

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VALEO NORTH AMERICA, INC., VALEO S.A., VALEO GMBH,
VALEO SCHALTER UND SENSOREN GMBH, and⁴
CONNAUGHT ELECTRONICS LTD.,
Petitioner,

v.

MAGNA ELECTRONICS INC.,
Patent Owner.

Case IPR2015-01410¹
Patent 8,643,724 B2

Before JUSTIN T. ARBES, MICHAEL J. FITZPATRICK, and
ROBERT J. WEINSCHENK, *Administrative Patent Judges*.

ARBES, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a)

¹ Case IPR2015-01414 has been consolidated with this proceeding.

I. BACKGROUND

Petitioners Valeo North America, Inc., Valeo S.A., Valeo GmbH, Valeo Schalter und Sensoren GmbH, and Connaught Electronics Ltd. (collectively, “Petitioner”) filed two Petitions requesting *inter partes* review of claims 1–86 of U.S. Patent No. 8,643,724 B2 (Ex. 1001, “the ’724 patent”) pursuant to 35 U.S.C. §§ 311–19, as listed in the following chart.

Case Number	Challenged Claims	Petition
IPR2015-01410	1–6, 10–18, ² 23, 25, 29–32, 41–43, 46–56, 58, 61, 62, 64–71, 73, 75–82, 84, and 86	Paper 1 (“Pet.”)
IPR2015-01414	7–9, 19–22, 24, 26–28, 33–40, 44, 45, 57, 59, 60, 63, 72, 74, 83, and 85	Paper 1 (“-1414 Pet.”)

On December 28, 2015, we instituted an *inter partes* review of claims 1, 3–12, 14, 15, 17, 19–52, 54–67, 69–79, and 81–86 on 17 grounds of unpatentability and consolidated Case IPR2015-01414 with Case IPR2015-01410 (Paper 7, “Dec. on Inst.”). Patent Owner Magna Electronics Inc. filed a Patent Owner Response (Paper 14, “PO Resp.”), and Petitioner filed a Reply (Paper 17, “Reply”). The parties did not request oral argument, and no hearing was held. *See* Paper 22.

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has shown by a preponderance of the

² Petitioner lists claim 19 in its Petition in Case IPR2015-01410, but does not include claim 19 in any asserted ground of unpatentability. *See* Pet. 1, 6. Thus, we presume that the initial listing of claims was a typographical error.

evidence that claims 1, 3–12, 14, 15, 17, 19–52, 54–67, 69–79, and 81–86 are unpatentable.

*A. The '724 Patent*³

The '724 patent relates generally to “rearview vision systems which provide the vehicle operator with scenic information in the direction rearward of the vehicle.” Ex. 1001, col. 1, ll. 22–25. According to the '724 patent, there was a need in the art to “reduce the amount of time spent gathering information [about] the condition around the vehicle in order to safely carry out a vehicle maneuver, such as a turn or a lane change,” and also a need to “eliminate exterior rearview mirrors by utilizing image capture devices, such as cameras, in combination with dashboard displays.” *Id.* at col. 1, ll. 28–59. Prior art camera-based systems typically used more than one camera to reduce blind spots, but displayed multiple images, which could confuse the driver. *Id.* at col. 1, l. 60–col. 2, l. 3. Specifically, “[w]hen multiple image capture devices are positioned at different longitudinal locations on the vehicle, objects behind the vehicle are at different distances from the image capture devices,” such that the same object would have a different size in each display. *Id.* at col. 2, ll. 3–8.

³ Petitioner previously filed petitions seeking *inter partes* review of the '724 patent in Cases IPR2015-00252 and IPR2015-00253. The petitions were denied. See *Valeo N. Am., Inc. v. Magna Elecs., Inc.*, Case IPR2015-00252 (PTAB May 13, 2015) (Paper 7); *Valeo N. Am., Inc. v. Magna Elecs., Inc.*, Case IPR2015-00253 (PTAB May 13, 2015) (Paper 7). U.S. Patent No. 7,859,565 B2 (“the '565 patent”), which has a similar specification to the '724 patent, also was challenged in Cases IPR2014-00220 and IPR2014-01203.

To address these issues, the '724 patent discloses a multi-camera vision system having two image capture devices on the sides of the vehicle and one at the rear of the vehicle, and a reconfigurable display device that displays a synthesized image from the image capture devices. *Id.* at col. 2, l. 59–col. 3, l. 25. Figure 1 of the '724 patent is reproduced below.

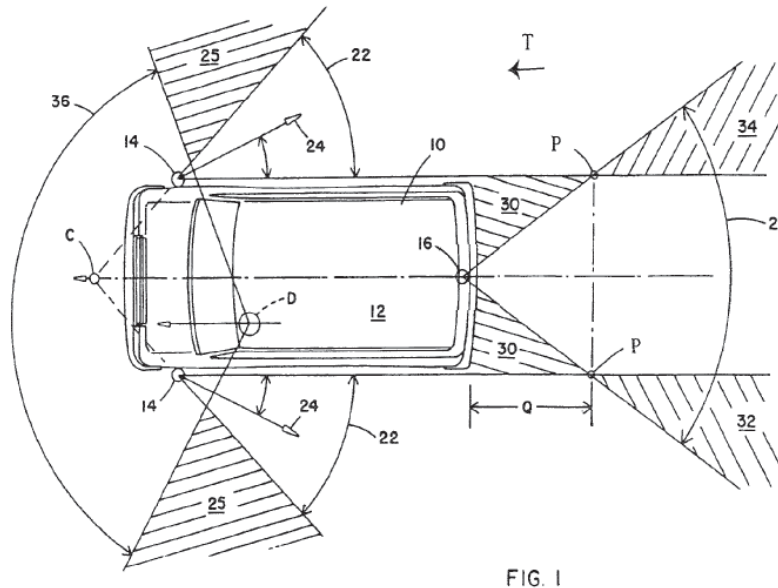


Figure 1 depicts vehicle 10 traveling in direction T and comprising side image capture devices 14 each with field of view 22 and center image capture device 16 with field of view 26. *Id.* at col. 5, l. 47–col. 6, l. 21. The three captured images are processed and

juxtaposed on display 20 by image processor 18 in a manner which approximates the view from a single virtual image capture device positioned forwardly of the vehicle at a location C and facing rearwardly of the vehicle, with the vehicle being transparent to the view of the virtual image capture device.

Id. at col. 5, l. 63–col. 6, l. 2. The resulting display provides a “substantially seamless panoramic view rearwardly of the vehicle without duplicate or redundant images of objects.” *Id.* at col. 6, ll. 2–5.

Figure 3 of the '724 patent is reproduced below.

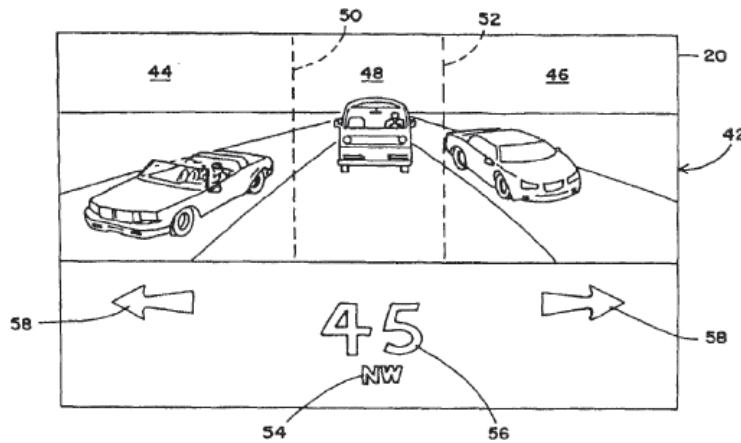


Figure 3 depicts composite image 42 comprising left image portion 44, right image portion 46, and center image portion 48, reversed from the images captured by the image capture devices, as well as compass readout 54, vehicle speed 56, and turn signals 58. *Id.* at col. 7, l. 44–col. 8, l. 7. Due to the different positioning of side image capture devices 14 and center image capture device 16, the system may process side images differently from the central images (e.g., by vertically compressing the central images) to avoid the appearance of disjointed objects. *Id.* at col. 14, l. 52–col. 16, l. 14.

B. Illustrative Claim

Claim 1 of the '724 patent recites:

1. A multi-camera vision system for a vehicle, said vehicular multi-camera vision system comprising:

at least three image capture devices disposed at a vehicle equipped with said vehicular multi-camera vision system;

said at least three image capture devices comprising a first image capture device disposed at a driver-side portion of the equipped vehicle at a first location;

said at least three image capture devices comprising a second image capture device disposed at a passenger-side portion of the equipped vehicle at a second location;

said at least three image capture devices comprising a third image capture device disposed at a rear portion of the equipped vehicle at a third location;

wherein said first image capture device has a first field of view exterior of the equipped vehicle;

wherein said second image capture device has a second field of view exterior of the equipped vehicle;

wherein said third image capture device has a third field of view exterior of the equipped vehicle;

wherein said first field of view of said first image capture device overlaps with said third field of view of said third image capture device defining a first overlap zone;

wherein said second field of view of said second image capture device overlaps with said third field of view of said third image capture device defining a second overlap zone;

wherein said first image capture device captures first image data;

wherein said second image capture device captures second image data;

wherein said third image capture device captures third image data;

an image processor;

wherein first image data captured by said first image capture device is received at said image processor via at least one of an analog data stream and a digital data stream;

wherein second image data captured by said second image capture device is received at said image processor via at least one of an analog data stream and a digital data stream;

wherein third image data captured by said third image capture device is received at said image processor via at least one of an analog data stream and a digital data stream;

wherein, responsive to processing by said image processor of received image data, a synthesized image is generated without duplication of objects present in said first overlap zone and in said second overlap zone and wherein said synthesized image approximates a view as would be seen by a virtual camera at a single location exterior of the equipped vehicle; and

wherein said synthesized image is displayed by a single display screen of a reconfigurable display device that is viewable by a driver of the equipped vehicle when normally operating the equipped vehicle.

C. Prior Art

The pending grounds of unpatentability in the instant *inter partes* review are based on the following prior art:

U.S. Patent No. 4,390,895, issued June 28, 1983 (Ex. 1018, “Sato”);

U.S. Patent No. 4,833,534, issued May 23, 1989 (Ex. 1017, “Paff”);

U.S. Patent No. 4,963,788, issued Oct. 16, 1990 (Ex. 1013, “King”);

U.S. Patent No. 4,966,441, issued Oct. 30, 1990 (Ex. 1014, “Conner”);

U.S. Patent No. 5,793,420, issued Aug. 11, 1998, filed Feb. 20, 1996 (Ex. 1015, “Schmidt”);

U.S. Patent No. 6,553,130 B1, issued Apr. 22, 2003, continuation of application filed Aug. 11, 1993 (Ex. 1006, “Lemelson”);

Japanese Patent Publication No. JP-A-64-14700, published Jan. 18, 1989 (Ex. 1008, “Aishin”);

Japanese Patent Publication No. H2-36417, published Aug. 17, 1990 (Ex. 1012, “Niles”);

Japanese Patent Publication No. 2-117935, published Sept. 21, 1990 (Ex. 1005, “Mitsubishi”);

UK Patent Application Publication No. GB 2233530 A, published Jan. 9, 1991 (Ex. 1010, “Fuji”);

Japanese Patent Publication No. H7-30149, published June 6, 1995 (Ex. 1003, “Yamamoto”);⁴

Tatsumi Otsuka *et al.*, *Flat Dot Matrix Display Module for Vehicle Instrumentation*, SAE Paper No. 871288, Nov. 8, 1987 (Ex. 1016, “Otsuka”);

M. Weihrauch, G. G. Meloeny, & T. C. Goesch, *The First Head Up Display Introduced by General Motors*, SAE Paper No. 890288, Feb. 1, 1989 (Ex. 1019, “Goesch”); and

G. Wang *et al.*, *CMOS Video Cameras*, IEEE TH0367-3/91/0000/0100, 1991 (Ex. 1009, “Wang”).

D. Pending Grounds of Unpatentability

The instant *inter partes* review involves the following grounds of unpatentability:

References	Basis	Claim(s)
Yamamoto, Mitsubishi, and Lemelson	35 U.S.C. § 103(a) ⁵	1, 3–6, 10–12, 14, 15, 17, 23, 25, 29–32, 41–43, and 46–48

⁴ We refer to “Aishin,” “Niles,” “Mitsubishi,” and “Yamamoto” as the English translations of the original references (Exhibits 1002, 1004, 1007, and 1011). Petitioner provided affidavits attesting to the accuracy of the translations. See Exs. 1003, 1005, 1008, 1012; 37 C.F.R. § 42.63(b). Also, when citing the asserted non-patent references, we refer to the page numbers at the lower right corner of each page. See 37 C.F.R. § 42.63(d)(2).

⁵ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. §§ 102, 103, and 112. Because the ’724 patent has an effective filing date before the effective date of the

References	Basis	Claim(s)
Yamamoto, Mitsubishi, Lemelson, Wang, and Aishin	35 U.S.C. § 103(a)	49–52, 54–56, 58, 61, 62, 64–67, 69–71, 73, 75–79, 81, 82, 84, and 86
Yamamoto, Mitsubishi, Lemelson, and Wang	35 U.S.C. § 103(a)	19
Yamamoto, Mitsubishi, Lemelson, and Aishin	35 U.S.C. § 103(a)	7–9 and 20–22
Yamamoto, Mitsubishi, Lemelson, and Niles	35 U.S.C. § 103(a)	24
Yamamoto, Mitsubishi, Lemelson, Aishin, and Schmidt	35 U.S.C. § 103(a)	26
Yamamoto, Mitsubishi, Lemelson, and Fuji	35 U.S.C. § 103(a)	27 and 28
Yamamoto, Mitsubishi, Lemelson, and Otsuka	35 U.S.C. § 103(a)	33 and 35–38
Yamamoto, Mitsubishi, Lemelson, Otsuka, and Conner	35 U.S.C. § 103(a)	34
Yamamoto, Mitsubishi, Lemelson, Otsuka, and Sato	35 U.S.C. § 103(a)	39
Yamamoto, Mitsubishi, Lemelson, Otsuka, and Paff	35 U.S.C. § 103(a)	40
Yamamoto, Mitsubishi, Lemelson, and King	35 U.S.C. § 103(a)	44
Yamamoto, Mitsubishi, Lemelson, and Goesch	35 U.S.C. § 103(a)	45

applicable AIA amendments, we refer to the pre-AIA versions of 35 U.S.C. §§ 102, 103, and 112.

References	Basis	Claim(s)
Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Fuji	35 U.S.C. § 103(a)	57, 72, and 83
Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Otsuka	35 U.S.C. § 103(a)	59
Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Paff	35 U.S.C. § 103(a)	60, 74, and 85
Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and King	35 U.S.C. § 103(a)	63

II. ANALYSIS

A. Claim Interpretation

The Board interprets claims of unexpired patents using the “broadest reasonable construction in light of the specification of the patent in which [they] appear[.]” 37 C.F.R. § 42.100(b). For claims of an expired patent, such as the ’724 patent, however, the Board’s claim interpretation analysis is similar to that of a district court. *See In re Rambus Inc.*, 694 F.3d 42, 46 (Fed. Cir. 2012). Claim terms are given their plain and ordinary meaning as would be understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc). “There are only two exceptions to this general rule: 1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the specification or during prosecution.”

Thorner v. Sony Computer Entm't Am. LLC, 669 F.3d 1362, 1365 (Fed. Cir. 2012). We apply this standard to the claims of the expired '724 patent.⁶

1. Previously Interpreted Terms

In the Decision on Institution, we interpreted the term “synthesized image” to mean the image generated by combining the received image data captured by the image capture devices, and interpreted the “at least one of” clauses in the challenged claims to signify a disjunctive list of alternatives (i.e., only one limitation is required). Dec. on Inst. 11 (stating that the analysis would be the same under either the broadest reasonable interpretation or the district court standard). The parties do not dispute these interpretations. We do not perceive any reason or evidence that compels any deviation from these interpretations. Accordingly, we adopt our previous analysis for purposes of this Decision.

⁶ The '724 patent expired during trial on May 22, 2016. See PO Resp. 8; Reply 1. Patent Owner argues that Petitioner “should have known that the '724 patent would expire during this proceeding,” and by proposing interpretations under the broadest reasonable interpretation standard in the Petitions, “waived its opportunity to provide” proposed claim interpretations under the district court standard. PO Resp. 13–14. We disagree. The '724 patent had not yet expired when the Petitions were filed. Further, as noted in the Decision on Institution, our analysis was not impacted by whether we apply the broadest reasonable interpretation or the district court standard. Dec. on Inst. 11 n.5. The same holds true for our analysis at this stage of the proceeding. Also, because the parties had not addressed the expiration date of the '724 patent in the Petitions and Preliminary Responses, we expressly “encouraged [them] to address the expiration date of the '724 patent and the appropriate claim interpretation standard in their papers during trial.” *Id.*

2. “*Synthesized Image is Generated Without Duplication of Objects*”

Independent claims 1, 49, 65, and 78 recite that “a synthesized image is generated without duplication of objects present in said first overlap zone and in said second overlap zone.” Petitioner argues that the “without duplication of objects” clause means that “there is minimal multiple exposure of objects appearing in overlap zones in the synthesized image.” See Pet. 11; Reply 3–7. Patent Owner responds that the clause should be interpreted to mean that “the generated synthesized image shows primarily one representation (with minimal multiple exposure) of each object in the captured scene despite the claimed locations of image capture devices.”⁷ PO Resp. 8–11.

At the outset, we observe that the parties appear to agree that the claims allow for *some* duplication, as both proposed interpretations include the phrase “minimal multiple exposure.”⁸ Thus, the difference between the proposed interpretations is Patent Owner’s addition that the generated synthesized image shows “primarily” one representation of each object in the scene “despite the claimed locations of image capture devices.” According to Patent Owner, the additional language is warranted based on

⁷ Patent Owner argues that Petitioner’s proposed interpretations “*are* appropriate under *Phillips*.” PO Resp. 9 (emphasis added). Contrary to Petitioner’s argument, we presume this to be a typographical error, as Patent Owner subsequently argues that Petitioner’s proposed interpretation of the “without duplication of objects” clause *is not* correct under the district court standard. See *id.* at 9–11; Reply 4.

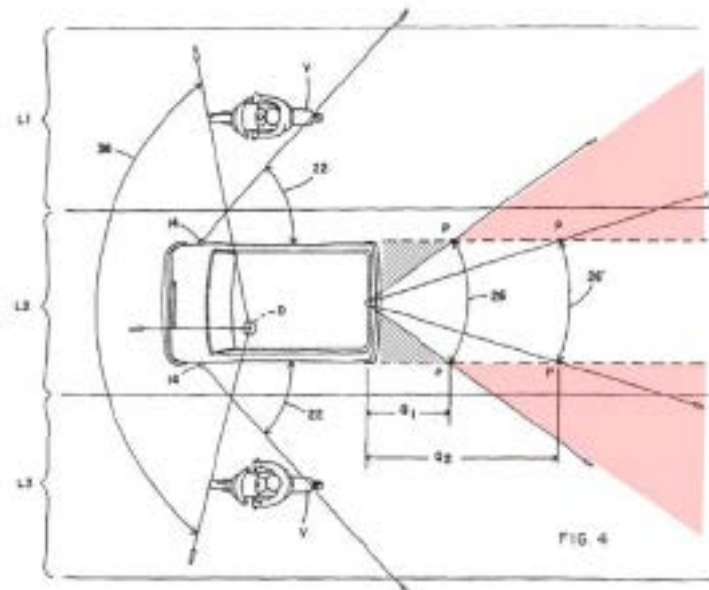
⁸ In another *inter partes* review involving a patent with a similar specification as the ’724 patent, the panel similarly interpreted “without duplication of image information” as “with minimal multiple exposure in the composite image.” *Valeo N. Am., Inc. v. Magna Elecs., Inc.*, Case IPR2014-00220, 12 (PTAB May 28, 2015) (Paper 59).

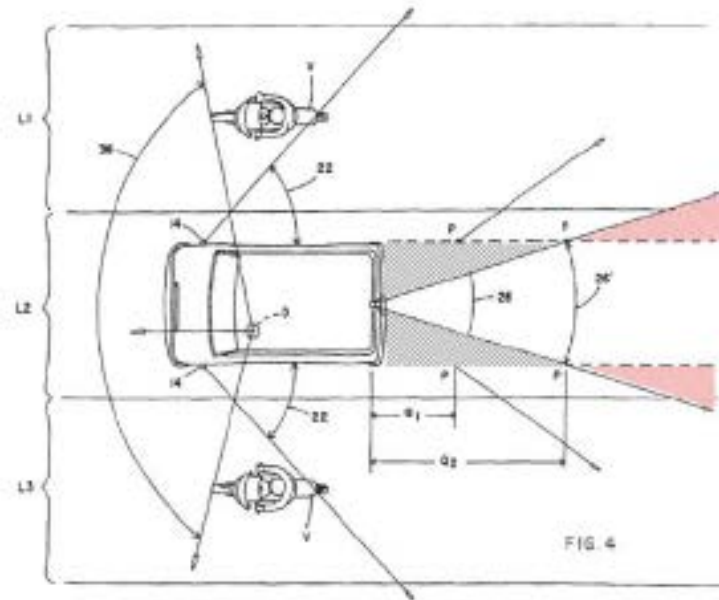
other language in the claims. *Id.* at 9–11. Specifically, the claims require that the image capture devices be located at the “driver-side portion,” “passenger-side portion,” and “rear portion” of the vehicle, and that the synthesized image be without duplication of objects “present in said first overlap zone and in said second overlap zone,” such that, according to Patent Owner, the unprocessed image data from the devices would exhibit the effects of parallax. *Id.* Parallax is a “displacement in the apparent position of an object viewed along two different lines of sight,” which can be avoided by multiple cameras sharing a “common center of projection.” Ex. 1020 ¶ 36; *see* Ex. 2004 ¶ 44; *infra* Section II.C.1.

The fact that other parts of the claims recite locations of the image capture devices and the overlap zones does not mean that anything more should be read into the “without duplication of objects” clause, which appears clear on its face. Further, the claims do not say anything about parallax or require that the problem of parallax be solved for the synthesized image. Indeed, parallax is not the same as the duplication of objects. *See* Ex. 1066 ¶ 11 (“*Duplication* . . . is different from *parallax*. For example, when each of the cameras have a common center of projection, there will be little or no parallax, but given their overlapping fields of view, the cameras may nonetheless capture the same objects multiple times resulting in duplication.” (citation omitted)). Thus, we are not persuaded that reading in any language pertaining to parallax effects would be appropriate based on the language of the claims.

Nor does the Specification support Patent Owner’s proposed interpretation. The Specification does not define what it means to generate a synthesized image “without duplication of objects,” but discloses exemplary

ways in which duplication can be minimized. The Specification discloses that an object in overlap zone 32 or 34 (shown in Figure 1 above) will appear on the display “in multiple image portions in a redundant or duplicative fashion” because it will be captured by the center image capture device and one of the side image capture devices. Ex. 1001, col. 7, ll. 2–7. Duplication may be reduced “to a satisfactory extent by moving points P away from the vehicle and thereby increasing distance Q . . . to a length that will exclude vehicles travelling at a typical separation distance behind vehicle 10 from overlapping zones 32, 34.” *Id.* at col. 7, ll. 7–16, 32–36; see also *id.* at col. 7, ll. 60–64 (points P may be moved “a sufficient distance behind vehicle 10 to reduce redundant and duplicative images between image portions 44–48”). Petitioner provides the following figures on page 6 of its Reply to illustrate the process.





The first figure is an annotated version of Figure 1 of the '724 patent, and the second figure is a modified version where points P are moved further behind the vehicle to reduce object duplication in the images (which in turn increases the size of blind zones 30). In addition to adjusting the field of view by moving points P, the Specification discloses adjusting the field of view by “utilizing a selective presentation of pixels of the captured image in the displayed image.” *Id.* at col. 7, ll. 41–43. Thus, although the Specification discloses one way to minimize duplication—by adjusting the field of view of the center image capture device—that way is not required by the claims themselves, which simply recite generation “without duplication of objects.”

Patent Owner acknowledges that the Specification discloses the above process, but argues that it “is not the whole story.” PO Resp. 7, 10–11. Patent Owner contends that the system further accounts for duplication by processing the image from the center image capture device differently than the images from the side image capture devices. *Id.* (citing Ex. 1001,

col. 15, ll. 19–23). Again, we do not see why the exemplary types of processing described in the Specification should be read into the claims.⁹ Further, we do not agree with Patent Owner because the cited portion of the Specification regarding different processing pertains to vertical image compression/scaling, not avoiding duplication of objects in the synthesized image, which is described earlier in columns 6–7 of the Specification. See Ex. 1001, col. 15, ll. 19–40 (“Central image portion 48' is reduced vertically, or compressed, by removing specified scan lines, or pixel rows, from the image captured by center image capture device 16 in a graduated fashion.”); Ex. 1066 ¶ 15–16; Reply 7.

Patent Owner’s proposed interpretation improperly reads in limitations pertaining to parallax that are not required by the surrounding claim language or the Specification. It also introduces ambiguity into the claims, as it is not clear how one could determine what is “primarily” one representation in a synthesized image. Accordingly, we interpret “synthesized image is generated without duplication of objects” to mean the synthesized image is generated with minimal multiple exposure of objects appearing in the overlap zones.

⁹ Indeed, the Specification describes other forms of image processing, such as “[l]uminant and chrominant blending” and “[i]mage morphing and warping compensation techniques,” which Patent Owner does not contend are required to compensate for duplication of objects. See Ex. 1001, col. 18, ll. 1–15.

3. “*Synthesized Image Approximates a View as Would be Seen by a Virtual Camera at a Single Location Exterior of the Equipped Vehicle*”

Independent claims 1, 49, 65, and 78 further recite that the “synthesized image approximates a view as would be seen by a virtual camera at a single location exterior of the equipped vehicle.” Petitioner argues that the clause should be given its plain and ordinary meaning, i.e., “the claimed view must be from a single virtual camera and does not have to be perfect or precise such that there may be some deviation from the actual view.” *See* Reply 7–10. As support, Petitioner cites a dictionary definition of the word “approximate” as “nearly exact; not perfectly accurate or correct.” Ex. 1069, 3; *see* Reply 8.

Patent Owner argues that the clause should be interpreted to mean “a view that appears to be from a single virtual camera without different image sizes and disjointed boundary lines.” PO Resp. 11–13. Patent Owner’s arguments are similar to those made with respect to the “without duplication of objects” clause, and again rely on the Specification’s disclosure of exemplary image processing. *See id.* We do not see any basis for reading in language pertaining to parallax effects into the claims for the reasons set forth above. *See supra* Section II.A.2. Patent Owner’s proposed interpretation, which dictates that the view be “without different image sizes and disjointed boundary lines,” also is inconsistent with and would read out the term “approximate” in the claims. *See* Reply 8–10. A view would not need to have completely uniform image sizes or completely eliminate disjointed boundary lines to “approximate” a view seen by the recited virtual camera.

Nothing in the claim language or Specification otherwise limits the “approximates a view” clause, and we conclude that the plain and ordinary meaning of the term “approximate” applies. No further interpretation is necessary. Accordingly, we interpret “synthesized image approximates a view as would be seen by a virtual camera at a single location exterior of the equipped vehicle” to mean the synthesized image is a nearly exact representation of what would be seen by a virtual camera at a single location exterior of the vehicle.

4. “Reconfigurable Display”

Petitioner argues that “reconfigurable display” should be interpreted to mean “a display in which a portion of the display upon which the driver views the synthesized image is used as a high-information content display to selectively display various types of auxiliary information.” Pet. 11 (citing Ex. 1001, col. 12, ll. 49–64; Ex. 1022 ¶ 38). Patent Owner states that it “does not acquiesce” to Petitioner’s proposed interpretation, but does not provide a proposed interpretation of its own. PO Resp. 13 n.4.

Independent claims 1, 49, 65, and 78 recite that “said synthesized image is displayed by a single display screen of a reconfigurable display device that is viewable by a driver of the equipped vehicle when normally operating the equipped vehicle.” The Specification of the ’724 patent discloses:

Alternatively, the remaining portion of the display can be a *reconfigurable high-information content display area to selectively display various types of information*. Such information may include incoming facsimile or pager information, phone numbers, and navigational aids including pull-up maps, route guidance information, global positioning

system (GPS) data, intelligent vehicle highway system (IVHS) information, as well as radio and environmental system control settings, and the like. Display 20 is especially useful for displaying such alternative data. . . . The content of the *auxiliary information* displayed may be user-selectable by a keypad, trackball, or other input device on the dashboard, steering column, or other position readily accessible to the driver.

Ex. 1001, col. 12, l. 55–col. 13, l. 7 (emphasis added). We agree with Petitioner that the “reconfigurable display” selectively presents information to be viewed by the driver.¹⁰ Petitioner’s proposed interpretation is consistent with the claim language and written description of the ’724 patent, and we adopt it for purposes of this Decision.

B. Level of Ordinary Skill in the Art

Section 103(a) forbids issuance of a patent when “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.”

KSR Int’l Co. v. Teleflex Inc., 550 U.S. 398, 406 (2007) (quoting 35 U.S.C. § 103(a)). Petitioner argues that a person of ordinary skill in the art at the time of the filing of the ’724 patent (May 1996) would have had “a bachelor’s or master’s degree in engineering, computer science, or physics with some experience in the automotive industry (e.g., two to five years),”

¹⁰ Certain dependent claims further recite the type of reconfigurable display device (e.g., “flat-panel display device” in claim 33), what types of information are displayed on the display screen of the device (e.g., “a map” and “vehicle speed” in claim 29), and how content on the display screen is “user-selectable,” i.e., selectable *by the user* (e.g., via a “keypad” in claims 30–31).

and “a working understanding of combining image data from multiple cameras and microprocessor driven controls for displays, actuators, and elementary decision making.” Pet. 10. Petitioner’s declarants, George Wolberg, Ph.D., and Ralph V. Wilhelm, Jr., Ph.D., agree with this assessment. *See* Ex. 1020 ¶ 25; Ex. 1022 ¶ 18. Patent Owner argues that a person of ordinary skill in the art would have had “at least a bachelor’s degree in electrical, electronic, or mechanical engineering, or computer science, or equivalent experience, and at least two years of experience in the relevant field, such as vision systems for real-world applications, such as encountered in vehicular vision systems,” citing the testimony of Ralph Etienne-Cummings, Ph.D. PO Resp. 4 n.2 (citing Ex. 2004 ¶¶ 24–25).

Neither party explains in detail why their proposed level of ordinary skill in the art should be adopted. After reviewing the evidence, including the cited prior art, however, we are persuaded that Petitioner’s definition is substantially correct. The ’724 patent describes “rearview vision systems which provide the vehicle operator with scenic information in the direction rearward of the vehicle” using “image capture devices, such as CMOS [(complementary metal-oxide semiconductor)] imaging arrays and the like.” Ex. 1001, col. 1, ll. 22–27. “Camera-based rearview vision systems” had been proposed at the time, but had not “obtained commercial acceptance” and suffered from various problems according to the ’724 patent. *Id.* at col. 1, l. 60–col. 2, l. 55. The ’724 patent further acknowledges that various aspects of the disclosed systems, such as, for example, CMOS and charge-coupled device (CCD) imaging arrays, optical correction systems, various types of image filtering, backlit liquid-crystal displays (LCDs), and systems for measuring the distance of an object behind the vehicle, were

known at the time. *See, e.g., id.* at col. 11, ll. 60–64, col. 12, ll. 33–37, col. 13, ll. 26–41, col. 17, ll. 48–62, col. 20, ll. 42–53, col. 22, ll. 3–19, 44–55. Drs. Wolberg and Wilhelm further testify as to the development and state of the art by the time of the ’724 patent, which we find helpful in assessing what background knowledge would have been available to a person of ordinary skill in the art. *See, e.g.,* Ex. 1020 ¶¶ 27–39; Ex. 1022 ¶¶ 20–27.

As a whole, the evidence indicates a higher level of ordinary skill than what Patent Owner proposes, and suggests, for example, that an ordinarily skilled artisan would have had at least some understanding of ways in which images from multiple cameras could be combined. *See, e.g.,* Ex. 1020 ¶¶ 28–38; Ex. 1003, 3, 6; Ex. 1005, 3–6. Accordingly, based on our review of the ’724 patent, the types of problems and solutions described in the ’724 patent and cited prior art, and the testimony of the parties’ declarants, we conclude that a person of ordinary skill in the art would have had a bachelor’s or master’s degree in engineering, computer science, or physics (or equivalent work experience), with some familiarity with how cameras may be used in vehicles and a working understanding of combining image data from multiple cameras and microprocessor-driven controls for displays, actuators, and elementary decision making. We apply this level of ordinary skill in the art for purposes of this Decision.

*C. Obviousness Ground Based on Yamamoto, Mitsubishi, and Lemelson
(Claims 1, 3–6, 10–12, 14, 15, 17, 23, 25, 29–32, 41–43, and 46–48)*

1. Yamamoto

Yamamoto describes a television monitor system for a vehicle that allows the user to see what is behind the vehicle without having to use a rear-view mirror or side mirrors. Ex. 1003, 5. Figure 1 of Yamamoto is reproduced below.

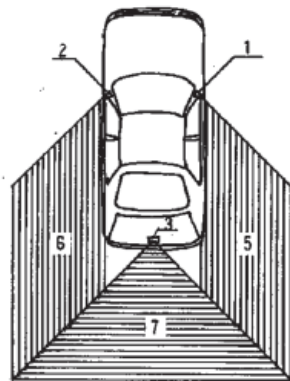


Figure 1 depicts miniature color television cameras 1, 2, and 3, with corresponding view ranges 5, 6, and 7, positioned at the same height at different locations on the vehicle. *Id.* at 5–6. Figure 5 of Yamamoto is reproduced below.

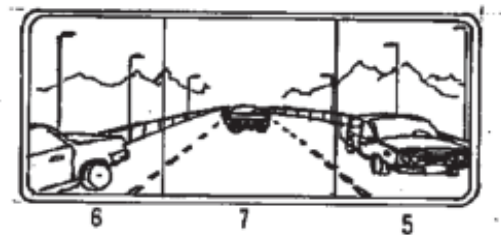


Figure 5 depicts a composite image from the three cameras, which is displayed on a television monitor in front of the driver. *Id.* “[I]mages captured by the three cameras are trimmed by the television monitor . . . to compose a single image to display.” *Id.* at 6.

2. Mitsubishi

Mitsubishi describes a “visibility assisting device for a vehicle occupant which synthesizes and displays inside the cabin video from a plurality of imaging devices installed in the vehicle.” Ex. 1005, 3. Mitsubishi describes how using multiple cameras instead of a single camera behind a vehicle is advantageous to capture a “wide area beyond the field of view of the driver from the driver’s seat.” *Id.* Figure 1 of Mitsubishi is reproduced below.

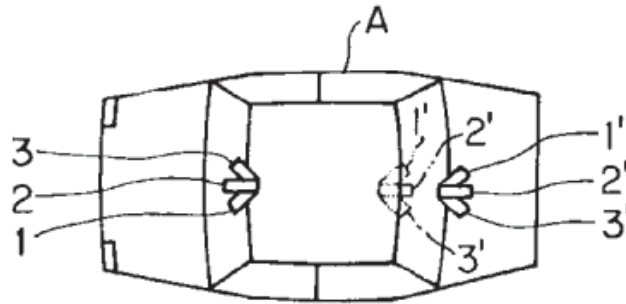


Figure 1 depicts cameras 1', 2', and 3' facing the rear of vehicle A such that the images captured by each camera partially overlap and the entire field of vision is covered. *Id.* at 4–5. The system also includes image processing circuit 4, which synthesizes the images from the three cameras and corrects for overlap by, for example, comparing the left and middle images to recognize matching patterns and align the images with each other. *Id.* at 4, 6–8, Fig. 3.

3. Lemelson

Lemelson describes an automobile system comprising a television camera that “scans the roadway ahead of the vehicle as the vehicle travels” and a display to “warn the driver of the vehicle of approaching and existing hazards.” Ex. 1006, Abstract. The display may be a real-time video display

with “highlighting of hazards, special warning images such as flashing lights, alpha-numeric messages, distance values, speed indicators and other hazard and safety related messages.” *Id.* at col. 6, ll. 47–55.

4. Whether Petitioner Has Proven That Yamamoto Is Prior Art

Before reaching the merits of Petitioner’s obviousness ground, we must determine whether Yamamoto is prior art to the ’724 patent under 35 U.S.C. § 102(a). *See* Pet. 6. It is Petitioner’s burden to prove that it is, as Petitioner bears the burden of proving unpatentability by a preponderance of the evidence. *See* 35 U.S.C. § 316(e); *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.”). Yamamoto published on June 6, 1995. Ex. 1003, 2. The ’724 patent claims the benefit of a series of applications ultimately descending from U.S. Patent Application No. PCT/US96/07382, filed on May 22, 1996. Ex. 1001. Thus, based on their dates alone, Yamamoto would qualify as prior art under 35 U.S.C. § 102(a).

A patent owner, however, may “antedate a reference by proving earlier conception and reasonable diligence in reducing to practice.” *Perfect Surgical Techniques, Inc. v. Olympus Am., Inc.*, 841 F.3d 1004, 1007 (Fed. Cir. 2016). “An alleged prior inventor would need to prove conception only if the alleged prior inventor had not successfully reduced the invention to practice before the critical date of the patent-at-issue” *Fox Group, Inc. v. Cree, Inc.*, 700 F.3d 1300, 1304–05 (Fed. Cir. 2012). Reduction to practice typically requires the alleged prior inventor to have “(1) constructed

an embodiment or performed a process that met all the claim limitations and (2) determined that the invention would work for its intended purpose,” but also may be shown constructively by the filing of a patent application, provided the application satisfies the requirements of 35 U.S.C. § 112, first paragraph. *See id.* (citation omitted); *Hyatt v. Boone*, 146 F.3d 1348, 1352 (Fed. Cir. 1998).

Patent Owner seeks to antedate Yamamoto by showing that U.S. Patent No. 5,670,935 (Ex. 2002, “the ’935 patent”) amounts to an earlier constructive reduction to practice. PO Resp. 14–17. The ’935 patent issued on September 23, 1997, from U.S. Patent Application No. 08/445,527 (“the ’527 application”) filed on May 22, 1995, and lists the same three inventors as the ’724 patent (Kenneth Schofield, Mark L. Larson, and Keith J. Vadas). *See* Exs. 1001, 2002. Patent Owner contends that claims 1, 3, 7–12, 14, 15, 17, 19–27, 33, 34, 36–38, 42, 43, 46–50, 52, 54–56, 62, 64, 65, 67, 70, 71, 75, and 77 of the ’724 patent are supported by “the ’935 patent disclosure,”¹¹ citing the testimony of Dr. Etienne-Cummings and arguing that the Board and Dr. Wolberg previously acknowledged that the ’565 patent, which is a continuation of the ’935 patent, contains a “similar” specification to the ’724 patent. *See* PO Resp. 16–17 (citing Ex. 2004 ¶¶ 54–100; Dec. on Inst. 3 n.3; Ex. 1020 ¶ 56). Patent Owner also contends that the earliest application of which the ’724 patent claims the benefit was copending with the ’527 application. *Id.*

¹¹ Patent Owner does not argue that challenged claims 4–6, 28–32, 35, 39–41, 44, 45, 51, 57–61, 63, 66, 69, 72–74, 76, 78, 79, and 81–86 are supported.

Patent Owner's arguments are not persuasive for three reasons. First, as explained above, to establish an earlier constructive reduction to practice, Patent Owner must show that the '527 application provides sufficient written description support for the challenged claims. Patent Owner states that "each limitation of [the set of claims listed above] is supported in the '935 patent disclosure," but includes no substantive arguments in its Response explaining why. *See id.* Rather, Patent Owner cites 46 paragraphs of Dr. Etienne-Cummings's declaration and a "Constructive Reduction to Practice Chart" spanning 43 pages. *Id.* (citing Ex. 2001; Ex. 2004 ¶¶ 54–99). Any arguments contained in these materials cannot be incorporated by reference into the Response. *See* 37 C.F.R. § 42.6(a)(3) ("Arguments must not be incorporated by reference from one document into another document.").¹² Consequently, we do not consider information presented in the declaration or claim chart but not discussed sufficiently in the Response.

Second, even if Dr. Etienne-Cummings's analysis and the claim chart are considered, they are not sufficient. The claim chart provides only block

¹² *See also* Paper 8, 3 ("The patent owner is cautioned that any arguments for patentability not raised in the response will be deemed waived."); *Apple, Inc. v. Ameranth, Inc.*, Case CBM2014-00013, 8 (PTAB Mar. 20, 2015) (Paper 37) ("Arguments that are not developed and presented in the Patent Owner Response, itself, are not entitled to consideration."), *reversed-in-part on other grounds*, No. 2015-1703, -- F.3d --, 2016 WL 6958650 (Fed. Cir. Nov. 29, 2016); *Cisco Sys., Inc. v. C-Cation Techs., LLC*, Case IPR2014-00454, 7–10 (PTAB Aug. 29, 2014) (Paper 12) (informative) (noting that "[o]ne purpose of the prohibition against incorporation by reference is to eliminate abuses" of the page limits established for the parties' substantive papers, and that citing "large portions of another document, without sufficient explanation of those portions, amounts to incorporation by reference").

quotes and figures from the '935 patent,¹³ but does not explain in any detail *why* they provide support for the various limitations of the challenged claims. *See* Ex. 2001. Likewise, the majority of Dr. Etienne-Cummings's declaration merely states that "the features of [the respective claim] are disclosed" at the block-quoted portions of the '935 patent, without explanation. *See, e.g.*, Ex. 2004 ¶¶ 56–61, 64, 65, 67–74, 76–99.

Third, we agree with Petitioner that the '935 patent does not provide sufficient written description support for the independent claims of the '724 patent (claims 1, 49, 65, and 78), each of which recites that the "synthesized image is displayed by a single display screen of a reconfigurable display device that is viewable by a driver of the equipped vehicle when normally operating the equipped vehicle." *See* Reply 13–15. As explained above, we interpret "reconfigurable display" to mean a display in which a portion of the display upon which the driver views the synthesized image is used as a high-information content display to selectively display various types of auxiliary information. *See supra* Section II.A.4. Patent Owner cites various excerpts from the '935 patent describing display 20, but these portions do not call the display device "reconfigurable" or disclose that it is used to selectively display information. *See, e.g.*, Ex. 2001, 5–6 (citing Ex. 2002, col. 3, l. 61–col. 4, l. 5, col. 5, ll. 48–50, col. 6, ll. 5–12, 22–39); Ex. 2004 ¶ 56. Indeed, the '724 patent Specification

¹³ It is unclear why Patent Owner attempts to map the disclosure of the '935 patent, rather than the '527 application, to the challenged claims. The '935 patent issued on September 23, 1997 (after Yamamoto published), from the '527 application filed on May 22, 1995 (before Yamamoto published). Patent Owner does not provide a copy of the '527 application in the record to show that the written description is the same as that of the issued '935 patent.

includes language similar to the portions of the '935 patent cited by Patent Owner, but the '724 patent Specification includes an additional disclosure stating that “[a]lternatively, the remaining portion of the display can be a reconfigurable high-information content display area to selectively display various types of information.” *Compare* Ex. 1001, col. 12, ll. 49–64 (emphasis added), *with* Ex. 2002, col. 6, ll. 5–12. That language, or anything similar to it, is not found in the '935 patent. Thus, we are not persuaded that the '935 patent provides sufficient written description support for the independent claims, such that it can be considered an earlier constructive reduction to practice.

Based on the record presented, we are persuaded that Yamamoto is prior art under 35 U.S.C. § 102(a).

5. Claim 1

Petitioner relies on Yamamoto as teaching most of the limitations of claim 1. Pet. 14–27. For example, Petitioner argues that Yamamoto teaches first and second “image capture devices” disposed at “driver-side” and “passenger-side” portions of the vehicle (i.e., cameras 1 and 2), a third “image capture device” disposed at a “rear portion” of the vehicle (i.e., camera 3), where the fields of view of the first and second cameras overlap with the field of view of the third camera (i.e., ranges 5 and 6 overlap with range 7 in Figure 1). *Id.* at 16–20. Petitioner relies on the combination of Yamamoto and Mitsubishi for the limitations of claim 1 pertaining to the “synthesized image.” *Id.* at 19–27. With respect to the limitation of generating a synthesized image “without duplication of objects present in [the overlap zones],” Petitioner contends that (1) Yamamoto trims

the images from the three cameras to generate a composite image, and
(2) Mitsubishi processes the images from its cameras to identify patterns and generate a composite image without duplication of objects. *Id.* at 24–25.

According to Petitioner and Dr. Wolberg, a person of ordinary skill in the art would have had reason to incorporate the “more sophisticated” image processing techniques of Mitsubishi in Yamamoto’s system to improve the image shown to the driver, avoid driver confusion, and improve safety. *Id.* at 19–20, 25 (citing Ex. 1020 ¶¶ 101–03, 110–11). For example,

Dr. Wolberg testifies that a person of ordinary skill in the art would have

readily appreciated that Yamamoto’s trimming of image data results in reduction of duplication and is done to account for some amount of overlap between the camera images captured by cameras 1–3. Accordingly, a [person of ordinary skill in the art] would have been motivated to look to Mitsubishi to process the camera images of Yamamoto in a more sophisticated manner to improve the image synthesis described in Yamamoto. Such processes as described in Mitsubishi would improve upon the image synthesis that is described in Yamamoto to make the Yamamoto vision system more robust.

Ex. 1020 ¶ 101. Petitioner also argues that Yamamoto teaches a synthesized image that “approximates a view as would be seen by a virtual camera at a single location,” i.e., “forward of the driver exterior of the equipped vehicle, looking rearward to capture the scene behind the driver.” Pet. 25–28 (citing Ex. 1020 ¶¶ 113–15).

Finally, Petitioner relies on Lemelson as teaching a “reconfigurable display device,” and argues that a person of ordinary skill in the art would have had reason to incorporate the functionality of such a device in Yamamoto’s display device to enhance the image shown to the driver and provide additional vehicular information that may be of use to the driver. *Id.*

at 27–28 (citing Ex. 1022 ¶¶ 82–89). Dr. Wilhelm elaborates on that point, opining that “Lemelson teaches a whole range of additional beneficial uses” for a vehicle rearview vision system with a display and, “[i]f a display was implemented in the vehicle to show camera images surrounding the vehicle, the incremental cost of making the display show auxiliary information would have been minimal.” Ex. 1022 ¶¶ 87–88. Dr. Wilhelm opines that it would have been obvious to a person of ordinary skill in the art to “augment” the combined system of Yamamoto and Mitsubishi to “include a reconfigurable display capable of displaying other useful information to the driver, such as visual enhancements including color or flashing lights, user-selectable features for the display, accident monitoring, navigation features such as maps, etc., as taught by Lemelson.” *Id.* ¶ 88.

Petitioner’s arguments as to how each limitation of claim 1 is taught and why a person of ordinary skill in the art would have had reason to combine the references’ teachings are supported by the testimony of Drs. Wolberg and Wilhelm, and are persuasive.

*a. Whether Yamamoto and Mitsubishi Teach
the “Synthesized Image” Limitations*

Patent Owner contends that Yamamoto and Mitsubishi do not teach the limitation that “a synthesized image is generated without duplication of objects present in said first overlap zone and in said second overlap zone,” as recited in independent claims 1, 49, 65, and 78. PO Resp. 21–28. According to Patent Owner, “the images of Yamamoto would have exhibited the effects of unresolved parallax, even with Mitsubishi’s processing,” and “images that exhibit the effects of unresolved parallax will not be a

synthesized image generated without duplication of objects.” *Id.* at 22. Patent Owner contends that Yamamoto’s combined image would exhibit parallax effects because the three cameras do not share a common center of projection. *Id.* at 22–23. According to Patent Owner, Yamamoto’s “trimming” of the images would not resolve those effects because it would not account for (1) objects being scaled differently as viewed by the cameras in different locations, or (2) boundary lines of objects being disjointed. *Id.* at 23–24. Patent Owner contends that Mitsubishi does not “remedy Yamamoto’s deficiency” because Mitsubishi’s processing is only designed to combine images from cameras that “share a common center of projection or are disposed along a single row,” and would not solve parallax issues caused by the three camera arrangement in Yamamoto. *Id.* at 24–26.

For similar reasons, Patent Owner argues that Yamamoto and Mitsubishi do not teach the other “synthesized image” limitation of the independent claims: “said synthesized image approximates a view as would be seen by a virtual camera at a single location exterior of the equipped vehicle.” *Id.* at 28–32. Again, Patent Owner contends that the combined image produced by Yamamoto’s system would exhibit parallax effects, even if Mitsubishi’s image processing were incorporated. *Id.* As support for all of its arguments, Patent Owner cites the testimony of Dr. Etienne-Cummings, which largely mirrors Patent Owner’s arguments in the Response. See PO Resp. 22–32; Ex. 2004 ¶¶ 102–36.

Patent Owner’s arguments are not persuasive because they are premised on its proposed interpretations of the “synthesized image” limitations. As explained above, we do not agree with Patent Owner’s proposed interpretations because the claims do not say anything about

parallax or require that the problem of parallax be solved for the synthesized image. *See supra* Sections II.A.2–3. Rather, we interpret “synthesized image is generated without duplication of objects” to mean the synthesized image is generated with minimal multiple exposure of objects appearing in the overlap zones, and interpret “synthesized image approximates a view as would be seen by a virtual camera at a single location exterior of the equipped vehicle” to mean the synthesized image is a nearly exact representation of what would be seen by a virtual camera at a single location exterior of the vehicle. *Id.* Thus, the claims allow for a “minimal” level of multiple exposure and only require a “nearly exact” representation of what the virtual camera would see. We are not persuaded that any parallax effects that might remain when the pattern recognition techniques of Mitsubishi are used in Yamamoto’s system, as Petitioner asserts, would cause more than “minimal” multiple exposure or prevent the resulting image from being a “nearly exact” representation. *See* Ex. 1020 ¶ 110; Ex. 1066 ¶ 25.

Moreover, even if the resulting image in the combined system would suffer from some parallax effects, we do not see how that contradicts Petitioner’s asserted reason for why a person of ordinary skill in the art would have modified Yamamoto’s system, or why parallax concerns would have outweighed the advantage of improved image processing, such that an ordinarily skilled artisan would have abandoned the three camera arrangement of Yamamoto. *See* Reply 15–17; *Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000) (“The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another. Instead, the benefits, both lost and gained, should

be weighed against one another.”). In that respect, we find Dr. Wolberg’s analysis of how and why a person of ordinary skill in the art would have combined the references’ teachings compelling. *See* Ex. 1020 ¶¶ 101–15; Ex. 1066 ¶¶ 22–37.

Petitioner’s contentions also are supported by the fact that Yamamoto discloses the same three camera arrangement and same method of reducing duplication of objects as the ’724 patent. *See* Reply 16. Yamamoto discloses that its “images captured by the three cameras are *trimmed* by the television monitor (4) to compose a single image to display.” Ex. 1003, 3, 6 (emphasis added). The ’724 patent similarly discloses reducing duplication of objects via adjusting the field of view of the center image capture device “by utilizing a *selective presentation of pixels* of the captured image in the displayed image.” Ex. 1001, col. 7, ll. 41–43 (emphasis added). Thus, in both cases, the portions where there is overlap between the images will be trimmed off.

Finally, we do not find Dr. Etienne-Cummings’s analysis persuasive because, as Petitioner points out, it does not account for the full teachings of the references. *See* Reply 18–20. Dr. Etienne-Cummings testifies that he performed an experiment by taking three images from the locations on a vehicle corresponding to the cameras in Yamamoto. Ex. 2004 ¶¶ 124–27. Trimming the images and combining them into a single view, as taught by Yamamoto, results in “significant discontinuities and mismatches between the three images” according to Dr. Etienne-Cummings. *Id.* ¶¶ 128–31. Dr. Etienne-Cummings also created a combined image by shifting the left and right images to better overlap with the center image, as taught by

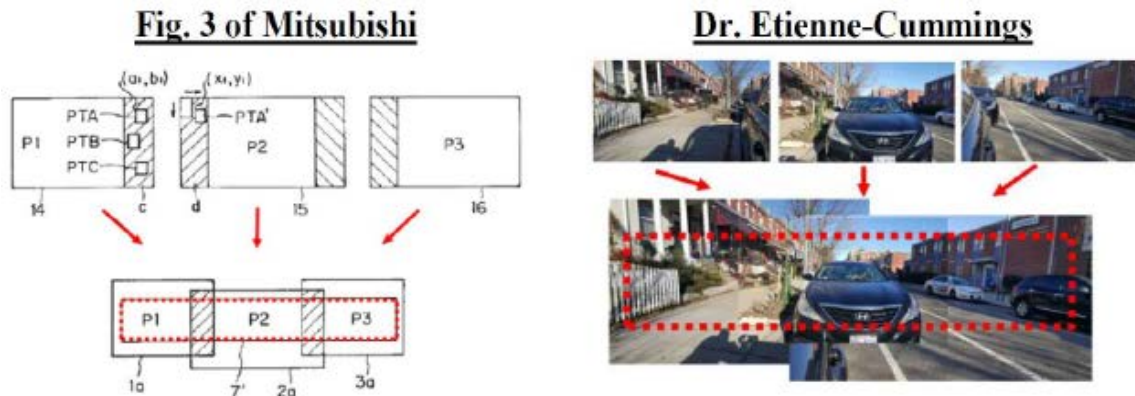
Mitsubishi, and rescaling,¹⁴ trimming, and changing the aspect ratio of the images, as shown below. *Id.* ¶¶ 132–34.



According to Dr. Etienne-Cummings, the above image still does not avoid “duplication of objects” present in the overlap zones and “approximate[]” a view seen by a virtual camera because “[t]he combined image continues to have many instances of incongruity, distortions and discontinuities” due to the effects of parallax. *Id.* ¶ 135.

¹⁴ Even if the “synthesized image” limitations required scaling of the individual images to combine them, doing so would have been within the skill of a person of ordinary skill in the art and would have been obvious to perform in the combined device of Yamamoto and Mitsubishi, for the reasons explained by Dr. Wolberg. See Ex. 1020 ¶¶ 102, 110; Ex. 1066 ¶¶ 33–37; Reply 17–18.

Dr. Etienne-Cummings's analysis, however, does not crop images in the manner taught by Mitsubishi. Petitioner provides the following illustration on page 19 of its Reply.



The figure on the left above is a version of Figure 3 of Mitsubishi, annotated to show region 7' in red. Mitsubishi recognizes that "the display areas 1a, 2a, 3a in images P1, P2 and P3 cover the entire field of view from cameras 1, 2 and 3," and those cameras have different lines of sight that do not match up exactly. Ex. 1005, 7–8. Thus, the combined image is cropped so that only "the desired portions (denoted by 7)" will be displayed. *Id.* The images on the right are from Dr. Etienne-Cummings, with a corresponding region annotated in red. Petitioner correctly points out that Dr. Etienne-Cummings's resulting image is not cropped to display only the desired region, as done in Mitsubishi. Reply 19. Doing so would result in the following image, shown on page 19 of the Reply, according to Petitioner.



The image shown above properly accounts for the type of processing taught by Mitsubishi, and shows minimal multiple exposure of objects in the overlap zones and is a nearly exact representation of what would be seen by a virtual camera at a single location exterior of the vehicle. *See Reply 18–20; Ex. 1066 ¶¶ 26–32.*

We are persuaded that Yamamoto and Mitsubishi teach “a synthesized image . . . generated without duplication of objects present in said first overlap zone and in said second overlap zone,” and that “said synthesized image approximates a view as would be seen by a virtual camera at a single location exterior of the equipped vehicle,” as recited in claims 1, 49, 65, and 78.

b. Weight to be Given to the Testimony of Drs. Wolberg and Wilhelm

Similar to the arguments made in its Preliminary Responses, Patent Owner contends that Petitioner’s obviousness analysis is “unsupported by meaningful evidence” due to various issues with the testimony of Petitioner’s declarants, Drs. Wolberg and Wilhelm. *Compare PO Resp. 37–50, with Paper 6, 8–19.* Reviewing the full record now at the conclusion of trial, we remain unpersuaded that the testimony is defective.

First, Patent Owner argues that the declarants’ testimony is unreliable because they changed their opinions on the level of ordinary skill in the art from prior cases. *PO Resp. 38–41.* We agree that Drs. Wolberg and Wilhelm changed their opinions on the level of ordinary skill in the art, but do not find their definitions substantially different from what they proposed previously. *See Dec. on Inst. 17.* For example, Dr. Wolberg originally testified that he believed a person of ordinary skill in the art would have

been familiar with “image stitching and image compositing,” and now testifies that such an individual would have understood “combining image data from multiple cameras.” *See, e.g.*, Ex. 1020 ¶ 25; IPR2015-00252, Ex. 1019 ¶ 25. Similarly, both declarants testified in each proceeding that an ordinarily skilled artisan would have had education in engineering, computer science, or similar fields. *See, e.g.*, Ex. 1020 ¶ 25; Ex. 1022 ¶ 18; IPR2015-00252, Ex. 1019 ¶ 26, Ex. 1020 ¶ 18. Thus, we do not discount their testimony because of the slight change in proposed levels of ordinary skill in the art.

Second, Patent Owner asserts that Dr. Wolberg’s testimony is unreliable because there is no evidence in his curriculum vitae (Ex. 1021) that he has any specific experience in the automotive industry. PO Resp. 41–43. Dr. Wolberg, however, opines that he had the capabilities of a person of ordinary skill in the art (as he identifies such an individual) at the time of the ’724 patent. Ex. 1020 ¶¶ 25–26. Dr. Wolberg’s qualifications also include considerable experience with image processing and computer vision systems, and as such, we conclude that he is qualified to testify regarding the matters addressed in his declarations. *See id.* ¶¶ 2–11; Ex. 1021; *SEB S.A. v. Montgomery Ward & Co., Inc.*, 594 F.3d 1360, 1372–73 (Fed. Cir. 2010) (upholding admission of the testimony of an expert who had “sufficient relevant technical expertise,” despite lacking expertise in the design of the patented invention); *Mytee Prods., Inc. v. Harris Research, Inc.*, 439 F. App’x 882, 886–87 (Fed. Cir. 2011) (unpublished) (upholding admission of the testimony of an expert who “had experience relevant to the field of the invention,” despite admission that he was not a person of ordinary skill in the art).

Third, Patent Owner argues that Dr. Wolberg's and Dr. Wilhelm's reliance on each other for portions of their opinions, and purported failure to consider each claim "as a whole," undermines their opinions, such that their testimony should be given little to no weight. PO Resp. 43–53. For example, with respect to claim 1, Dr. Wolberg focuses on the combination of Yamamoto and Mitsubishi pertaining to "image synthesis," and testifies as follows:

My opinions in this declaration supplement and are supplemented by opinions from Dr. Ralph Wilhelm in his declaration at Ex. 1022. My opinions focus on claims and limitations within claims that relate to the images that are obtained from the camera and issues related to image synthesis. To the extent that certain features described in the '724 patent more specifically relate to reconfigurable display technology, Dr. Ralph Wilhelm's area of expertise, I defer to and rely on Dr. Wilhelm's opinions, which I have reviewed, assume to be true and accurate, and adopt for purposes of this declaration.

Having reviewed Yamamoto, [Mitsubishi], and Lemelson, based on my experience and my review of Dr. Wilhelm's declaration, I assume that the [person of ordinary skill in the art] would have been motivated to combine these references for the reasons discussed in Dr. Wilhelm's declaration.

Ex. 1020 ¶¶ 93–94, 101–102. Conversely, Dr. Wilhelm focuses on the combination of Lemelson with the other references, based on his knowledge of "reconfigurable display technology," and "assume[s]" that a person of ordinary skill in the art would have had reason to combine the teachings of Yamamoto and Mitsubishi based on Dr. Wolberg. Ex. 1022 ¶¶ 80–81, 87–88.

As explained previously, we are not persuaded that the manner in which Drs. Wolberg and Wilhelm have expressed their opinions is *per se*

improper, but rather that their assumptions based on the testimony of the other affect the weight to be accorded their testimony. *See* Dec. on Inst. 18–20. Each declarant explains in substantial detail why he believes certain limitations of the claims are taught by the prior art references and why he believes a person of ordinary skill in the art would have had reason to combine certain teachings of the references. Our review of the testimony indicates that it is both consistent with the evidence of record and supportive of the arguments Petitioner makes in its Petitions for the challenged claims—albeit with less weight than if a single individual had testified as to all issues, without relying on any testimony from another declarant. That is simply a matter of degree, however. Further, opinion testimony as to the ultimate legal conclusion of obviousness is not required to prove obviousness. But, and contrary to Patent Owner’s assertions, Drs. Wolberg and Wilhelm in fact provide their opinions as to the ultimate obviousness of each challenged claim as a whole. *See, e.g.*, Ex. 1020 ¶¶ 92, 95, 121, 131, 137; Ex. 1022 ¶¶ 79, 82, 94, 98, 101. Finally, we note that Patent Owner had the opportunity during trial to cross-examine both individuals, but did not do so.

c. Conclusion

We have reviewed the Petition, Patent Owner Response, and Reply, as well as the evidence discussed in each of those papers, and are persuaded, by a preponderance of the evidence, that claim 1 would have been obvious based on Yamamoto, Mitsubishi, and Lemelson under 35 U.S.C. § 103(a), for the reasons set forth by Petitioner. *See* Pet. 14–28; Reply 15–20, 23–25.

6. *Claims 3–6, 10–12, 14, 15, 17, 23, 25, 29–32, 41–43, and 46–48*

Petitioner argues in its Petition that claims 3–6, 10–12, 14, 15, 17, 23, 25, 29–32, 41–43, and 46–48, which depend from claim 1, are unpatentable over Yamamoto, Mitsubishi, and Lemelson under 35 U.S.C. § 103(a), relying on supporting testimony from Drs. Wolberg and Wilhelm for many of the claims. Pet. 29–43 (citing Exs. 1020, 1022). For example, with respect to claim 10, which recites that “said first image capture device is disposed at the equipped vehicle at substantially the same height relative to ground as is said second image capture device,” Petitioner points out that Yamamoto’s cameras 1–3 are “installed at the same height so that the monitor television (4) may integrate captured images correctly.” *Id.* at 30 (quoting Ex. 1003, 6). With respect to claims 11 and 12, which recite that the first and second image capture devices are disposed forward of where the driver sits and at substantially the same distance from where the driver sits, respectively, Petitioner argues that Yamamoto teaches cameras 1 and 2 at the same position on either side of the vehicle, forward of the driver’s seat. *Id.* at 31–32 (citing Ex. 1003, 3, Fig. 1). We have reviewed the Petition, Patent Owner Response,¹⁵ and Reply, as well as the evidence discussed in each of those papers, and are persuaded, by a preponderance of the evidence, that claims 3–6, 10–12, 14, 15, 17, 23, 25, 29–32, 41–43, and 46–48 would have been obvious based on Yamamoto, Mitsubishi, and Lemelson under 35 U.S.C. § 103(a), for the reasons set forth by Petitioner. *See id.* at 29–43.

¹⁵ In its Response, Patent Owner relies on its arguments with respect to independent claim 1, and does not argue separately the limitations of dependent claims 3–6, 10–12, 14, 15, 17, 23, 25, 29–32, 41–43, and 46–48.

*D. Obviousness Ground Based on Yamamoto, Mitsubishi,
Lemelson, Wang, and Aishin
(Claims 49–52, 54–56, 58, 61, 62, 64–67, 69–71, 73, 75–79,
81, 82, 84, and 86)*

1. Wang

Wang describes a “single chip CMOS video camera,” including “a 312×287 pixel image sensor array, together with the necessary sensing, addressing and amplifying circuitry.” Ex. 1009, 1. Wang discloses:

We introduce a new capability that extends the CMOS ASIC [(application-specific integrated circuit)] marketplace in a sector of high growth rates. This market sector is that of image sensing and processing, covering applications from electronic cameras to “smart” vision systems.

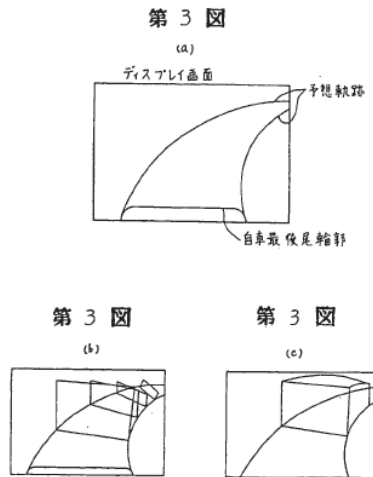
Cameras and vision systems addressed by today’s CCD technology appear cumbersome, power-hungry and expensive. The experimental work reported here demonstrates that high-quality image sensors can be implemented entirely in commodity ASIC CMOS technology, operating from single 5v supplies.

Id. According to Wang, the single chip CMOS video camera “matches the performance of CCD cameras” and has lower “cost, power consumption and size” than existing solid-state cameras of the time. *Id.* at 4.

2. Aishin

Aishin describes a “predicted path display apparatus for vehicles, in which an image in a field of rear vision, or a field of lateral rear vision and a predicted path are displayed on a screen at the time of reverse travel of a vehicle.” Ex. 1008, 3. The device comprises a camera that captures the scene rearward of the vehicle, a steering sensor that detects the angle of the steering wheel, an image processing device, and a “display device for

superposing and displaying a projected image by the camera and an image of a predicted path by the image processing device.” *Id.* Figures 3(a)–(c) of Aishin are reproduced below.¹⁶



The figures above depict various versions of the display showing the predicted path of the vehicle when the camera is mounted at the rear of the vehicle. *Id.* at 8, Fig. 2(a).

3. Whether Petitioner Has Proven That Wang Is Prior Art

Before reaching the merits of Petitioner’s obviousness ground, we must determine whether Wang is a prior art printed publication under 35 U.S.C. § 102(b). *See* 35 U.S.C. § 311(b); Pet. 7. Again, it is Petitioner’s burden to prove that it is. *See* 35 U.S.C. § 316(e). The determination of whether a document is a “printed publication” under 35 U.S.C. § 102 “involves a case-by-case inquiry into the facts and circumstances surrounding the reference’s disclosure to members of the public.” *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). “Because there are

¹⁶ Figures 3(a)–(c) appear in the original Japanese reference. Ex. 1007, 6. The text of Figure 3(a) is translated as “Display Screen,” “Predicted Path,” and “Profile of Vehicle Tail.” Ex. 1008, 16.

many ways in which a reference may be disseminated to the interested public, ‘public accessibility’ has been called the touchstone in determining whether a reference constitutes a ‘printed publication’ bar under 35 U.S.C. § 102(b).” *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016) (citation omitted). “A reference will be considered publicly accessible if it was ‘disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.’” *Id.* (citation omitted).

We first summarize the evidence presented regarding Wang’s alleged public accessibility. Wang is a publication of the Institute of Electrical and Electronics Engineers (IEEE) and has a copyright notation of “TH0367-3/91/0000/0100\$01.00 © 1991 IEEE” on the first page. *See* Ex. 1009, 1. Petitioner contends that the document was published “on May 27–31, 1991,” citing the testimony of Dr. Wolberg. Pet. 7. Dr. Wolberg testifies that “[a]s a person who regularly reviews scholarly articles, including IEEE publications such as the Wang article, and as someone who regularly attends conferences such as the IEEE conference in which the Wang paper was presented,” he believes that Wang was published in May 1991. Ex. 1020 ¶ 84. Dr. Wolberg also discusses two publications (Exhibits 1040 and 1042) that cite Wang prior to the effective filing date of the ’724 patent (May 22, 1996), “which further indicates to [Dr. Wolberg] that Wang was publicly accessible.” *Id.*; *see* Ex. 1040, 12 (cited reference 16); Ex. 1042, 3 (cited reference 4). Finally, he cites the University of Edinburgh website, which “states that the authors of the Wang article began work on CMOS imaging sensors as early as 1986, and began publishing articles

reporting the results of their work that led to the incorporation of a CMOS chip in a video camera in 1989.” Ex. 1020 ¶ 84 (citing Ex. 1044).

Petitioner presents additional evidence with its Reply that allegedly confirms Wang’s public accessibility prior to May 22, 1996. Reply 11–12. First, Petitioner submits a declaration from Gerard P. Grenier, the Senior Director of Publishing Technologies for the IEEE.¹⁷ Ex. 1055. Mr. Grenier states that Wang “was published and presented as part of [the] Euro [A]SIC ’91 [conference] which occurred May 27–31, 1991.” *Id.* ¶ 9. According to Mr. Grenier, “[t]he Article was published by IEEE as part of the conference proceedings on the date of the conference. Copies of the conference proceedings were made available to attendees of the conference.” *Id.* ¶ 6. Mr. Grenier also testifies that “IEEE maintains records of the dates on which articles were first made available for public download,” “[t]hese records are maintained as part of the ordinary course of business of the IEEE [and] are updated regularly as articles are published,” and he has “personal knowledge of the records.” *Id.* ¶ 7. Second, Petitioner submits a copy of Wang, with a “EURO ASIC ’91” cover page and table of contents, “[s]helved” at the Linda Hall Library in Kansas City, Missouri in 1991. Ex. 1046. Third, Petitioner submits a certified copy of Wang from the Library of Congress, with the same cover page and table of contents and a date stamp of June 5, 1992. Ex. 1060. Fourth, Petitioner notes that the U.S. Court of Appeals for the Federal Circuit affirmed a Board decision finding similar claims with a priority date of February 26, 1993, unpatentable based in part on Wang in

¹⁷ Petitioner submitted a substantially similar version of the declaration, dated approximately one month earlier, with its Petition, but did not discuss the declaration in the Petition. *Compare* Ex. 1039, *with* Ex. 1055. Our analysis applies equally to both versions of the declaration.

In re Magna Elecs., Inc., 611 F. App'x 969, 973 (Fed. Cir. 2015)
(unpublished) (Ex. 1045). Reply 11.

Patent Owner disputes the sufficiency of Petitioner's evidence of public accessibility. PO Resp. 17–21. Based on all of the evidence of record,¹⁸ however, we are persuaded that Wang was disseminated or otherwise made available prior to May 22, 1996, to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence could have located it. Most probative are the Library of Congress certification and Linda Hall Library documentation, which show that Wang was catalogued and readily available through these libraries. *See* Exs. 1046, 1060. Mr. Grenier further testifies that copies of the article were made available to attendees of the EURO ASIC '91 conference, which was an IEEE academic conference pertaining to ASICs. *See* Ex. 1039; Ex. 1055; Ex. 1060, 2–13 (stating that the conference “includes reports on ASIC design experiences, advances in design methods and tools, and on the evolution of ASIC technology,” and is “the definitive place . . . for the academic community to exchange ideas”; listing numerous papers to be

¹⁸ We are persuaded that all of Petitioner's evidence should be considered, including the evidence introduced with the Reply, under 37 C.F.R. § 42.23(b). Further, during a conference call with the parties on May 26, 2016, Patent Owner sought authorization to file a motion to “strike” Petitioner's new evidence and portions of Petitioner's Reply. *See* Paper 20. We determined that a motion to strike was not appropriate at that time, but stated that “[s]hould either party request a hearing in this proceeding, . . . the parties may address the propriety of the exhibits and Petitioner's Reply during oral argument. If the parties choose not to request a hearing, Patent Owner may request another conference call and we will determine whether additional briefing or any other action may be appropriate at that time.” *Id.* at 3; Ex. 1071, 20:14–22:18. Patent Owner did not request oral argument, and did not request another conference call to address the issue.

presented relating to, for example, digital signal processing ASICs, chip architecture, and graphic application and image processing ASICs). Given the level of ordinary skill in the art of the '724 patent set forth above, *see supra* Section II.B, we are persuaded that the EURO ASIC '91 conference is the type of conference that ordinarily skilled artisans would have been interested in and likely attended. The dates and documentation for the conference also are consistent with the other submitted evidence, including the copyright notation of Wang itself, which states in part “© 1991 IEEE.” *See* Ex. 1009, 1. Finally, as Petitioner correctly points out, the first article cited by Dr. Wolberg shows that Wang in fact was accessed by some other individuals working in the field of image sensors. *See* Reply 12; Ex. 1040.

Based on the record presented, we are persuaded that Wang is a prior art printed publication under 35 U.S.C. § 102(b).

4. Claims 49, 65, and 78

Independent claims 49, 65, and 78 recite limitations similar to those of claim 1. Petitioner again relies on Yamamoto, Mitsubishi, and Lemelson for the majority of the limitations in the claims, and relies on Wang and Aishin for additional limitations. Pet. 43–51. For example, the claims recite that “each of said at least three image capture devices comprises a CMOS imaging array.” Petitioner notes that Mitsubishi teaches using “imaging devices [that] can be any type of imaging device able to output video images, such as video cameras . . . and CCDs.” *Id.* at 45 (quoting Ex. 1005, 8). Although Yamamoto, Mitsubishi, and Lemelson do not disclose explicitly CMOS imaging arrays, Petitioner contends that it would have been obvious to use such arrays because CMOS imaging arrays were known at

the time to be useful in “smart vision systems” and were known to “achieve CCD performance with dramatically lower cost, power consumption, and size,” as evidenced by Wang. *Id.* at 44–45; *see* Ex. 1009, 1, 4. Petitioner further argues that using a CMOS video camera, based on Wang, in place of the camera of Yamamoto or CCD video camera of Mitsubishi, would have been “merely [the] predictable use of prior art elements.” Pet. 45–46.

We agree with Petitioner. The record amply supports Petitioner’s contention that CCD and CMOS video cameras were known options available to a person of ordinary skill in the art, and Wang discloses various advantages to using a CMOS video camera that would have motivated an ordinarily skilled artisan to use such a device in a “smart vision system” like the vehicle rearview vision systems of Yamamoto and Mitsubishi. *See* Ex. 1009, 1, 4; Ex. 1020 ¶¶ 144–45, 170; *see also* Ex. 1001, col. 13, ll. 26–41 (acknowledging that CCD imaging arrays and “CMOS imaging arrays of the type manufactured by VLSI Vision Ltd. of Edinburgh, Scotland” were available the time); *Magna*, 611 F. App’x at 972–73 (finding substantial evidence for the Board’s holding that, based on Wang, replacement of a CCD camera (as disclosed in Aishin) with a CMOS camera in a similar context would have been “nothing more ‘than the predictable use of prior art elements’” (citation omitted)).

Claims 49, 65, and 78 also recite that “said third vehicular camera disposed at the rear of the equipped vehicle is operable as a backup camera.” Petitioner notes that Yamamoto and Mitsubishi both teach cameras that face rearward of the vehicle, but they do not disclose explicitly the use of any of the cameras as a “backup camera.” Pet. 46. Petitioner argues that, based on Aishin’s similar teaching of a rearward-facing camera and display of a

projected path of the vehicle on a display screen during reverse travel, it would have been obvious to use Yamamoto's camera 3 as a backup camera "because a view of the immediate rear of the vehicle is almost always necessary when driving in reverse" and doing so would have improved the system by "reduc[ing] the amount of processing necessary for displaying an image to the driver during reverse travel." *Id.* at 46–47 (citing Ex. 1020 ¶¶ 169–73). Dr. Wolberg elaborates on this point, opining that a person of ordinary skill in the art

would have readily appreciated that it is straightforward to use the central rearward-facing camera, such as camera 3 of Yamamoto, to assist the driver in backing up. Use of one camera image when backing up helps focus the driver's attention to the rear (and not the sides) of the vehicle. In this case, there would be no need to limit the [field of view] of the rear camera to avoid overlap with the side cameras which have been removed for back-up use.

Ex. 1020 ¶ 171. We agree with Dr. Wolberg's analysis, as it is consistent with the disclosures of Yamamoto and Aishin, and provides a logical reason for why a person of ordinary skill in the art would have considered using camera 3 when the driver is backing up.

In its Response, Patent Owner relies on its arguments with respect to the "synthesized image" limitations (present in claims 1, 49, 65, and 78), and does not argue separately the additional limitations of claims 49, 65, and 78, or the asserted combination with Wang and Aishin for those claims. *See* PO Resp. 21–32. We are not persuaded by Patent Owner's arguments for the reasons explained above. *See supra* Section II.C.5.

Based on the record presented, we are persuaded that Petitioner has met its burden to demonstrate unpatentability by a preponderance of the evidence. We recognize that Petitioner's asserted ground is based on the

combination of five references. The challenged claims, however, merely recite various permutations of well-known components, and Petitioner has provided articulated reasoning with rational underpinnings as to why a person of ordinary skill in the art would have thought to use each one, with supporting testimony from Drs. Wolberg and Wilhelm. *See, e.g.*, Pet. 19–20, 24–28, 43–50; Ex. 1020 ¶¶ 101–03, 106–11, 114–15, 144–45, 170–72; Ex. 1022 ¶¶ 82–89. The prior art references also are very similar, and readily complement each other in the manner argued by Petitioner. For example, as discussed herein, Yamamoto discloses a particular three camera arrangement for a vehicle rearview vision system, but includes limited detail as to how the images from the three cameras would be combined together. Mitsubishi similarly discloses the use of three cameras in a vehicle rearview vision system, and describes an advantageous way to combine their images. Likewise, Yamamoto and Mitsubishi both utilize video cameras, but are not limited to a particular type. Wang discloses the advantages of using a CMOS video camera in particular. Yamamoto, Mitsubishi, and Aishin all disclose the use of cameras capturing the scene rearward of a vehicle, with Aishin describing a particular use as a backup camera. Finally, Yamamoto, Mitsubishi, and Aishin all disclose the use of a display in a vehicle rearview vision system, and Lemelson is used to show that adding the well-known feature of a reconfigurable display device in a vehicle would have been obvious to a person of ordinary skill in the art.

We have reviewed the Petition, Patent Owner Response, and Reply, as well as the evidence discussed in each of those papers, and are persuaded, by a preponderance of the evidence, that claims 49, 65, and 78 would have been obvious based on Yamamoto, Mitsubishi, Lemelson, Wang, and Aishin

under 35 U.S.C. § 103(a), for the reasons set forth by Petitioner. *See* Pet. 43–51; Reply 15–20.

5. *Claims 50–52, 54–56, 58, 61, 62, 64, 66, 67, 69–71, 73, 75–77, 79, 81, 82, 84, and 86*

Petitioner argues in its Petition that dependent claims 50–52, 54–56, 58, 61, 62, 64, 66, 67, 69–71, 73, 75–77, 79, 81, 82, 84, and 86 are unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, and Aishin under 35 U.S.C. § 103(a), again relying on supporting testimony from Drs. Wolberg and Wilhelm for many of the claims. Pet. 51–60 (citing Exs. 1020, 1022). Many of the limitations of these claims appear in similar form or in various combinations in other claims addressed above, and Petitioner refers to its previous analysis. *See id.* For example, similarly to claim 29, claims 58, 73, and 84 recite “at least one of (a) said display screen of said reconfigurable display device is operable to display at least one of . . . (iv) a map.” Petitioner cites Lemelson’s teaching of a reconfigurable display device that displays a map. *Id.* at 37–38, 58; *see* Ex. 1006, col. 15, ll. 45–67 (display 32 may display “a map showing the road or street, along which the vehicle is travelling and its location and direction of travel”). We have reviewed the Petition, Patent Owner Response,¹⁹ and Reply, as well as the evidence discussed in each of those papers, and are persuaded, by a preponderance of the evidence, that claims 50–52, 54–56, 58, 61, 62, 64, 66, 67, 69–71, 73, 75–77, 79, 81, 82, 84, and 86 would have been obvious

¹⁹ In its Response, Patent Owner relies on its arguments with respect to independent claims 49, 65, and 78, and does not argue separately the limitations of dependent claims 50–52, 54–56, 58, 61, 62, 64, 66, 67, 69–71, 73, 75–77, 79, 81, 82, 84, and 86.

based on Yamamoto, Mitsubishi, Lemelson, Wang, and Aishin under 35 U.S.C. § 103(a), for the reasons set forth by Petitioner. *See* Pet. 51–60.

*E. Obviousness Ground Based on Yamamoto, Mitsubishi,
Lemelson, and Aishin
(Claims 7–9 and 20–22)*

Petitioner argues that claims 7–9 and 20–22 are unpatentable over Yamamoto, Mitsubishi, Lemelson, and Aishin under 35 U.S.C. § 103(a). -1414 Pet. 32–37. Claim 7 recites that “the image displayed by said display screen includes a visual indication of the location of the equipped vehicle in said view.” Claims 8 and 9 depend from claim 7 and recite, respectively, that “said visual indication approximates the footprint occupied by the equipped vehicle” and “said visual indication comprises an outline of an area substantially occupied by the equipped vehicle.” Petitioner argues that Aishin teaches these features and that a person of ordinary skill in the art would have been motivated to incorporate them into a display like that of Yamamoto to provide additional safety information to the driver. *Id.* at 32–34 (citing Ex. 1008, 8, Figs. 3(b)–(c); Ex. 1020 ¶¶ 81, 149–51, 176–78). Claims 20–22 recite various limitations pertaining to the image displayed by the display screen, and Petitioner relies on disclosures from Lemelson and Aishin. *Id.* at 34–37 (citing Ex. 1020 ¶¶ 147–52; Ex. 1022 ¶ 103). Petitioner’s arguments as described above are supported by the testimony of Drs. Wolberg and Wilhelm, and are persuasive.

Patent Owner argues that Aishin does not teach the limitations of claims 7–9. PO Resp. 32–35. Patent Owner points out that Figure 3(c) of Aishin only shows a box along a predicted path of travel of the vehicle, whereas claim 7 requires that the visual indication be “of the location of the

equipped vehicle in said view” (i.e., the vehicle’s *current* location) and claims 8 and 9 recite the footprint or area currently “occupied” by the vehicle. *Id.* at 32–33. Patent Owner cites dead space 66' shown in Figure 10 of the '724 patent as an exemplary visual indication of a vehicle’s current location. *Id.* at 33–34 (citing Ex. 1001, col. 15, ll. 50–61).

Patent Owner’s argument is not persuasive, as Petitioner does not rely solely on Figure 3(c)’s predicted path. In its Petition, Petitioner relies on Aishin’s “box” depicting the vehicle body as the recited “visual indication,” citing Figures 3(b) and 3(c) and their accompanying description. -1414 Pet. 32–34. Dr. Wolberg testifies similarly. *See, e.g.*, Ex. 1020 ¶¶ 80–81 (“The purpose of Aishin is to enable a driver to directly grasp surrounding circumstances along the predicted locus to enhance safe operation of the vehicle. . . . In addition to a locus of the vehicle, a profile of the vehicle is drawn in order to emphasize a rearmost portion of the vehicle.”). The relied upon portion of Aishin discloses:

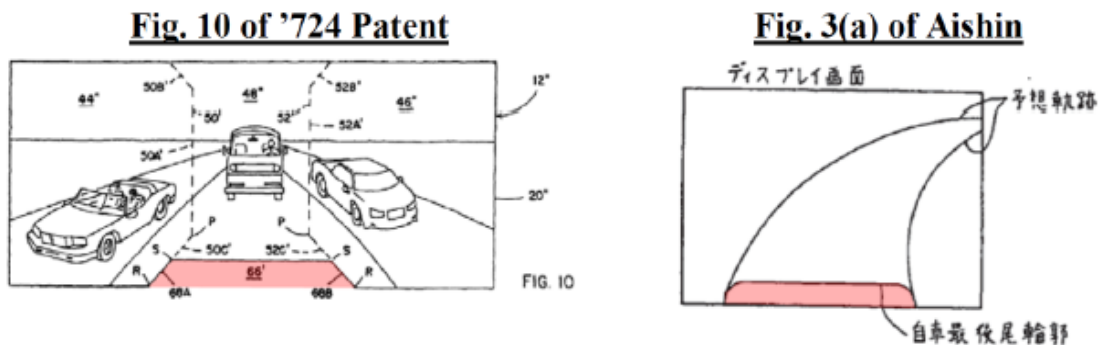
In superimposing the predicted path, when the mounting position of camera 7 is located in the rear of the vehicle as shown in Fig. 2(a), not only the path of the vehicle but also a profile of the vehicle may be drawn as shown in Fig. 3(a), so as to emphasize the rearmost portion of the vehicle captured on the screen by camera 7.

Further, a more cognitively comprehensible display can be provided, by drawing frames aligned at equal intervals along a path on the ground as shown in Fig. 3(b) so as to present a sense of perspective, or by drawing a vehicle body as a box on the basis of a path of front and rear wheels in a given position as shown in Fig. 3(c).

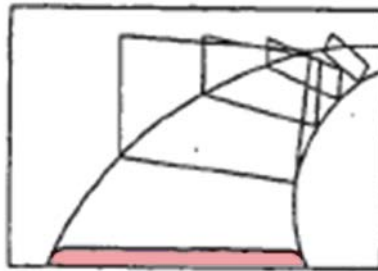
Ex. 1008, 8. Thus, based on the camera being mounted at the rear of the vehicle, the figures depict not just boxes for the predicted path of the vehicle, but also a box in Figure 3(a) for the “profile of the vehicle” at its

rearmost portion. See *id.* at 8, 16 (translation of bottom notation in Figure 3(a) as “Profile of Vehicle Tail”).

Importantly, that same “profile of the vehicle” is shown in Figure 3(b) of Aishin cited by Petitioner. See -1414 Pet. 32–34; Reply 20–21. It also is very similar to dead space 66' in the '724 patent cited by Patent Owner. To illustrate, Petitioner provides the following annotated versions of Figure 10 and Figure 3(a) on page 21 of its Reply.



As shown in the figures above, the portions annotated in red both constitute a “visual indication” of the vehicle’s current location in the view. An annotated version of Figure 3(b) also is reproduced below.



Again, the portion of the figure annotated in red above is the same as in Figure 3(a), and constitutes a “visual indication” of the vehicle’s current location in the view (claim 7), just like dead space 66' in Figure 10 of the '724 patent. It also approximates the footprint “occupied” by the vehicle when viewed from the rearward camera (claim 8) and comprises an outline

of an area substantially “occupied” by the vehicle when viewed from the rearward camera (claim 9).

We have reviewed the -1414 Petition, Patent Owner Response, and Reply, as well as the evidence discussed in each of those papers, and are persuaded, by a preponderance of the evidence, that claims 7–9 and 20–22 would have been obvious based on Yamamoto, Mitsubishi, Lemelson, and Aishin under 35 U.S.C. § 103(a), for the reasons set forth by Petitioner. *See* -1414 Pet. 32–37; Reply 20–21.

*F. Obviousness Ground Based on Yamamoto, Mitsubishi,
Lemelson, and Goesch
(Claim 45)*

1. Goesch

Goesch describes the use of head up displays (HUDs) in automobiles. Ex. 1019. A HUD is “an instrument which allows the driver of a vehicle to view key driving/status data superimposed on the visual field through the windshield rather than requiring looking down at the instrument panel for necessary or useful information.” *Id.* at 4. Figure 1 of Goesch is reproduced below.

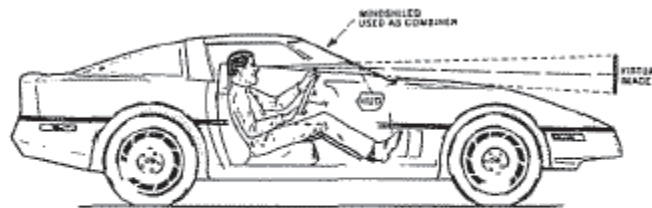


Figure 1 - Basic Automotive HUD Concept

Figure 1 depicts the basic design, with a vacuum fluorescent display tube (VFD) and mirrors in the dashboard being used to project an image of information, such as the vehicle’s speed, onto the windshield “just above the

hood line in the driver's central vision area at approximately front bumper range." *Id.* at 4–5. Thus, "the driver can keep his eyes looking toward the road ahead while accessing and responding to the information," and "with the image focused to appear two or more meters forward of the driver, the need to re-accommodate from the road to the image is reduced." *Id.* at 4.

2. Analysis

Petitioner argues that claim 45 is unpatentable over Yamamoto, Mitsubishi, Lemelson, and Goesch under 35 U.S.C. § 103(a). -1414 Pet. 49–50. Claim 45 depends from claim 1, and recites that "the image displayed by said display screen comprises a focal length that is substantially the depth of the field of the driver viewing objects beyond said equipped vehicle." Petitioner argues that Goesch teaches the recited focal length. *Id.* According to Petitioner, it would have been obvious to combine Goesch's teaching regarding a particular focal length with the teachings of the other references to "provide an image which does not require a driver to shift his/her focus from the road, resulting in a safer display of information." *Id.* at 50 (citing Ex. 1022 ¶¶ 140–43). Petitioner's arguments are supported by the testimony of Dr. Wilhelm, and are persuasive.

Patent Owner makes two arguments. First, Patent Owner contends that Goesch's head up display projects a virtual image, not an "image displayed by [a] display screen" as recited in claim 45. PO Resp. 36 (citing Ex. 2004 ¶¶ 137–38). Petitioner, however, relies on Yamamoto and Lemelson as teaching the "display screen" of the reconfigurable display device, and relies on Goesch only for the concept of a particular focal length for an image displayed to a driver. -1414 Pet. 30–31, 49–50. Thus, Patent

Owner's argument based on Goesch alone is not persuasive. *See In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) ("Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references.").

Second, Patent Owner argues that the references together do not teach the recited limitation because Goesch's head up display "does not provide any suggestion for creating an image on a display screen with such a focal length." PO Resp. 36–37. According to Patent Owner, Goesch has its focal length specifically because it is a head up display, and "cannot simply be adopted into a display screen." *Id.* (citing Ex. 2004 ¶¶ 139–40). Patent Owner, however, does not explain in any detail *why* Goesch's focal length could not be used for the image displayed by a display screen of the type disclosed in Yamamoto and Lemelson. *See id.* Moreover, as Petitioner correctly points out, in the head up display of Goesch, the image that the driver sees on the windshield originates from the VFD (i.e., a display screen). Reply 22–23. The VFD emits light that reflects off of a mirror and is then incident on the windshield; based on how those components are designed and positioned, the resulting image shown on the windshield will have a particular focal length. *See* Ex. 1019, 4–5, Figs. 1–2 (describing a "high-brightness VFD" as the "image 'source'" and a "virtual image of the VFD graphics . . . produced at front bumper range using a relatively small aperture, folded reflective optical system"); Ex. 1070, 9 (textbook describing the physics of head up displays). Thus, because Goesch has a display screen itself (albeit one that is not viewed directly by the driver), we agree with Petitioner that a person of ordinary skill in the art would have been able to apply its teachings regarding a particular focal length to a traditional,

directly-viewed display screen of the type described in Yamamoto and Lemelson, and would have been motivated to do so by Goesch's explicit disclosure of the advantages of that focal length. *See* -1414 Pet. 49–50; Reply 22–23; Ex. 1019, 4 (stating that the HUD allows the driver to keep his or her eyes focused on the road); Ex. 1022 ¶¶ 141–43.

We have reviewed the -1414 Petition, Patent Owner Response, and Reply, as well as the evidence discussed in each of those papers, and are persuaded, by a preponderance of the evidence, that claim 45 would have been obvious based on Yamamoto, Mitsubishi, Lemelson, and Goesch under 35 U.S.C. § 103(a), for the reasons set forth by Petitioner. *See* -1414 Pet. 49–50; Reply 21–23.

*G. Obviousness Ground Based on Yamamoto, Mitsubishi,
Lemelson, and Wang
(Claim 19)*²⁰

Petitioner argues that claim 19 is unpatentable over Yamamoto, Mitsubishi, Lemelson, and Wang under 35 U.S.C. § 103(a). -1414 Pet. 17–32. Claim 19 recites that “each of said at least three image capture devices comprises a CMOS imaging array.” As with Petitioner's previous ground based in part on Wang discussed above, Petitioner relies on Wang as teaching a CMOS imaging array and argues that it would have been obvious to a person of ordinary skill in the art to employ that type of imaging array in a vehicle rearview vision system like Yamamoto and Mitsubishi, with

²⁰ Patent Owner in its Response does not make any arguments directed specifically to the claims addressed in the remainder of this Decision (claims 19, 24, 26–28, 33–40, 44, 57, 59, 60, 63, 72, 74, 83, and 85). *See infra* Sections II.G–M. Thus, our analysis is limited to Petitioner's arguments and supporting evidence.

supporting testimony from Dr. Wolberg. *See id.* (citing Ex. 1020 ¶¶ 144–45); *supra* Section II.D. We have reviewed the -1414 Petition and supporting evidence, and are persuaded, by a preponderance of the evidence, that claim 19 is unpatentable based on the asserted ground for the reasons stated in the -1414 Petition.

*H. Obviousness Ground Based on Yamamoto, Mitsubishi,
Lemelson, and Niles
(Claim 24)*

Petitioner argues that claim 24 is unpatentable over Yamamoto, Mitsubishi, Lemelson, and Niles under 35 U.S.C. § 103(a). -1414 Pet. 37–38. Claim 24 recites that “the image displayed by said display screen comprises indicia and . . . said indicia responds to at least one of the vehicle’s steering system, the vehicle’s differential system and a compass.” Petitioner argues that Lemelson teaches the display of indicia providing information to the driver, but does not disclose explicitly that the indicia is responsive to the vehicle’s steering system. *Id.* Petitioner relies on Niles, which teaches the display of markers that are dynamically adjustable based on a tire direction sensor. *Id.*; *see* Ex. 1012, 3, Figs. 2, 3. Among other reasons, Petitioner contends that “[b]ecause backing up is one of the most dangerous maneuvers in a vehicle, and is prone to many accidents, it would have been obvious” to combine the teaching of Niles with those of the other references to “provide the driver with more information overlaid on the synthesized image when traveling in reverse” and thereby improve driver awareness and safety, citing Dr. Wolberg’s testimony. -1414 Pet. 38 (citing Ex. 1020 ¶¶ 153–57 (“It would also have been obvious to a [person of ordinary skill in the art] to display such distance indicia, as described in

Niles, to make the driver display more robust and enhance driver awareness and safety.”)). We have reviewed the -1414 Petition and supporting evidence, and are persuaded, by a preponderance of the evidence, that claim 24 is unpatentable based on the asserted ground for the reasons stated in the -1414 Petition.

*I. Obviousness Ground Based on Yamamoto, Mitsubishi,
Lemelson, Aishin, and Schmidt
(Claim 26)*

Petitioner argues that claim 26 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Aishin, and Schmidt under 35 U.S.C. § 103(a). -1414 Pet. 38–40. Claim 26 recites that “the image displayed by said display screen comprises a graphic overlay that includes indicia of the anticipated path of travel of the equipped vehicle and . . . said graphic overlay is disabled when the vehicle’s gear actuator is not in reverse gear.” As with Petitioner’s previous ground based in part on Aishin discussed above, Petitioner relies on Aishin as teaching “indicia of the anticipated path of travel” and argues that it would have been obvious to a person of ordinary skill in the art to enhance the combined device of Yamamoto, Mitsubishi, and Lemelson by displaying such information. *Id.*; *see supra* Section II.E. Petitioner further relies on Schmidt, which teaches that it was “well known to utilize the transmission of a vehicle as a switch and one skilled in the art [was] able to connect the rear camera to the display if the vehicle is placed in reverse.” Ex. 1015, col. 9, ll. 16–26; *see* -1414 Pet. 39. According to Petitioner and Dr. Wilhelm, it would have been obvious to disable the display of information when the vehicle is not in reverse gear, among other reasons, to “allow more pertinent information to be displayed instead of a

rearward scene, which is not required when the direction of travel is not rearward.” -1414 Pet. 39–40 (citing Ex. 1022 ¶¶ 102–05). We have reviewed the -1414 Petition and supporting evidence, and are persuaded, by a preponderance of the evidence, that claim 26 is unpatentable based on the asserted ground for the reasons stated in the -1414 Petition.

*J. Obviousness Grounds Based on Combinations with Fuji
(Claims 27, 28, 57, 72, and 83)*

Petitioner argues, under 35 U.S.C. § 103(a), that claims 27 and 28 are unpatentable over Yamamoto, Mitsubishi, Lemelson, and Fuji, and claims 57, 72, and 83 are unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Fuji. -1414 Pet. 40–42, 50–58. Claim 27 recites that “the display luminance of said display screen of said reconfigurable display device is variable responsive to a sensing of an ambient light level.” Claim 28 recites that “the display luminance of said display screen of said reconfigurable display device is variable responsive to at least one of . . . (ii) an ambient light sensor.” Claims 57, 72, and 83 recite “at least one of” either limitation. For the additional limitations of these claims, Petitioner argues that Fuji teaches a display screen with luminance responsive to sensing ambient light levels. *Id.* at 40–41; *see* Ex. 1010, 7–8, Figs. 1–2. Petitioner contends that “the systems of Yamamoto and Lemelson were designed to provide the driver with the maximum amount of useful information on a reconfigurable display under all types of environmental conditions,” and it would have been obvious to combine their teachings with Fuji, among other reasons, because a person of ordinary skill in the art “would have readily appreciated that a reconfigurable display of any type

would only be useful if it was viewable to the driver at all times, *i.e.*, in the daytime and at night.” -1414 Pet. 41–42 (citing Ex. 1022 ¶¶ 106–11).

We have reviewed the -1414 Petition and supporting evidence, and are persuaded, by a preponderance of the evidence, that claims 27, 28, 57, 72, and 83 are unpatentable based on the asserted grounds for the reasons stated in the -1414 Petition.

*K. Obviousness Grounds Based on Combinations with Otsuka
(Claims 33–40 and 59)*

Petitioner argues, under 35 U.S.C. § 103(a), that claims 33 and 35–38 are unpatentable over Yamamoto, Mitsubishi, Lemelson, and Otsuka; claim 34 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Otsuka, and Conner; claim 39 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Otsuka, and Sato; claim 40 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Otsuka, and Paff; and claim 59 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Otsuka. -1414 Pet. 42–48, 58–59.

Claim 33 recites that “said reconfigurable display device comprises a flat-panel display device.” Claims 35–38, which depend from claim 33, recite various features of the flat-panel display device. Claim 59 recites “at least one of (a) said reconfigurable display device comprises a flat-panel display device.” For the additional limitations of these claims, Petitioner argues that Yamamoto and Mitsubishi teach the use of a TV monitor display and Lemelson teaches a reconfigurable display, but the references do not disclose specifically the use of a flat-panel display device. *Id.* at 42–44, 58–59. Petitioner relies on Otsuka, which teaches various types of displays for vehicle instrumentation and compares them to each other based on

display capacity, legibility, ease of operation, cost, reliability, etc. *Id.* (citing Ex. 1016, 2 (“Among the electronic display devices currently employed in vehicles are LED (light emitting diode), VFT (vacuum fluorescent tube), LCD (Liquid Crystal Display), PDP (plasma display), CRT (cathode ray tube), and EL (Electro Luminescent display).”)). Among other reasons, Petitioner contends that it would have been an obvious design choice to select a particular display type, such as a flat-panel display device that “takes up less space inside the vehicle and still provides a clear image to the driver.” *Id.* (citing Ex. 1022 ¶¶ 112–16, 156–59); *see* Ex. 1016, 2 (“Due to the recent increase in safety and operational information supplied to vehicle operators, an important need has arisen; the development of an effective display unit which uses a minimal amount of dashboard space.”).

Claim 34 recites that “said flat-panel display device comprises a back-lit liquid crystal display device.” Petitioner argues that back-lit LCD displays were well-known at the time of the ’724 patent, as evidenced by Conner; a person of ordinary skill in the art would have made a design choice of what type of display to use; and such an individual would have known that back-lighting improves color displays like the one in Lemelson. -1414 Pet. 44–46 (citing Ex. 1014; Ex. 1022 ¶¶ 117–19).

Claim 39 recites that “each of said at least three image capture devices comprises an array of photosensing pixels and . . . a mosaic spectral filter masks incident radiation in order to produce pixels which respond respectively to red, green and blue light.” Petitioner argues that such filters in image capture devices were well-known at the time of the ’724 patent, as evidenced by Sato, and a person of ordinary skill in the art would have been motivated to include them to more “easily recognize obstacles and objects

and avoid potential hazardous situations while operating the vehicle.” *Id.* at 46–47 (citing Ex. 1018; Ex. 1022 ¶¶ 120–24).

Claim 40 recites that “each of said at least three image capture devices comprises an array of photosensing pixels and comprises filtering to [at] least one of (a) at least partially block near infrared radiation from pixels of said array.” Petitioner argues that infrared filters in image capture devices were well-known at the time of the ’724 patent, as evidenced by Paff, and a person of ordinary skill in the art would have been motivated to “keep the infrared [light] from unduly influencing the image.” *Id.* at 47–48 (citing Ex. 1017; Ex. 1022 ¶¶ 125–28).

We have reviewed the -1414 Petition and supporting evidence, and are persuaded, by a preponderance of the evidence, that claims 33–40 and 59 are unpatentable based on the asserted grounds for the reasons stated in the -1414 Petition.

*L. Obviousness Grounds Based on Combinations with King
(Claims 44 and 63)*

Petitioner argues, under 35 U.S.C. § 103(a), that claim 44 is unpatentable over Yamamoto, Mitsubishi, Lemelson, and King, and claim 63 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and King. -1414 Pet. 48–49, 60. Claims 44 and 63 recite that “said display device comprises a circular polarizer.” For the additional limitation of these claims, Petitioner argues that the use of polarizers in displays was well-known at the time of the ’724 patent, as evidenced by King. *Id.* (citing Ex. 1013, col. 5, ll. 9–15 (“If desired, a circularly polarized filter . . . may be used with the structure of FIG. 1 to further reduce the reflected light and to

achieve acceptable contrast in high ambient light conditions.”)). Among other reasons, Petitioner contends that “Lemelson contemplates display of information on the reconfigurable display device under varying environmental conditions, including during the daytime when ambient light is high,” and it would have been obvious to incorporate a circular polarizer as taught by King to “provide the driver with a visible display device under high ambient light conditions, *i.e.*, when operating the vehicle during the daytime when more sunlight is present.” *Id.* (citing Ex. 1022 ¶¶ 134–39). We have reviewed the -1414 Petition and supporting evidence, and are persuaded, by a preponderance of the evidence, that claims 44 and 63 are unpatentable based on the asserted grounds for the reasons stated in the -1414 Petition.

*M. Obviousness Ground Based on Yamamoto, Mitsubishi,
Lemelson, Wang, Aishin, and Paff
(Claims 60, 74, and 85)*

Petitioner argues that claims 60, 74, and 85 are unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Paff under 35 U.S.C. § 103(a). -1414 Pet. 59–60. Claims 60, 74, and 85 recite “at least one of . . . (b) each of said at least three image capture devices comprises an array of photosensing pixels and comprises filtering to [at] least one of (i) at least partially block near infrared radiation from pixels of said array.” As with Petitioner’s previous ground based in part on Paff discussed above, Petitioner relies on Paff as teaching infrared filtering and argues that it would have been obvious to a person of ordinary skill in the art to employ such filtering to “keep the infrared [light] from unduly influencing the image.” *Id.* (citing Ex. 1022 ¶¶ 160–62); *see supra* Section II.K. We have

reviewed the -1414 Petition and supporting evidence, and are persuaded, by a preponderance of the evidence, that claims 60, 74, and 85 are unpatentable based on the asserted ground for the reasons stated in the -1414 Petition.

III. ORDER

Petitioner has demonstrated, by a preponderance of the evidence, under 35 U.S.C. § 103(a), that:

- (1) claims 1, 3–6, 10–12, 14, 15, 17, 23, 25, 29–32, 41–43, and 46–48 are unpatentable over Yamamoto, Mitsubishi, and Lemelson;
- (2) claims 49–52, 54–56, 58, 61, 62, 64–67, 69–71, 73, 75–79, 81, 82, 84, and 86 are unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, and Aishin;
- (3) claim 19 is unpatentable over Yamamoto, Mitsubishi, Lemelson, and Wang;
- (4) claims 7–9 and 20–22 are unpatentable over Yamamoto, Mitsubishi, Lemelson, and Aishin;
- (5) claim 24 is unpatentable over Yamamoto, Mitsubishi, Lemelson, and Niles;
- (6) claim 26 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Aishin, and Schmidt;
- (7) claims 27 and 28 are unpatentable over Yamamoto, Mitsubishi, Lemelson, and Fuji;
- (8) claims 33 and 35–38 are unpatentable over Yamamoto, Mitsubishi, Lemelson, and Otsuka;
- (9) claim 34 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Otsuka, and Conner;
- (10) claim 39 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Otsuka, and Sato;
- (11) claim 40 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Otsuka, and Paff;

- (12) claim 44 is unpatentable over Yamamoto, Mitsubishi, Lemelson, and King;
- (13) claim 45 is unpatentable over Yamamoto, Mitsubishi, Lemelson, and Goesch;
- (14) claims 57, 72, and 83 are unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Fuji;
- (15) claim 59 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Otsuka;
- (16) claims 60, 74, and 85 are unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and Paff; and
- (17) claim 63 is unpatentable over Yamamoto, Mitsubishi, Lemelson, Wang, Aishin, and King.

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 3–12, 14, 15, 17, 19–52, 54–67, 69–79, and 81–86 of the '724 patent have been shown to be unpatentable.

This is a final decision. Parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2015-01410
Patent 8,643,724 B2

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