperture layer comprising a plurality of apertures separated by a ***stop region***.” Ex. 1001, 56:57–59 (emphasis added). Independent claim 26 contains a similar limitation. *See id.* at 58:1–2.

In its Petition, Petitioner contended that no terms require construction. Pet. 12. Petitioner also indicated that preliminary constructions were exchanged in the ITC litigation prior to its termination. *Id.* Although those constructions touched upon the meaning of certain terms in limitation 21(f)

such as “aperture,” they are not related to the dispute over claim terminology that the parties raise before us. Ex. 1019, 1³.

In its Response, Patent Owner argued that we should construe “stop region” as “an optically non-transparent region configured to define a field of view for a photosensor.” PO Resp. 32 (citing Ex. 2010 ¶¶ 99–100).

In its Reply, Petitioner disagrees with Patent Owner’s construction. Pet. Reply 2–5. Petitioner contends that “the specification describes the *aperture layer* as defining a field of view in certain embodiments; it does not purport to define the term ‘stop region’ to require defining a field of view.” *Id.* at 3. Thus, Petitioner argues that “stop region” should be construed as “the optically non-transparent region of the aperture layer.” *Id.* at 4.

In its Sur-Reply, Patent Owner repeated that the term should be construed as “an optically non-transparent region that defines a field of view for a photosensor.” PO Sur-Reply 2.

The parties’ dispute over this claim language thus centers on the meaning of “*stop region*” in limitations 21(f) and 26(f). To determine what this means in the context of the ’405 patent, we consider the intrinsic evidence.

We begin with the language of the claims. The claims recite “an aperture layer comprising a plurality of apertures separated by a stop region.” Thus, the claim language only expressly requires that the “stop region” separate the apertures in the aperture layer. *See* Ex. 1001, 56:57–59

³ For Exhibit 1019, we use the numbering of the “Joint Claim Construction Chart” rather than the Exhibit numbering herein.

The '405 patent's Specification contains several references to the “stop region.” Patent Owner points to this discussion of the claimed “stop region”:

An input aperture layer 1740 including an optically transparent aperture 1744 and *optically non-transparent stop region 1746 configured to define a narrow field of view when placed at the focal plane of an imaging optic* such as bulk receiver optic 202 or 1008 (shown in FIGS. 2 and 10, respectively; not shown in FIG. 17). Aperture layer 1740 is configured to receive the input marginal ray lines 1733. The term “optically transparent” herein refers to as allowing most or all light to pass through. Light herein refers to spectrum of light in the near-ultraviolet, visible, and near-infrared range (e.g. 300 nm to 5000 nm). Optically non-transparent herein refers to as allowing little to no light to pass through, but rather absorbing or reflecting the light. Aperture layer 1740 can include optically transparent apertures separated from each other by optically non-transparent stop regions. The apertures and stop regions can be built upon a single monolithic piece such as an optically transparent substrate. Aperture layer 1740 can optionally include a one-dimensional or two-dimensional array of apertures 1744.

Ex. 1001, 37:17–38 (emphasis added).

In particular, Patent Owner relies on the emphasized portion of the first sentence quoted above—“optically non-transparent stop region 1746 configured to define a narrow field of view when placed at the focal plane of an imaging optic”—to support its construction for “stop region.” PO

Resp. 26. Patent Owner argues that “[s]top region **1746** shown in Figure 17 above is not simply a non-transparent element that stops light propagating in an area—it defines the field of view for photosensor **1771**.” *Id.* at 27.

Petitioner argues that Patent Owner is improperly attempting to limit claim scope based on this sentence and preferred embodiments. Pet. Reply 3.

Petitioner contends that Patent Owner misinterprets this portion of the

sentence out of context, and it is the aperture layer, not the stop region defining the field of view. *Id.* (citing Ex. 1033 ¶ 15; Ex. 1001, 37:17–23).

We agree with Petitioner that Patent Owner misreads this portion of the Specification. Although the paragraph quoted is difficult to parse, we believe, when read in context of the entire paragraph, and entire Specification, it is the aperture layer, and not just the stop region that defines the field of view. To begin with, the paragraph is discussing the properties of the “aperture layer,” which suggests that what is “configured to define a narrow field of view” is the aperture layer, not just the “stop region.” Ex. 1001, 37:19–20. Moreover, the remainder of the sentence provides important context. *See id.* at 37:20–21. It states that the defining the narrow field of view occurs “when placed at the focal plane of an imaging optic.” *Id.* at 37:21–22. The Specification describes that what is “placed at the focal plane of an imaging optic” is the entire “aperture layer” not just the “stop region.” *See, e.g., id.* at 3:50–52 (“an aperture layer having a plurality of discrete apertures arranged along a focal plane of the bulk receiver optic”), 4:16–18 (same). Thus, we disagree with Patent Owner that this portion of the Specification supports their construction.

Patent Owner contends that its construction “is further confirmed by examples in the specification of other non-transparent and light-blocking elements that do **not** define a field of view—and which the specification **never** describes as stop regions.” PO Resp. 27; *see also* PO Sur-Reply 2–3. In particular, Patent Owner points to the ’405 patent’s disclosure in Figure 17 of “non-transparent regions and tube structures to reduce cross talk,” *id.* (citing Ex. 1001, 37:46–49), which Patent Owner argues “[t]he ’405 patent never suggests . . . qualify as stop regions,” *id.* at 28. Patent

Owner identifies the embodiment of Figure 19 as having similar disclosure of a non-transparent region, which is not designated as a “stop region.” *See* PO Resp. 29–30 (citing Ex. 1001, Figs. 19A–B, 39:29–46, 39:47–59; Ex. 2010 ¶ 104). In particular, Patent Owner argues that the structures described as “stop regions” in the ’405 patent all define the field of view. *Id.* at 30. Patent Owner asserts that there are “example[s] of non-transparent, light-blocking elements that do **not** define the field of view, and which the ’405 patent explicitly does **not** describe as stop regions.” *Id.*

Petitioner responds that these examples of non-transparent structures not called “stop regions” that Patent Owner identifies “merely show that the term ‘stop region’ refers to non-transparent regions *in the aperture layer*.” Pet. Reply 3 (citing Ex. 1033 ¶ 16). Petitioner argues that “[t]he specification . . . consistently describes the stop region as the optically non-transparent region of the aperture layer without separately requiring it to define a field of view.” *Id.* at 4 (citing Ex. 1001, 38:44–47, 38:55–58, 38:66–39:2, 39:9–12, 40:56–63, 41:13–25).

We agree with Petitioner that the Specification consistently describes the “stop region” as the optically non-transparent region of the *aperture layer*. *See* Ex. 1001, 37:19–20, 37:33–34, 38:45–46, 38:56–57, 39:8, 39:44–45, 39:57–58, 40:3–4, 40:55, 41:11, 41:18–19, 42:4–5, 42:13. Thus, the fact other non-transparent regions, not in the aperture layer, are not described as “stop regions” does not necessarily support importing additional limitations into the term “stop region.” Moreover, the Specification repeatedly describes the “stop region” “reduc[ing] stray light in to the receiver channel” without referring to the “field of view.” Ex. 1001, 38:67–39:2; *see also id.* at 40:58–59 (“absorb or reflect any incident stray light outside the diameter

of aperture 2049”), 40:61–63, 41:15–17, 41:24–25, 42:18–19. Indeed, contrary to Patent Owner’s assertion (PO Sur-Reply 3), the Specification repeatedly describes the *aperture* as what defines the “maximal cylinder of light desired to be passed.” Ex. 1001, 40:56–57 (“Aperture 2049 defines the maximal cylinder of light desired to be passed . . .”), 41:13–14, 42:7–8. Thus, we disagree with Patent Owner’s contention that the Specification supports importing its “field of view” limitation into the term “stop region.” See PO Sur-Reply 4.

Neither party argues that the prosecution history of the ’405 patent lends any insight into proper construction of “stop region.” See PO Resp.; Pet.; Pet. Reply; PO Sur-Reply.

Turning to the extrinsic evidence, Patent Owner contends that “[m]ultiple independent sources . . . confirm that the term ‘stop’ when used in the context of an aperture—consistent with the specification—is a term of art used to describe an element that restricts the path of light to define a field of view.” PO Resp. 30 (citing Ex. 2010 ¶¶ 107–108); PO Sur-Reply 6. In particular, Patent Owner cites to two treatises that explain that the “aperture stop” or “stop” is a feature “which limits the size or diameter of the beam of rays which can pass through the system.” *Id.* at 31 (citing Ex. 2013, 49); see also *id.* (“The *aperture stop* of an optical system is the actual physical component that limits the size of the *maximum cone* of rays.” (citing Ex. 2007, 21)). Patent Owner argues that this description “is entirely consistent with the ‘stop region’ described in the ’405 patent, as it limits the field of view (and thus the maximum ‘cone of rays’) for the aperture.” *Id.* at 31–32; PO Sur-Reply 6. Petitioner responds that the extrinsic evidence deals with the term “aperture stop” and not “stop region.” Pet. Reply 4–5.

In addition, Petitioner notes that the references “explain that the field of view is determined by a diameter, such as of the ‘clear aperture of the lens’—not by an optically non-transparent region.” *Id.* at 5 (citing Ex. 2013, 49).

As the intrinsic evidence is sufficient to determine the meaning of “stop region,” we do not resort to extrinsic evidence such as the declarations and deposition testimony of the parties’ experts. *See Phillips*, 415 F.3d at 1317 (explaining that extrinsic evidence is less significant than intrinsic evidence). Moreover, contrary to Patent Owner’s assertions, we agree with Petitioner that these references are consistent with the portions of the Specification that explain that it is the diameter of the aperture that defines the field of view. *See* Ex. 2013, 49 (“In every optical system, there is some feature, usually a diameter, which limits the size or diameter of the beam of rays which can pass through the system.”); Ex. 1001, 40:56–57 (“Aperture 2049 defines the maximal cylinder of light desired to be passed . . .”), 41:13–14, 42:7–8.

The ’405 patent makes clear that “stop region” is merely the optically non-transparent region of the aperture layer. We disagree with Patent Owner’s contention that it must also define the field of view. We need not construe the term any further to resolve the parties’ dispute over this claim language. *See Realtime*, 912 F.3d at 1375.

2. Remaining Terms

We determine that no other terms require construction to resolve the parties' disputes in this case. *See id.*

D. Obviousness Grounds Based on Pacala

Petitioner contends that claims 21, 23, 26–31, and 34 would have been obvious over the combinations of Pacala and Droz; and claims 24, 25, 32, and 33 would have been obvious over Pacala, Droz, and Villeneuve. Pet. 13–44; Pet. Reply 2–15. Patent Owner disputes that the challenged claims would have been obvious over this combination. PO Resp. 23–44; PO Sur-Reply 2–17.

1. The Prior Art

In this section, we discuss the disclosures of Pacala, Droz, and Villeneuve and address the parties' contentions whether the claim limitations are met by the combination. For the reasons that follow, we determine that claims 21 and 23–34 would have been obvious over the combinations of these references set forth below.

a) Pacala

Pacala is titled “Cost-Effective LIDAR Sensor for Multi-Signal Detection, Weak Signal Detection and Signal Disambiguation and Method of Using Same.” Ex. 1004, Code (54). Pacala relates to “the use of cost-effective robust time-of-flight (ToF) lidar sensors for real-time wide-field-of-view three-dimensional mapping and object detection.” *Id.* ¶ 3. Pacala describes a “lidar-based apparatus” that is “used for multi-signal detection, weak signal detection and signal disambiguation.” *Id.* ¶ 10.

Figure 1 of Pacala is show below.

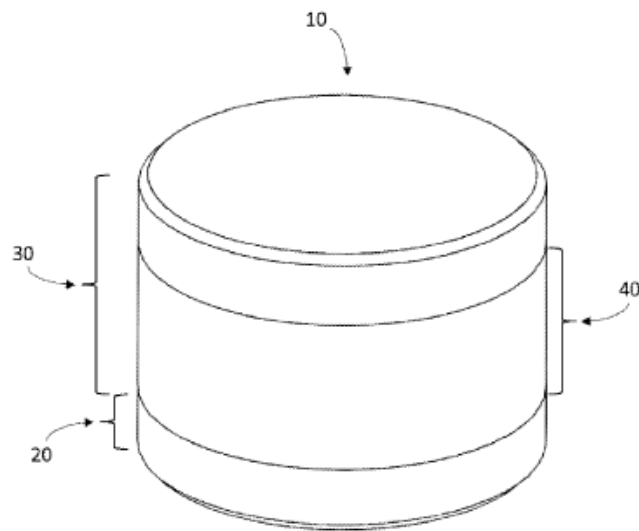


Fig. 1

Figure 1, above, is a schematic diagram of an external view of a lidar sensor.

Id. ¶ 12. Pacala's lidar sensor 10 contains static base 20, static head assembly 30, and window 40. *Id.*

Figure 2 of Pacala is shown below.

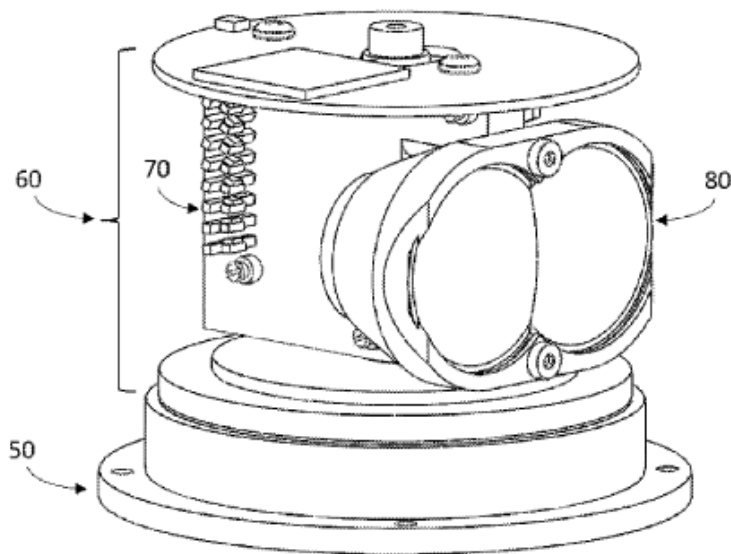


Fig. 2

Figure 2, above, is a schematic diagram of an internal view of a lidar sensor. *Id.* ¶ 13. Figure 2 of Pacala depicts a motor and “spinning turret 60 that contains optoelectronic components 70 (including optical transmitters and receivers).” *Id.* ¶ 13.

b) *Droz*

Droz is titled “Array of Waveguide Diffusers for Light Detection Using an Aperture.” Ex. 1006, Code (54). *Droz* relates to a system for limiting “noise on light detectors using an aperture.” *Id.* at Code (57). Figure 3B of *Droz* is shown below.

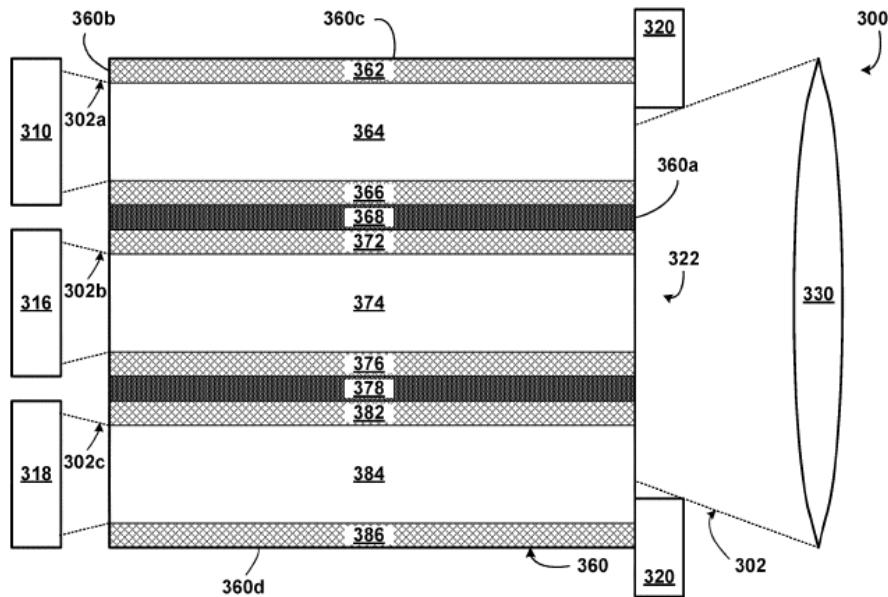


FIG. 3B

Figure 3B, above, illustrates a cross-section view of a noise limiting system. *Id.* at 2:44–48. Figure 3B includes a light detector array which includes a plurality of light detectors. *Id.* at 13:1–6. The system “also includes an opaque material 320, an aperture 322, and a lens 330,” as well as “a waveguide array 360 interposed between aperture 322 and arrays 310, 316, 318.” *Id.* at 13:13–22.

c) *Villeneuve*

Villeneuve is titled, “Pulsed laser for lidar system.” Ex. 1007, Code (54). Villeneuve describes a LiDAR system with one or more “sensor heads,” each of which is configured to emit pulses of light. Ex. 1007, 14:12–17, 15:6–13, 16:57–65. To improve the performance of the system across a range of distances (up to a Maximum distance), Villeneuve teaches aligning the field of view of a light source FOV_L) and the field of view of a receiver (FOV_R). *Id.* at 55:37–56:52. More specifically, Villeneuve explains that light emitted by the light source will be sent in the direction of FOV_L , and reflected light within the FOV_R may be detected at the receiver. *Id.* at 55:47–55.

To ensure that emitted light is detected at the receiver across different ranges, Villeneuve teaches that the angular size of the FOV_L and FOV_R , each of which defines a cone-shaped region, may be “approximately equal.” *Id.* at 55:41–47, 56:10–15, 56:31–33. Villeneuve further teaches that the FOV_L and FOV_R “may be substantially coincident with one another and may have an angular overlap of approximately 100%.” *Id.* at 57:4–7. For example, in Figure 34, reproduced below, the two fields of view “are approximately the same size and have an angular overlap of approximately 90%”:

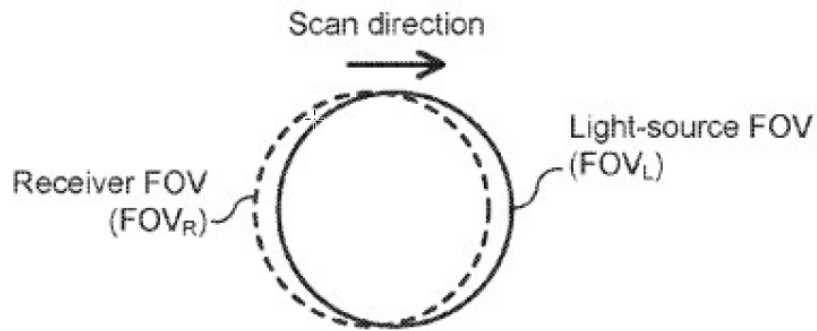


Figure 34

Ex. 1007, Fig. 34. Figure 34, reproduced above, shows an example light-source field of view and receive field of view with a corresponding scan direction. *Id.* at 3:1–3. Petitioner submits that “[b]y aligning the fields of view in this manner, Villeneuve teaches that the receiver may detect reflected light at a range of distances up to the maximum range of the system. *Id.* at 57:31–59.

2. Obviousness of Claims 21, 23, 26–31 and 34 over Pacala and Droz

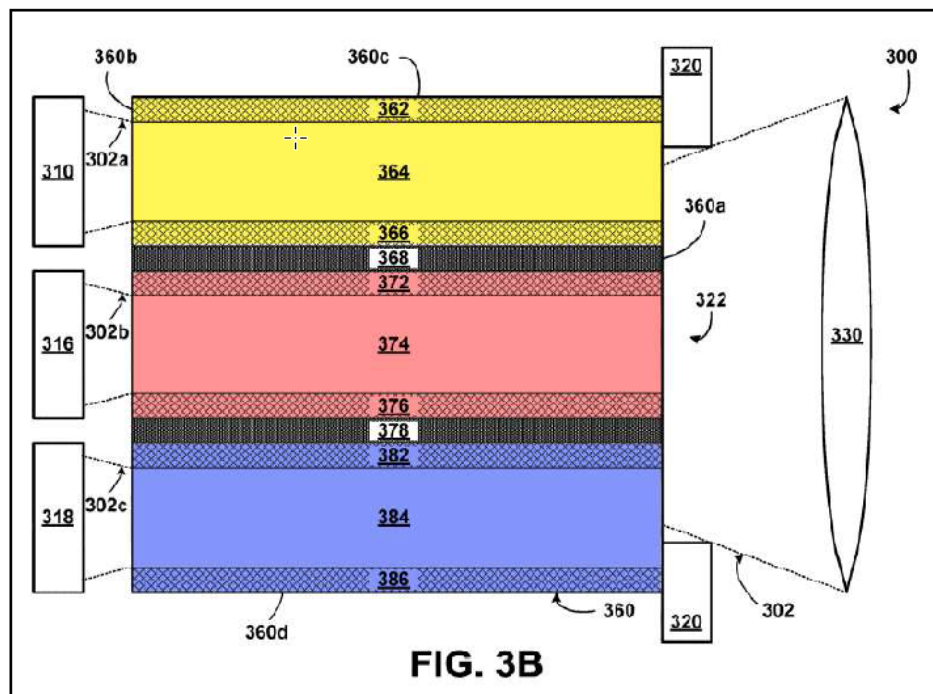
a) Analysis of Independent Claim 21

In this section, we analyze Petitioner’s and Patent Owner’s contentions concerning disputed limitations of independent claim 21 below. We then address the undisputed limitations. Throughout, we use Petitioner’s identifiers to indicate the limitations under discussion. For the reasons that follow, we determine that claim 21 would have been obvious over the combination of Pacala and Droz.

(1) Dispute Over “Stop Region”

Petitioner contends that the combination of Pacala and Droz discloses the portion of claim 21’s limitation 21(f) reciting “aperture layer comprising a plurality of apertures separated by a stop region.” Pet. 27–28; Pet.

Reply 2, 6–9. Petitioner submits that Pacala does not expressly teach an “aperture layer,” so Petitioner turns to Droz’s “waveguide array 360” to supply this limitation. Pet. 27 (citing Ex. 1006, 13:23–26). Petitioner notes that “[e]ach waveguide includes an optically transparent core layer (e.g., core layers 364, 374, and 384), surrounded by cladding layers (e.g., cladding layers 362, 366, 372, 376, 382, and 386) designed to reflect light at the edge of a core layer and guide it through the waveguide. *Id.* (citing Ex. 1006, 13:27–54). To explain its contention, Petitioner provides the following annotated version of Droz’s Figure 3B:



Pet. 27. Petitioner’s annotated version of Droz’s Figure 3B shows waveguide array 360, which includes cladding layers 362, 366, 372, 376, 382, and 386, core layers 364, 374, and 384, and absorbing layers 368 and 378. Petitioner has colored each of the three waveguides shown in the waveguide array a different color (yellow, red and blue). *Id.* Petitioner

explains that “[e]ach waveguide receives a portion of light 302 on an input side of the waveguide (side 360a) and guides the light toward and out of an output end of the waveguide (side 360b).” *Id.* at 28 (citing Ex. 1006, 14:4–17). Petitioner submits that “[l]ight detectors (e.g., light detector arrays 310, 316, and 318) are ‘positioned adjacent to the output end’ of a waveguide ‘to intercept and detect’ light guided through that waveguide.” *Id.* (citing Ex. 1006, 14:11–17). Petitioner notes that “each respective input end of the waveguides in array 360 may correspond to a respective aperture of system 300.” *Id.* at 28 (citing Ex. 1006, 16:18–21).

Petitioner argues that “[w]hen applied to Pacala’s LiDAR device, Droz’s waveguide array would provide a plurality of apertures (the input ends of the waveguides).” *Id.* (Ex. 1003 ¶¶ 150–151). Petitioner asserts that “Droz also teaches that a layer of light-absorbing material (e.g., absorbing layers 368 and 378) is provided between waveguides to absorb leakage from one waveguide to an adjacent waveguide.” *Id.* (citing Ex. 1006, 13:39–43, 14:47–60). Petitioner contends that “[t]he light-absorbing material comprises a stop region separating the apertures.” *Id.* (citing Ex. 1003 ¶ 151).

Patent Owner argues that Petitioner has not shown the combination accounts for this limitation under its proposed construction for “stop region.” PO Resp. 32–38. PO Sur-Reply 7–12. Patent Owner does not address whether Droz meets this limitation under Petitioner’s proposed construction.

As we explained above, we decline to adopt Patent Owner’s proposed construction for the term “stop region.” *See supra* III.C.1. We have reviewed Petitioner’s evidence and arguments, and find that, under the construction for “stop region” we adopted above, Petitioner has shown that

Droz discloses the claimed “aperture layer comprising a plurality of apertures separated by a *stop region*.” *See* Pet. 27–28; Ex. 1003 ¶¶ 150–151.

(2) *Motivation to Combine and Reasonable Expectation of Success*

Petitioner contends that a POSITA would have been motivated to implement the teachings of Droz in Pacala’s LiDAR device for several reasons. Pet. 18–20; Ex. 1003 ¶¶ 129–133. First, Petitioner argues that a POSITA would have understood that the teachings of Droz are generally applicable to LiDAR devices, including the LiDAR device of Pacala. *Id.* at 18 (citing Ex. 1003 ¶ 133). In particular, Petitioner asserts that a person of ordinary skill would have recognized that Pacala’s device was subject to improvements, and Droz teaches several such improvements that could be predictably and successfully applied to other LiDAR systems, including Pacala’s device. *Id.*

Second, Petitioner contends that, to the extent Pacala does not disclose the use of SPAD arrays, “a POSITA would have been motivated to modify Pacala to incorporate SPAD arrays” as taught by Droz. *Id.* at 19 (citing Ex. 1003 ¶ 130). Petitioner notes that Pacala teaches that conventional LiDAR devices “can miss low intensity pulses.” *Id.* (citing Ex. 1004 ¶ 7). Petitioner submits that Droz teaches that using a plurality of interconnected SPADs to represent a pixel “improve[s] the sensitivity of the system,” thereby “enhancing the[] detection qualities” of the system. *Id.* (citing Ex. 1006, 1:10–23, 3:63–67). Petitioner asserts that Droz also discloses that once an individual SPAD absorbs a photon, it “cannot detect additional photons until the SPAD is quenched”—a period of time “referred to as the recovery time.” *Id.* (citing Ex. 1006, 11:2–10). Petitioner contends that “[a]

POSITA would have thus understood that employing an array of SPADs beneficially reduces the likelihood of missed pulses due to an individual SPAD's recovery time, because a plurality of SPADs is used to detect photon associated with a single pixel.” *Id.* (citing Ex. 1003 ¶ 130).

Third, Petitioner argues that “a POSITA would have been motivated to modify Pacala to incorporate optical filters in view of Droz.” Pet. 19 (citing Ex. 1003 ¶ 131). Petitioner submits that Droz teaches that optical filters that “selectively transmit light within a predefined wavelength range” (e.g., bandpass filters) may be used to “reduce ambient light or background light from adversely affecting measurements” by a SPAD array. *Id.* (citing Ex. 1006, 7:51–64). Petitioner notes that Droz explains that the “reduction in light intensity” is “particularly beneficial” for SPAD arrays because “reducing the light power incident on” the individual SPADs increases the accuracy of each individual SPAD in the array. *Id.* at 19–20 (citing Ex. 1006, 10:63–11:15). Petitioner asserts that “[a] POSITA would further have known that the particular positioning of the optical filters within the system is a design choice, and that the filter may be positioned in any number of locations between the bulk optics and the detectors to achieve the intended function.” *Id.* at 20 (citing Ex. 1003 ¶ 131).

Fourth, Petitioner argues that “a POSITA would have been motivated to modify Pacala to use waveguides as taught by Droz.” *Id.* (citing Ex. 1003 ¶ 132). Petitioner contends that “Droz teaches that waveguides increase ‘the number of light detectors able to fit into a detection area,’ and thus allow for more SPADs within the SPAD array, increasing sensitivity and detection quality as discussed above.” *Id.* (citing Ex. 1006, 3:34–67). Petitioner notes that “Droz also teaches that waveguides prevent received light from

‘diverg[ing] and overlap[ping] prior to arriving at the array of light detectors,’ and thus allow for more precise detection even when the distance between adjacent detectors is small—particularly when a light-absorbing material is included between adjacent waveguides.” *Id.* (citing Ex. 1006, 4:1–28, 4:4–48, 13:39–43, 14:47–60).

Patent Owner argues that Petitioner has failed to show a POSITA would have been motivated to combine Pacala and Droz because “Petitioner and its expert have ignored the substantial differences between the Pacala and Droz systems and the potentially insurmountable challenge presented by attempting to incorporate the waveguides of Droz into the Pacala system.” PO Resp. 38. Patent Owner asserts that Pacala discloses a “compact” LiDAR system whose components are “tightly” packed into a spinning turret. *Id.* (citing Ex. 1004, Figs. 1–2). Patent Owner contends that “Pacala also repeatedly emphasizes the cost-effectiveness of its compact design.” *Id.* at 39 (citing Ex. 1004 ¶¶ 3, 10, 14). Patent Owner argues that “the Pacala-Droz combination would have required at least eight core layers of stacked plates of glass or polymer, at least seven absorbing layers of carbon black or black chrome (between the core layers), and at least sixteen cladding layers made of polymer-coated or fluorine-doped glass (sandwiching the core layers).” *Id.* at 41 (citing Ex. 2010 ¶¶ 112-113).

After this characterization of the references, Patent Owner submits that “Petitioner and its expert provide only generalities about the Pacala-Droz combination, and provide no [] analysis or reasoned explanation as to how the proposed combination could have been built.” *Id.* at 41–42. Patent Owner argues that Petitioner’s expert admitted on cross examination that he did not know what the device would weigh or its weight distribution. *Id.*

at 42 (citing Ex. 2011, 54:6–13, 54:20–55:4, 56:21–57:2). Patent Owner contends that “adding the stack of solid materials in Droz’s waveguides to the spinning Pacala system would have changed the gyroscopic forces acting on the spinning system.” *Id.* (citing Ex. 2010 ¶ 118).

We begin by noting that Patent Owner does not dispute Petitioner’s contentions concerning the motivation to incorporate Droz’s SPADs and filters into Pacala. *See* PO Resp. 38–44. We have reviewed Petitioner’s arguments and evidence regarding those aspects of the combinations and find them well-reasoned and supported. Thus, we find Petitioner has shown sufficiently that POSITA would have been motivated to combine those teachings of Droz (SPADs and filters) with a reasonable expectation of success. *See* Ex. 1003 ¶¶ 130–131. We focus our analysis on the parties’ dispute regarding the combination of Droz’s teachings regarding waveguides with Pacala’s device.

We find that Petitioner has shown sufficiently that there is a motivation to combine Droz’s teachings of waveguides with Pacala’s device with a reasonable expectation of success. *See* Ex. 1003 ¶ 132. We agree with Petitioner that a POSITA would have been motivated to incorporate waveguides based on Droz’s teaching that waveguides increase “the number of light detectors able to fit into a detection area,” which would allow for more SPADs within the SPAD array, increasing sensitivity and detection quality.” *See* Pet. 20 (citing Ex. 1006, 3:34–67). Moreover, we also agree with Petitioner that Droz further teaches that waveguides prevent received light from “diverg[ing] and overlap[ping] prior to arriving at the array of light detectors,” which would allow for more precise detection even when the distance between adjacent detectors is small—particularly when a light-

absorbing material is included between adjacent waveguides. *Id.* (citing Ex. 1006, 4:1–28, 4:4–48, 13:39–43, 14:47–60). Patent Owner’s arguments that Petitioner has failed to show a motivation to combine because Petitioner failed to account for the alleged difficulty of the combination are not persuasive for a number of reasons.

First, as Petitioner explains, “[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference.” *Allied Erecting & Dismantling Co. v. Genesis Attachments*, 825 F.3d 1373, 1381 (Fed. Cir. 2016) (quoting *In re Keller*, 642 F.2d 413, 425 (CCPA 1981)). Indeed, “whether one prior art reference can be incorporated into another is ‘basically irrelevant.’” *Uber Techs., Inc. v. X One, Inc.*, 957 F.3d 1334, 1341 (Fed. Cir. 2020). Thus, “a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements.” *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012). We agree with Petitioner that Patent Owner’s arguments attempt to require a showing that Droz’s waveguides could be bodily incorporated into Pacala’s device to show obviousness. *See Allied Erecting*, 825 F.3d at 1381 (noting “it is not necessary that [the references] be physically combinable to render obvious the [challenged patent]”).

Second, we agree with Petitioner that Patent Owner’s arguments are premised on unsupported characterizations of the references. For example, Patent Owner characterizes Pacala as “repeatedly emphasiz[ing] the cost-effectiveness of its compact design.” PO Resp. 39 (citing Ex. 1004 ¶¶ 3, 10, 14). Although the embodiment shown in Figs 1 and 2 of Pacala may appear

(and perhaps is) “compact,”⁴ Pacala does not expressly characterize it as such, or discuss, let alone mention, any alleged benefits of its size. Pacala does discuss cost, but Pacala’s cost benefits are obtained by the particular measurement method, *see, e.g.*, Ex. 1004 ¶¶ 5, 6, 10 (“This advanced TDC-based pulse width time-of-flight (ToF) approach achieves the low cost associated with the TDC-based pulse width ToF approach.”), 14), not on the alleged compactness (or weight) of the device. However, even if Pacala did “emphasize” these characteristics, as Patent Owner contends, “simultaneous advantages and disadvantages ... do[] not necessarily obviate motivation to combine.” *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006). An obviousness showing does not “require that a particular combination must be the preferred, or the most desirable, combination described in the prior art in order to provide motivation for the current invention.” *Novartis Pharms. Corp. v. West-Ward Pharms. Int’l Ltd.*, 923 F.3d 1051, 1059 (Fed. Cir. 2019) (citation omitted). Thus, we do not find Patent Owner’s arguments regarding Pacala’s advantages to undermine Petitioner’s reasoning regarding motivation to combine.

There are similar problems with Patent Owner’s characterization of Droz. Although neither Patent Owner nor Dr. Janét, provide any quantification of the size or weight of Droz’s waveguides, Patent Owner does repeatedly characterize the layers in Droz’s waveguide as a stack of “plates” of “solid” material. *See* PO Resp. 41 (“the waveguides of Droz

⁴ We note that Patent Owner notes that Dr. Shanley characterized it as “compact.” PO Sur-Reply 15 (citing Ex. 2018, 78:6–79:16). We find that the important point is not whether Pacala is, in fact, “compact,” but that it is not recognized as a key feature of Pacala’s device, as Patent Owner seems to suggest.

consist of ‘stacked’ plates and layers, each of which consists of solid material” and “the Pacala-Droz combination would have required at least eight core layers of stacked plates of glass or polymer, at least seven absorbing layers of carbon black or black chrome (between the core layers), and at least sixteen cladding layers made of polymer-coated or fluorine-doped glass (sandwiching the core layers)”). The unsaid implication of the choice of “stacked plates” and “solid” material is that the waveguides have a significant mass, but Patent Owner provides no evidence to support any conclusion about whether the mass of Droz’s waveguides would pose a significant hurdle in incorporating waveguides into Pacala’s device. Indeed, as Petitioner points out in its Reply⁵ (Pet. Reply 13), Droz explains:

By way of example, consider an aperture having a cross-sectional area of 2000 μm (long axis) by 200 μm (short axis). In this example, the plurality of waveguides can be implemented as 10 stacked waveguides, each having a length (along the long axis of the aperture) of 200 μm . In this example, the portion of the light entering the input end of a waveguide may have a cross-sectional area of 200 μm by 200 μm , which may be suitable to accommodate hundreds of SPADs (e.g., each SPAD having a cross-sectional area between 200 μm^2 and 600 μm^2).

⁵ Patent Owner argues that Petitioner’s reference to this portion of Droz is “improper on reply.” We disagree. Patent Owner raised the argument that it would be difficult to incorporate Droz’s waveguides and choose to characterize Droz’s waveguides in a manner that suggests they are quite massive. We find that Petitioner’s pointing out disclosure in Droz that undermines that characterization to be a proper reply argument. Patent Owner also asserts that Petitioner’s contentions are “unsupported attorney argument.” We also disagree with this assertion. Petitioner’s arguments are directly supported by the plain text of Droz. Moreover, we do not rely on them to find that Droz’s waveguides are a certain size, but to find that Dr. Janét’s testimony on the issue of the difficulty of incorporating Droz’s waveguides into Pacala’s device is entitled to little weight.

Ex. 1006, 3:48–58.

This discussion suggests that the cross-sectional area of each of Droz’s waveguides (200 μm by 200 μm (or 0.2 mm by 0.2 mm)), which is relatively small. This discussion is the only disclosure in either reference relating to the actual measurements of any component of either Pacala’s or Droz’s devices. However, Dr. Janét did not discuss it or even appear to consider it, even though the size of Droz’s waveguides seems to be a crucial element to Dr. Janét’s suggestion that incorporating Droz’s waveguides into Pacala’s device would present a significant engineering challenge. *See* Ex. 2010 ¶ 118 (“Similarly, a POSITA would have understood that adding the stack of solid materials in Droz’s waveguides to the spinning Pacala system would have changed the gyroscopic forces acting on the spinning system. A POSITA would have understood that adding mass to a spinning device—particularly a stack of solid materials like Droz’s waveguides—will impact the rotational forces acting upon the device.”). We find Dr. Janet’s failure to consider this disclosure significantly undermines the credibility of his testimony—which seems to rely on an assumption that the waveguides have a sufficient mass to materially affect the operation of Pacala’s device. Therefore, we give Dr. Janét’s testimony on the challenges of incorporating Droz’s waveguides into Pacala’s device little weight.

Instead, we credit the un rebutted testimony of Dr. Shanley that it was well within the level of the skill in the art to adjust the design of a LiDAR device to accommodate any added components. *See* Ex. 2011, 55:14–22 (explaining that industry practice is to use mechanical CAD programs that “talk with the optical CAD programs and come up with the optimal design”), 56:1–20 (explaining that the POSITA would have access to these programs

and “a mechanical engineer out of school or an optical engineer or an electrical engineer, they can all run these programs that does it” and explaining that the systems will give you “the form, fit, and function, including weight and all this right out of those systems”).

Patent Owner’s response to this testimony is that Dr. Shanley testified that this work is generally done by a team of people. *See* PO Sur-Reply 13 (citing Ex. 2011, 58:20–21). We see nothing inconsistent in his testimony on this point. Dr. Shanley testified that the operation of the software used to make these designs is all within the level of a POSITA. *See* Ex. 2011, 56:1–20. The fact that, in an industrial setting, the construction of actual commercial device involves a team of people is not inconsistent with Dr. Shanley’s explanation that the work of making this modification is all something within the level of a POSITA. Patent Owner offers no evidence to the contrary.

As for Patent Owner’s argument that Petitioner did not explain precisely how the combination would be made or do an engineering analysis of the size, weight, mass distribution, and rotational forces, PO Sur-Reply 12–14, we do not find it persuasive. “Obviousness does not require absolute predictability of success.” *In re O’Farrell*, 853 F.2d 894, 903 (Fed. Cir. 1988). Here, Petitioner has provided sufficient evidence to show that it was well within the level of skill in the art to combine these references.⁶ We find that this is sufficient.

⁶ We note this finding is consistent with the disclosure of the ’405 patent, Pacala, and Droz, which all omit the details of the precise mechanical implementation of the devices. *See Uber*, 957 F.3d at 1339 (“The specification of the [patent-at-issue] is entirely silent on how to transmit user

Accordingly, Petitioner shows by a preponderance of the evidence that a POSITA would have been motivated to combine Pacala and Droz with a reasonable expectation of success.

(3) 21(a): *An optical system for performing distance measurements, the optical system comprising:*

Petitioner contends that, to the extent the preamble is limiting, Pacala discloses limitation 21(a). Pet. 20–21 (citing Ex. 1003 ¶¶ 135–136). Petitioner notes that Pacala teaches a “lidar-based 3-D apparatus and method,” and that LiDAR systems “employ pulses of light to measure distance to an object,” and that a “lidar sensor . . . can measure the distance to a target or objects in a landscape.” *Id.* (citing Ex. 1004, Code (53), ¶ 4). Patent Owner does not dispute that Pacala discloses the preamble. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, to the extent the preamble is limiting, Petitioner has shown sufficiently that Pacala discloses the preamble.

locations and maps from a server to a user's mobile device, suggesting that a person of ordinary skill in the art was more than capable of selecting between the known methods of accomplishing this.”); *In re Epstein*, 32 F.3d 1559, 1568 (Fed. Cir. 1994) (“[T]he Board’s observation that appellant did not provide the type of detail in his specification that he now argues is necessary in prior art references supports the Board’s finding that one skilled in the art would have known how to implement the features of the references and would have concluded that the reference disclosures would have been enabling.”).

(4) 21(b): a stationary housing having a base, a top and an optically transparent window disposed between the base and the top and extending fully around a periphery of the stationary housing;

Petitioner argues that Pacala discloses limitation 21(b). Pet. 21–22 (citing Ex. 1003 ¶¶ 137–138). Petitioner asserts that Pacala teaches that lidar sensor 10 includes a “static base 20 and a static head assembly 30 that includes a window 40 that is transparent at the wavelength of the laser used in each transmitter.” *Id.* at 21 (citing Ex. 1004 ¶ 12). Petitioner contends that Figure 1 shows a window disposed between a static base and the top of the static head assembly. *Id.* (citing Ex. 1004, Fig. 1). Petitioner further submits that a person of ordinary skill in the art “would have understood and it would have been obvious that Pacala’s window extends fully around the periphery of the stationary housing comprising the static base and static head assembly.” *Id.* at 21–22 (citing Ex. 1003 ¶ 138; Ex. 1013 ¶¶ 14, 17, 21, Fig. 1, claim 12). Patent Owner does not dispute that Pacala discloses this limitation. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, Petitioner has shown sufficiently that Pacala discloses this limitation.

(5) 21(c): a light ranging device disposed within the housing and comprising:

Petitioner contends that Pacala discloses limitation 21(c). *See* Pet. 22 (citing Ex. 1003 ¶ 139). Petitioner submits that “Pacala teaches that its system is a ‘lidar sensor,’ which is a ‘light detection and ranging sensor.’” *Id.* (citing Ex. 1004 ¶¶ 4, 11–12, Figs. 1–2). Petitioner contends that “Figure 1 provides an ‘external view’ of the system; accordingly, the ‘light ranging’ components are disposed internal to (i.e., within) the housing

depicted in Figure 1.” Petitioner asserts that Pacala teaches that “this ‘internal’ portion of its lidar sensor includes a ‘a spinning turret 60 that contains optoelectronic components 70 (including optical transmitters and receivers), collimation and focusing lenses 80 and distributed electronics,’ which are standard components in a lidar-based light ranging device.” *Id.* (citing Ex. 1004 ¶ 13). Patent Owner does not dispute that Pacala discloses this limitation. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, Petitioner has shown sufficiently that Pacala discloses this limitation.

(6) 21(d): a platform;

Petitioner argues that Pacala discloses limitation 21(d). Pet. 22–23 (citing Ex. 1003 ¶¶ 140–141). Petitioner submits that Pacala teaches that “Pacala teaches . . . that its lidar sensor includes a ‘spinning turret 60 that contains optoelectronic components 70 . . . , collimation and focusing lenses 80 and distributed electronics.’” *Id.* at 22 (citing Ex. 1004 ¶ 13, Fig. 2). Patent Owner does not dispute that Pacala discloses this limitation. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, Petitioner has shown sufficiently that Pacala discloses this limitation.

(7) 21(e): a light transmission module coupled to the platform and comprising a bulk transmitter optic and a plurality of optical emitters, each optical emitter in the plurality of optical emitters configured to generate and transmit pulses of radiation through the bulk transmitter optic and through the optically transparent window into a field external to the optical system; and

Petitioner argues that Pacala discloses limitation 21(e). *See* Pet. 23–25; Ex. 1003 ¶¶ 142–145. Petitioner contends that Pacala teaches that its “‘spinning turret 60 contains ‘optoelectronic components 70 (including optical transmitters and receivers), collimation and focusing lenses 80 and distributed electronics.’” *Id.* at 23 (citing Ex. 1004 ¶ 13). Petitioner asserts that a POSITA would have understood and it would have been obvious that Pacala’s spinning turret 60 comprises two modules coupled to the turret platform: a light transmission module and a light sensing module. *Id.* at 23–24 (citing Ex. 1003 ¶ 143; Ex. 1004, Fig. 2; Ex. 1014, 3:19–27, Figs. 2–3).

Petitioner submits that Pacala further discloses a bulk transmitter optic. *Id.* at 24 (citing Ex. 1003 ¶ 144). Petitioner notes that Pacala teaches that spinning turret 60 contains “collimation and focusing lenses 80.” *Id.* (citing Ex. 1004 ¶ 13). Petitioner contends that “[a] POSITA would have understood and it would have been obvious that these refer to two different lenses, and that the collimation lens is a bulk transmitter optic.” *Id.* (citing Ex. 1003 ¶ 144).

Petitioner argues that Pacala further discloses a plurality of optical emitters. *Id.* at 25 (citing Ex. 1003 ¶ 145). Petitioner notes that “Pacala discloses ‘optical transmitters’ (plural) that ‘irradiat[e] [a] target or landscape with light, using pulses.’” *Id.* (citing Ex. 1004 ¶¶ 4, 13).

Petitioner asserts that “[a] POSITA would have understood and it would have been obvious that because Pacala’s transmitters are positioned behind the collimation lens (the blue lens of lenses 80 in Figure 2, shown above) and are internal to the exterior housing and window (in Figure 1), light transmitted onto a target or landscape field will pass through the lens and window.” *Id.* (citing Ex. 1003 ¶ 145).

Patent Owner does not dispute that Pacala discloses this limitation. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, Petitioner has shown sufficiently that Pacala discloses this limitation.

(8) 21(f): a light sensing module coupled to the platform and comprising a bulk receiver optic, an aperture layer comprising a plurality of apertures separated by a stop region, a plurality of photosensors operable to detect photons emitted from the plurality of optical emitters and received through the bulk receiver optic after being reflected from surfaces within the field, and an optical filter disposed between the bulk receiver optic and the plurality of photosensors and configured to allow a band of radiation, including an operating wavelength of the plurality of optical emitters, to pass through the filter to the plurality of photosensors while blocking radiation outside the band from reaching the plurality of photosensors; and

Petitioner contends that the combined teachings of Pacala and Droz render limitation 21(f) obvious. *See* Pet. 25–29; Ex. 1003 ¶¶ 146–153. Petitioner submits that Pacala discloses a “bulk receiving optic,” *see* Pet. 26 (citing Ex. 1004 ¶ 13 (“focusing lens[]”). Petitioner also argues that Pacala discloses a “plurality of photosensors.” *Id.* at 26–27 (citing Ex. 1003 ¶ 148;

Ex. 1004 ¶¶ 4, 13). Petitioner acknowledges that Pacala does not expressly teach an aperture layer or optical filters. *See id.* at 27. For these limitations, Petitioner relies on teachings from Droz. With respect to the claimed “aperture layer,” Petitioner contends that Droz’s waveguide array 360 that includes a plurality of waveguides collectively comprises an aperture layer. *Id.* (citing Ex. 1006, 13:23–26). We set forth Petitioner’s contentions in detail above in our discussion of the dispute over the “stop region” limitation. *See supra* III.D.2.a.1. Besides its contentions regarding stop region, Patent Owner does not raise any other disputes regarding this limitation. For the reasons discussed above, we found those contentions unpersuasive. We have reviewed Petitioner’s contentions regarding the “aperture layer” and find that Petitioner has shown sufficiently that Droz teaches the claimed aperture layer. *See* Pet. 27–28.

Petitioner further contends that Droz teaches optical filter (optical filter 132) disposed between a bulk receiver optic and a plurality of photosensors that would selectively transmit light within a predefined wavelength range while blocking light outside that wavelength range. *See* Pet. 28–29 (citing Ex. 1006, 7:50–8:10, Fig. 1B; Ex. 1003 ¶ 152). Patent Owner does not dispute that Droz teaches this portion of the limitation. We have reviewed Petitioner’s evidence and argument and find that Petitioner has shown sufficiently that Droz teaches the claimed “optical filter.” *See* Pet. 28–29; Ex. 1003 ¶ 152.

We further find, as discussed above, *see supra* III.D.2.a.2, that Petitioner has shown a motivation to combine the teachings of Pacala and Droz.

Accordingly, we find that, Petitioner has shown sufficiently that the combination of Pacala and Droz teaches this limitation.

(9) 21(g): a motor disposed within the housing and operatively coupled to spin the platform and the light ranging device within the housing;

Petitioner argues that Pacala discloses limitation 21(g). *See* Pet. 30; Ex. 1003 ¶ 153. Petitioner submits that “Pacala teaches that static base 50 of its housing ‘contains a motor.’” *Id.* (citing Ex. 1004 ¶ 13). Petitioner contends that “[a] POSITA would have understood and it would have been obvious that the platform of spinning turret 60 (as shown in Figure 2) is operatively coupled to the motor of static base 50 to spin the platform and its light ranging device (implemented in the optical, electronic, and optoelectronic components of spinning turret 60),” and “[b]ecause static base 50 is static, spinning turret 60 must be coupled to the motor within static base 50 to spin.” *Id.* (citing Ex. 1004, Fig. 2; Ex. 1003 ¶ 153). Patent Owner does not dispute that Pacala discloses this limitation. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, Petitioner has shown sufficiently that Pacala discloses this limitation.

(10) 21(h): wherein: each photosensor in the plurality of photosensors comprises a plurality of single photon avalanche diodes (SPADs);

Petitioner asserts that the combined teachings of Pacala and Droz render limitation 21(h) obvious. *See* Pet. 31; Ex. 1003 ¶¶ 154–155. Petitioner submits that Pacala discloses that its optical receivers may be “a detector array” such as a SPAD array. *Id.* (citing Ex. 1004 ¶ 14). Petitioner contends that “[a] POSITA would have understood and it would have been

obvious that each photosensor (e.g., each pixel) in Pacala comprises a SPAD array with a plurality of SPADs.” *Id.* (citing Ex. 1003 ¶154; Ex. 1001, 11:39-43 (teaching that a “photosensor” may be “referred to by one skilled in the art as a ‘pixel’”); Ex. 1014, 2:51–57, 4:22–25).

Alternatively, Petitioner argues that “Droz teaches a plurality of light detector arrays, where each light detector array ‘correspond[s] to an image pixel.’” *Id.* (citing Ex. 1006, 4:9–11, 13:1–3, 14:37–40). Petitioner submits that Droz further teaches that each light detector array “may include a plurality of light detectors,” such as a plurality of SPADs. *Id.* (citing Ex. 1006, 13:3–6, 5:28–29, 18:55–57). As discussed above, Petitioner argues that, to the extent that Pacala does not teach this limitation, it would have been obvious to POSITA to modify Pacala to use a plurality of SPADs for each pixel, as taught by Droz. *Id.* (citing Ex. 1003 ¶ 155).

Patent Owner does not dispute that either Pacala or the combination of Pacala and Droz teaches this limitation. We addressed the motivation to combine Pacala and Droz above. *See supra* III.D.2.a.2. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, Petitioner has shown sufficiently that Pacala and the combination of Pacala and Droz teaches this limitation.

(11) 21(i): the plurality of apertures comprises at least first, second, third and fourth apertures;

Petitioner argues that the combination of Pacala and Droz render limitation 21(i) obvious. *See* Pet. 32–33; Ex. 1003 ¶ 156. As discussed above with respect to limitation 21(f) Petitioner relies on Droz’s waveguide array as teaching the claimed aperture layer. *See supra* III.D.2.a.8. Petitioner further contends that, in an exemplary embodiment, “the

waveguide array includes three waveguides (and thus three apertures).” Pet. 32 (citing Ex. 1006, Fig. 3B, 13:48–54). Petitioner notes that Droz further teaches that the waveguide array “may include fewer *or more* than the three waveguides shown.” *Id.* (citing Ex. 1006, 16:54–55). Petitioner contends that “[t]he number of waveguides corresponds to the number of photosensors; Pacala includes more than three optical receivers, and thus the combine system includes at least first, second, third, and fourth, apertures.” *Id.* (citing Ex. 1003 ¶ 156).

Other than its dispute regarding “stop region” and that there is no motivation to combine the references discussed above, Patent Owner does not dispute that the combination of Pacala and Droz teaches this limitation. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, Petitioner has shown sufficiently that the combination of Pacala and Droz teaches this limitation.

(12) 21(j): the plurality of photosensors comprises at least first, second, third and fourth photosensors; and the light sensing module includes a first optical path to the first photosensor through the first aperture, a second optical path to the second photosensor through the second aperture, a third optical path to the third photosensor through the third aperture, and a fourth optical path to the fourth photosensor through the fourth aperture.

Petitioner argues that the combination of Pacala and Droz render limitation 21(j) obvious. *See* Pet. 33; Ex. 1003 ¶¶ 157–158. Petitioner contends that “Droz teaches that each waveguide may guide a portion of light toward a different one of the plurality of light detector arrays (e.g., light detector arrays 310, 316, and 318 in Fig. 3B).” Pet. 33 (citing Ex. 1006,

14:4–17). Petitioner argues that an absorbing layer may be provided between each pair of waveguides (e.g., absorbing layers 368 and 378 in Figure 3B) to prevent leakage of light between adjacent waveguides. *Id.* (citing Ex. 1006, 14:47–60). Petitioner submits that “[w]hen applied to Pacala’s system, each waveguide (i.e., each aperture) would thus provide an optical path to its corresponding light detector array.” *Id.* (citing Ex. 1003 ¶ 158). Petitioner argues that “for four or more waveguides . . . , each of the four waveguides will have an associated light detector array and a corresponding optical path through the waveguide.” *Id.* (citing Ex. 1003 ¶¶ 157–158).

Other than its disputes regarding the claimed “stop region” and that there is no motivation to combine the references discussed above, Patent Owner does not dispute that the combination of Pacala and Droz teaches this limitation. We have reviewed Petitioner’s evidence and argument for this limitation, and find it sufficient. Accordingly, we find that, Petitioner has shown sufficiently that the combination of Pacala and Droz teaches this limitation.

(13) Secondary Considerations

Patent Owner contends that “there was significant industry skepticism of the use of SPADs in LIDAR systems prior to the ’405 patent.” PO Resp. 62 (citing Ex. 2010 ¶¶ 162–167). Specifically, Patent Owner contends that Petitioner’s expert, Dr. Shanley, considered using SPADs in LIDAR systems he worked on but chose instead to use photodiodes instead

of SPADs⁷ due to size requirements, power requirements, complexity, cost, lack of ease of use, lack of reliability, and lack of availability. *Id.* at 62–63 (citing Ex. 2011, 12:18–22, 14:10–15:4, 16:20–17:12, 18:10–15). Patent Owner further asserts that Dr. Shanley testified that his own team never used SPADs and that he was not aware of any system that used SPADs before the priority date of the ’405 patent. *Id.* at 63–64 (citing Ex. 2011, 79:2–80:16).

Patent Owner also argues there was a “failure of others” to develop arrays of SPADs for use in LIDAR systems. PO Resp. 64–65. Specifically, Patent Owner asserts that Sergey L. Vinogradov discussed repeated failure of researchers to develop practical SPAD arrays due to various issues such as low fill factor, high dark count rate in backside illuminated SPAD technology, and expense and inflexible scaling in Digital Silicon Photomultiplier (dSiPM) technology. *Id.* (citing Ex. 2010 ¶¶ 168–170; Ex. 2014, 3–4).

Petitioner argues that “[n]either PO nor its expert cites to any other source to establish that there existed widespread skepticism in the industry regarding the use of SPADs in LiDAR.” Pet. Reply 27. Petitioner also argues that Patent Owner ignores the widespread teaching of SPADs in LiDAR systems at the relevant time. *Id.* (citing Ex. 1028; Ex. 1029; Ex. 1032, 1; Ex. 1033 ¶¶ 28–30). Petitioner asserts that Dr. Shanley only testified that he did not use SPADs in a LiDAR device he designed in 2008, and that does not establish industry skepticism in 2017. *Id.* at 27–28. Petitioner asserts Droz, Borowski, Matsubara, Marino, and Takai disclose

⁷ Technically, a SPAD is a species of photodiode. *See, e.g.*, Ex. 1003 ¶ 46. We understand Patent Owner to be arguing that Dr. Shanley elected to use a photodiode that was not a SPAD in his 2008 project.

using SPADs in LiDAR systems to achieve known benefits before the '405 patent's priority date. *Id.* at 29 (citing Ex. 1033 ¶ 38; Ex. 1006; Ex. 1009 ¶¶ 3–7; Ex. 1028; Ex. 1029; Ex. 1032, 8). Petitioner contends that these references confirm that others were successful in using SPADs in LiDAR's system. *Id.*

In its Sur-Reply responding to Petitioner's contentions, Patent Owner reasserts, in response to Petitioner's contention that SPADs in LIDAR systems were ubiquitous or well-known, that Dr. Shanley testified he was unaware of any commercial or noncommercial LIDAR devices that used SPADs prior to the '408 patent. PO Sur-Reply 26–24 (citing Ex. 2015, 23:20–22, 79:2–80:13). Patent Owner argues that this evidence indicates that SPADs in LIDAR systems were not obvious to a POSITA in 2017. *Id.* at 24.

“For objective evidence of secondary considerations to be relevant, there must be a nexus between the claimed invention and the objective evidence.” *Volvo Penta of the Americas, LLC v. Brunswick Corp.*, 81 F.4th 1202, 1211 (Fed. Cir. 2023) (citing *In re GPAC*, 57 F.3d 1573, 1580 (Fed. Cir. 1995)). As Patent Owner did not assert nor demonstrate that a presumption of nexus applies in this case due to claimed invention being coextensive with a commercial product, to succeed in its assertion, Patent Owner must demonstrate that the evidence is a direct result of the unique characteristics of the claimed invention. *Id.*

However, Patent Owner has not established that the claimed invention has unique characteristics to which the evidence of secondary considerations would be applicable. *See* §§ III.D.2.a. Indeed, Patent Owner does not appear to make any showing in this regard. *See* PO Resp. 62–65.

Accordingly, Patent Owner's evidence of secondary considerations does not demonstrate nonobviousness. *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010) (citing *KSR*, 550 U.S. at 417 (“[W]here the inventions represented no more than ‘the predictable use of prior art elements according to their established functions,’ the secondary considerations are inadequate to establish obviousness as a matter of law”)).⁸

Even if Patent Owner had made a showing of nexus, Patent Owner's evidence of secondary considerations of nonobviousness is entitled to little weight.

Patent Owner's alleged evidence of industry skepticism relies on Dr. Shanley's testimony concerning the reasons that he decided not to use SPADs in a project that he worked on in 2008. PO Resp. 62–64 (citing Ex. 2011, 12:18–22, 14:10–15:4, 16:20–17:12, 18:10–15). Dr. Shanley's decision not to use SPADs in the 2008 project, however, does not reflect how an entire industry viewed the use of SPADs in LIDAR devices before the '405 patent's priority date. Furthermore, Dr. Shanley testified that, by 2016, SPADs were used in LIDAR system because of the known benefits they provided. Ex. 1033 ¶¶ 29–30. Hence, even if there was industry skepticism in 2008, Dr. Shanley's testimony establishes that that skepticism had dissipated by 2016. *Id.*

⁸ Although Petitioner did not argue there was no showing of nexus, we note that Patent Owner “bears the burden of showing that a nexus exists.” *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (quoting *WMS Gaming, Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1988)). Here, Patent Owner has not addressed the nexus between the evidence and the claim.

Moreover, Dr. Shanley pointed to several patents and papers that proposed use of SPADs in LIDAR applications before the '405 patent's priority date, including Droz (Ex. 1005), Borowski (Ex. 1009), Marino (Ex. 1028), and Matsubara (Ex. 1029). Ex. 1003 ¶¶ 37 (Droz), 51 (Matsubara), 88–96 (Borowski) 139 (Marino); Ex. 1045, 2–5; Ex. 1046, 1–11; Ex. 1047, 1–8. Ex. 1033 ¶¶ 28–33.

Patent Owner's evidence of failure of others depends largely on the Vinogradov paper. PO Resp. 64–65 (citing Ex. 2014, 3–4). We agree with Petitioner that Vinogradov's failure by 2015 to achieve a commercial product does not mean that no others disclosed the solution of how to do so, as the patents and papers identified above demonstrate. Ex. 1033 ¶¶ 36–37. Even if we considered the Vinogradov paper to be evidence of a failure to achieve the claimed invention, this failure is outweighed by the many successes represented by the patents and papers that Petitioner identifies.

Accordingly, we find Patent Owner's evidence of skepticism and failure of others to be unavailing in attempting to establish nonobviousness of the claimed invention.

(14) Summary as Claim 21

For all of the foregoing reasons, we find that Petitioner has shown by a preponderance of the evidence that a person of ordinary skill in the art would have had reason to combine the teachings of Pacala and Droz, with a reasonable expectation of success in arriving at the subject matter claim 21 recites. As noted above, we also agree with Petitioner's arguments and evidence that the combination of Pacala and Droz teach or suggest all of the limitations of claim 21, and Patent Owner has not shown objective evidence of nonobviousness that would outweigh the showing of obviousness. As a

result, Petitioner has shown by a preponderance of the evidence that claim 21 would have been obvious over the combination of Pacala and Droz.

3. Claims 23, 26–31, and 34

Claims 23 depends from claim 21. Claim 26 is independent. Claims 27–31 and 34 depend from claim 26. Petitioner provides a detailed mapping of how the combination of Pacala and Droz accounts for the limitations of claims 23, 26–31, and 34. Pet. 34–37. Patent Owner does not raise any other separate arguments regarding claims 23, 26–31, and 34 other than those we have considered above with respect to claim 21. *See generally* PO Resp. We have reviewed Petitioner’s contentions regarding claims 23, 26–31, and 34, and determine that Petitioner has shown by a preponderance of the evidence that claims 23, 26–31, and 34 would have been obvious over Pacala and Droz. Pet. 34–37.

4. Obviousness of Claims 24, 25, 32, and 33 over Pacala, Droz, and Villeneuve

Claims 24 and 25 depend from claim 21, and claims 32 and 33 depend from claim 26. Claims 24 and 32 recite the additional limitation of “wherein the plurality of optical emitters are arranged to form a plurality of emitter channels having non-overlapping fields of view, and the plurality of photosensors are arranged to form a plurality of receiver channels having non-overlapping the fields of view and having a one-to-one relationship with the plurality of emitter channels such that the field of view for each receiver channel is coincident with the field of view of a corresponding emitter channel.” Ex. 1001, 57:33–41, 58:51–59. Claims 25 and 33 recite “wherein the plurality of emitters are configured to project a plurality of illuminating beams in the field external to the optical system according to an illumination

pattern that substantially matches, in size and geometry across a range of distances from the system, a plurality of non-overlapping fields of view of the plurality of photosensors.” Ex. 1001, 57:43–49, 58:61–67.

Petitioner relies on the teachings of Villeneuve to use emitter and receiver channels having a one-to-one relationship and non-overlapping fields. *See* Pet. 39–44. Petitioner argues that a person of ordinary skill in the art would have been motivated to combine Villeneuve with Pacala-Droz because Villeneuve teaches that emitters and detectors with substantially coincident alignments “beneficially ensures that light emitted by an emitter will be received at the corresponding detector at a range of distances.” *Id.* at 40 (citing Ex. 1007, 55:57–57:59, Figs. 33–35). Petitioner also contends that “by May 2017 it was well known in the art that narrow fields of view at the detectors improve the signal to noise ratio, and thus the performance of the detectors.” *Id.* (citing Ex. 1003 ¶ 176). Petitioner asserts that “Villeneuve teaches how to practically align emitters and detectors (and their corresponding fields of view) and achieve specific angular extents (i.e., sizes) by selecting, for example, an aperture size for the emitter, and an active region for the detector.” *Id.* at 40–41 (citing Ex. 1007, 55:6–10, 59:9–12). Petitioner argues that a “POSITA could thus readily apply Villeneuve’s alignment and detector array and waveguide techniques to improve the Pacala-Droz combination with a reasonable expectation of success.” *Id.* at 41 (citing Ex. 1003 ¶ 177).

Patent Owner does not dispute Petitioner’s contentions for claims 24, 25, 32, and 33 besides the arguments considered above with respect to claim 21.

After review of the evidence, we determine that Petitioner has shown by a preponderance of the evidence that claims 24, 25, 32, and 33 would have been obvious over the combination of Pacala, Droz, and Villeneuve.

E. *Obviousness Grounds Based on Hall*

We do not reach the remaining grounds based on Hall because we have already decided that all challenged claims would have been obvious under the various grounds based on Pacala (§ III.D), as discussed above.

IV. CONCLUSION

After considering the evidence and arguments presented in the Petition, we determine that Petitioner has established by a preponderance of the evidence that the challenged claims of the '405 patent are unpatentable as obvious over the combinations of Pacala and Droz and Pacala, Droz, and Villeneuve, notwithstanding Patent Owner's arguments. Therefore, we do not reach the remaining grounds.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 318(a), claims 21 and 23–34 of the '405 patent have been shown to be unpatentable; and

FURTHER ORDERED that any party seeking judicial review must comply with the notice and service requirements of 37 C.F.R. § 90.2.⁹

⁹ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this Decision, we draw Patent Owner's attention to the April 2019 Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not shown Unpatentable
21, 23, 26–31, 34	103	Pacala, Droz	21, 23, 26–31, 34	
24, 25, 32, 33	103	Pacala, Droz, Villeneuve	24, 25, 32, 33	
21, 23– 33	103	Hall, Borowski, Spector ¹⁰		
34	103	Hall, Borowski, Spector, Droz		
Overall Outcome			21, 23–34	

¹⁰ Because we determine that claims 21 and 23–34 are unpatentable on the Pacala-based grounds, we do not reach the remaining grounds.

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