

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LEGEND3D, INC.,

Petitioner,

v.

PRIME FOCUS CREATIVE SERVICES CANADA INC.,

Patent Owner.

Case IPR2016-00806
Patent No. 8,922,628 B2

Before THOMAS L. GIANNETTI, MATTHEW R. CLEMENTS, and
ROBERT L. KINDER, *Administrative Patent Judges*.

KINDER, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a); 37 C.F.R. § 42.73

ORDER DENYING MOTION TO AMEND
37 C.F.R. § 42.121

Legend3D, Inc. (“Petitioner”) filed a Petition pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–18 (all claims) of U.S. Patent No. 8,922,628 B2, issued on December 30, 2014 (Ex. 1001, “the ’628 patent”). Paper 1 (“Pet.”). Prime Focus Creative Services Canada, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”). Applying the standard set forth in 35 U.S.C. § 314(a), we instituted an *inter partes* review of all challenged claims. Paper 13 (“Dec. on Inst.”).

During the trial, Patent Owner filed a Patent Owner Response (Paper 28, “PO Resp.”) in which it, *inter alia*, “concedes that, under the Board’s interpretation of ‘depth selection mask’ as laid out in its Institution Decision (Paper No. 13), [claims 1–6, 8–13, 17, and 18] in the Bond Patent [’628 patent] are unpatentable over the references cited in the Petition,” and argues that claims 7, 14, 15, and 16 are not unpatentable (*Id.* at 1). Petitioner filed a Reply to the Patent Owner Response (Paper 48, “Pet. Reply”). Patent Owner’s fully briefed Motion to Amend is pending. Paper 29 (“Mot. to Amend”); Paper 50 (“Opp. to Mot. to Amend”); Paper 58 (“Reply to Mot. to Amend”).

Patent Owner’s fully briefed Motion to Exclude the Second Declaration of Carlos Vazquez also is pending. Paper 61 (“PO Mot.”); Paper 65 (“Pet. Opp.”); Paper 66 (“PO Reply to Opp.”).

We also have considered Patent Owner’s Motion for Observations on Cross-Examination (Paper 60) and Petitioner’s Response (Paper 64) in making our final determinations. Below, we also address Petitioner’s Objections to Patent Owner’s Demonstrative Exhibits. Paper 68.

An oral hearing was held on June 21, 2017, and a copy of the transcript has been made part of the record. Paper 72 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6(b). This Decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the claims on which we instituted trial. Based on the record before us, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 1–18 of the ’628 patent are unpatentable under 35 U.S.C. § 103(a). We also *deny* Patent Owner’s Motion to Amend.

I. BACKGROUND

A. *The ’628 Patent (Ex. 1001)*

The ’628 patent is titled “System and Process for Transforming Two-Dimensional Images into Three-Dimensional Images.” Ex. 1001 (54). The ’628 patent relates to a system and method for the conversion of two-dimensional (2D) images into images providing the perception of three-dimensional (3D) images. *Id.* at Abst. More specifically, the claimed invention relates to 3D post-production processes and converting 2D images into 3D images through a “process that avoids the need for the time and cost intensive practice of rotoscoping or manually processing each frame of a sequence by tracing out the scene elements” *Id.* at 1:15–18, 4:33–42.

The ’628 patent also offers a solution to the problem of filling image information in image areas left blank by the process of shifting elements. *See id.* at 4:1–23 (“[O]ccluding objects in the scene, once shifted in the reconstruction or otherwise, will reveal portions of the scene for which there is no information contained in the image.”). The invention addresses these problems by manipulating pixels in an image in a partially or fully automated process of selecting and segmenting an image using the image’s own intrinsic qualities. *Id.* at 4:46–5:24.

The process first creates a “depth selection mask.” This depth selection mask is associated with a selected characteristic of the working image and associated with at least a portion of the working image and helps guide the transformation/remapping of an image in order to create a complementary image. *Id.* at 8:17–22, 11:20–25 (defining “depth selection mask” as a set of values in a given range). The process continues by assigning a vector field to each pixel, which helps orient the direction of displacement. *Id.* at 8:23–28, 12:56–58, 36:66–67. After determination of a vector field for each pixel, “vector-based remapping of image elements [occurs] by compressing or expanding portions of the image to provide the perception of shifting image elements to achieve the disparities required for stereo depth perception.” *Id.* at 5:2–6. The depth selection mask described above is applied to the vector field to create a “weighted displacement mask,” which guides the actual displacement of pixels. *Id.* at 5:12–17, 37:1–6. According to the ’628 patent, the ultimate result of these operations does not cause occluding objects to reveal any absent information that would need to be filled. *Id.* at 5:17–19.

B. Illustrative Claim

Claims 1 and 12 are independent. Claim 1 is illustrative of the claims at issue:

1. A process for creating a three dimensional media projection from a two-dimensional image, comprising:

copying a two-dimensional image to create a working image of the two dimensional image;

creating a depth selection mask associated with at least one characteristic of the working image and associated with at least a portion of the working image, including:

selecting a set of image features, and

determining a real value in a normalized range for the set of selected image features for each pixel location in the portion of the working image;

determining a vector field of each pixel of the portion of the working image;

applying the depth selection mask to the vector field of the portion of the working image to create a weighted displacement mask having a displacement vector associated with each pixel of the portion of the working image, the displacement vector having a magnitude and direction;

displacing each pixel of the portion of the working image in accordance with the magnitude of the vector associated with that pixel to create a modified working image; and

creating a stereo pair of images by pairing the two dimensional image with the modified working image.

Ex. 1001, 36:55–37:11. Claim 12 is a system version of method claim 1. It repeats all of the claim limitations of claim 1 essentially verbatim, while adding hardware such as “a video monitor,” “an input device,” “a control,” and “a processor.” *See id.* at 38:24–62.

C. Related Proceedings

The parties state that the ’628 patent is asserted in Civil Action No. 2:15-cv-02340-MWF-PLA (C.D. Cal.). Pet. 3; Paper 6 (Patent Owner’s Notice), 2.

Also, the ’628 patent was challenged in IPR2015-01350, in which we denied institution of *inter partes* review. *See Legend3D, Inc. v. Prime Focus*

Creative Servs. Can. Inc., Case IPR2015-01350 (PTAB Dec. 21, 2015) (Paper 14).

Patent Owner filed an application to reissue the '628 patent pursuant to 35 U.S.C. § 251 on December 29, 2016. Paper 32, 2 (“[t]he reissue application number is 15/394,366”). On February 2, 2017, we stayed examination of the reissue application pursuant to 35 U.S.C. § 315(d), and 37 C.F.R. §§ 42.3(a), 42.122(a), pending the completion or termination of this *inter partes* review proceeding. Paper 38.

D. Real Party-in-Interest

In accordance with 35 U.S.C. § 312(a)(2) and 37 C.F.R. § 42.8(b)(1), Petitioner identifies Legend3D, Inc., Northwater Intellectual Property Fund L.P. 3A, Augustus Ventures Limited, and Augustus Investments USA Limited as the real parties-in-interest in this proceeding. Pet. 2.

E. Evidence Relied Upon

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

U.S. Patent No. 7,573,475 B2, filed June 1, 2006, issued Aug. 11, 2009 (Ex. 1008, “Sullivan”);

U.S. Patent No. 8,488,868 B2, filed Apr. 2, 2008, issued July 16, 2013 (Ex. 1004, “Tam ’868”);

U.S. Patent No. 8,213,711 B2, filed July 23, 2009, issued July 3, 2012 (Ex. 1006, “Tam ’711”);

Liang Zhang and Wa James Tam, *NPL “Stereoscopic Image Generation Based on Depth Images for 3D TV”*, IEEE Transactions on Broadcasting, Volume 51, Issue 2, 191–199 (June 2005) (Ex. 1015, “Zhang”). Petitioner relies on Zhang, which is incorporated by reference into Tam ’868 (see Ex. 1004, 7:26–35).

Petitioner relies on the Declaration of Carlos Vazquez, Ph.D. (Ex. 1011) and the Reply Declaration of Dr. Vazquez (Ex. 1036¹). Patent Owner relies on the Declaration of David Forsyth, Ph.D. (Ex. 2010²) and the Reply Declaration of Dr. Forsyth (Ex. 1043).

F. Pending Grounds of Unpatentability

We instituted *inter partes* review of claims 1–18 of the ’628 patent as unpatentable under 35 U.S.C. § 103(a) over the combination of Sullivan, Tam ’868, and Tam ’711. Dec. on Inst. 19.

II. ANALYSIS

Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must establish the facts supporting its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). Below, we discuss whether Petitioner has met its burden with respect to claims 1–18.

A patent claim is unpatentable under 35 U.S.C. § 103(a) if 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 to a person of ordinary skill in the art at the time the invention was made. *KSR*

¹ Pursuant to our Order of March 30, 2017 (Paper 54), Petitioner refiled the Reply Declaration of Dr. Vazquez as the “Corrected Declaration of Carlos Vazquez” still bearing Exhibit 1036.

² Exhibit 2010 is the “Corrected” Declaration of Dr. David Forsyth, originally filed as Ex. 2005. Any citations in the parties’ briefing to Exhibit 2005 are deemed to refer to Exhibit 2010. See Paper 37, 2.

Int'l Co. v. Teleflex Inc., 550 U.S. 398, 406 (2007). Obviousness is resolved based on underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness,³ i.e., secondary considerations. See *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

*A. Patent Owner's Motion to Exclude the
Second Declaration of Carlos Vazquez*

Patent Owner moves pursuant to Federal Rule of Evidence 702 and 37 C.F.R. §§ 42.53 and 42.65 to exclude the Second Declaration of Dr. Vazquez (Ex. 1036, hereafter “Second Declaration”). PO Mot. 1. Patent Owner presents three main arguments: (1) “Mr. Vazquez did not apply his analysis to the facts of this case” and thus paragraphs 16–41 of his analysis should be excluded under Federal Rule of Evidence 702, (2) “Mr. Vazquez improperly reforms prior testimony,” and thus paragraph 42 of his Second Declaration should be excluded, and (3) “Mr. Vazquez did not disclose the bases for his opinion,” and therefore his testimony should be excluded. *Id.* at 1, 4, 10; see also Papers 51, 57 (Patent Owner Objections to Ex. 1036). We first consider the legal standards for a motion to exclude and then we consider the merits of each argument in turn.

1. Legal Standards

A motion to exclude deals with the admissibility of evidence under the Federal Rules of Evidence. See 37 C.F.R. §§ 42.62 (applying the

³ In this proceeding, the parties have not identified any objective evidence of nonobviousness that allegedly bears on the patentability of the challenged claims.

Federal Rules of Evidence to *inter partes* reviews), 42.64; Office Patent Trial Practice Guide, 77 Fed. Reg. 48,758 (August 14, 2012) (“Admissibility of evidence is generally governed by the Federal Rules of Evidence.”). As stated in the Office Patent Trial Practice Guide, the parties may submit motions to exclude regarding evidence “believed to be inadmissible.” Office Patent Trial Practice Guide, 77 Fed. Reg. 48,758. Further, a motion to exclude “must explain why the evidence is not admissible (*e.g.*, relevance or hearsay).” *Id.* at 48,767.

2. Rule 702 Challenge to Paragraphs 16–41

Patent Owner contends that Mr. Vazquez did not apply his analysis to the facts of this case and thus paragraphs 16–41 of the Second Declaration should be excluded under Rule 702. PO Mot. 1–4. Paragraphs 16–41 of the Second Declaration relate to Dr. Vazquez’s views as to the proper construction of the term “distortion.” *Id.* at 2. Patent Owner argues “that the claim construction offered by Mr. Vazquez is impossible in the context of the Bond Patent.” *Id.* at 3. Patent Owner contends Dr. Vazquez presents conflicting positions and that he did not apply his analysis to the facts of the ’628 patent. *Id.* at 3–4. Patent Owner contends Dr. Vazquez’s proposed claim construction positions cannot be correct if the proper facts are applied. *See* PO Reply to Opp., 2 (“Mr. Vazquez’s claim construction results in a definition of ‘distortion’ that fails to do the things that the Bond Patent states ‘distortion’ must do.”).

Petitioner addresses Patent Owner’s contentions by arguing the merits of Dr. Vazquez’s claim construction positions. Pet. Opp. 2–7. Petitioner offers additional details concerning the context of each of Dr. Vazquez’s

deposition answers purportedly in conflict with his claim construction position. *Id.* at 3–6.

Federal Rule of Evidence 702 precludes expert testimony when it is not “based on sufficient facts or data” or is not “the product of reliable principles and methods.” F.R.E. 702(b)–(c). Expert opinion that is not “sufficiently tied to the facts of the case” is “not relevant and, ergo, non-helpful.” *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579, 591 (1993). Rule 702(d) further limits expert testimony to situations where “the expert has reliably applied the principles and methods to the facts of the case.” F.R.E. 702 thus serves “a ‘gatekeeping role,’ the objective of which is to ensure that expert testimony admitted into evidence is both reliable and relevant.” *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1360 (Fed. Cir. 2008).

Patent Owner’s contentions, as well as Petitioner’s counter arguments, address the merits of Dr. Vazquez’s claim construction position. Patent Owner’s contentions do not, however, offer a viable basis for excluding Dr. Vazquez’s testimony pursuant to F.R.E. 702. Patent Owner argues that Dr. Vazquez did not properly rely on the disclosure of the ’628 patent in forming his opinion, and that he is offering testimony that conflicts with the teachings of the ’628 patent. Even if true, these reasons are not a sufficient basis for exclusion under Rule 702 because Dr. Vazquez could also provide his understanding of the plain and ordinary meaning of a contested claim term.

Patent Owner has not established a basis to exclude Dr. Vazquez’s testimony. The policy considerations for excluding expert testimony, such as those implemented by the gatekeeping framework established by the

Supreme Court in *Daubert*, are less compelling in bench proceedings, such as *inter partes* reviews, than in jury trials. *See, e.g., Volk v. United States*, 57 F. Supp. 2d 888, 896 n.5 (N.D. Cal. 1999). Patent Owner's contentions go to the weight that should be given to Dr. Vazquez's testimony concerning claim construction. Claim construction is a legal determination, and we are capable of weighing his testimony against the other evidence considered on this issue. We therefore deny Patent Owner's request to exclude paragraphs 16–41 of the Second Declaration.

3. *Alleged Reforming Prior Testimony – Paragraph 42*

The issues raised by Patent Owner with respect to paragraph 42 were considered in our prior Order where we struck paragraph 43 of Dr. Vazquez's original Second Declaration because it was “an attempt to recant or reform prior testimony.” Paper 54, 2–3. Patent Owner contends that paragraph 42 should also be stricken because that paragraph contains statements that conflict with deposition testimony given as to whether Zhang's (Ex. 1015) formula (3) pushes data such that pixels travel downstream in the direction of the displacement vector. PO Mot. 4–7. According to Patent Owner, “[p]aragraph 42 of the second declaration is an equally improper reformation of previous testimony, just one that was more artfully drafted than the previously stricken paragraph 43.” *Id.* at 10.

Petitioner contends the statements in paragraph 42 of the Second Declaration do not conflict with prior testimony. Petitioner contends that “[t]he direction of the pixel movement relative to the image, and the direction of the displacement vector as a mathematical construct are distinct concepts” and thus Patent Owner has taken Dr. Vazquez's testimony out of context. Pet. Opp. 8. Petitioner argues that “a person of ordinary skill in the

art would understand that the movement of the pixels (upstream or downstream – *i.e.*, pulling operation or pushing operation, respectively) could easily be implemented regardless of the plus or minus sign” found in Zhang formula (3). *Id.* at 9. In either situation, Petitioner contends the plus and minus sign still indicates the direction of the displacement vector regardless of pushing or pulling. *Id.*

We find Petitioner’s contentions persuasive. We do not see a conflict with the prior deposition testimony or an attempt to recant that testimony. Patent Owner has not established that the statements in paragraph 42 of the Second Declaration reform or recant prior testimony.

4. Alleged Failure to Disclose Bases for Opinion

Patent Owner contends that Dr. Vazquez’s testimony should be stricken or afforded no weight because Dr. Vazquez failed to disclose the underlying facts or data on which the opinion is based as required by 37 C.F.R. § 42.65(a). PO Mot. 10–11. Patent Owner argues “[D]r. Vazquez reviewed certain documents in forming the opinion in his declaration, failed to disclose those documents, and now claims he cannot recall which documents he reviewed.” *Id.* at 11.

Petitioner contends that the questions posed to Dr. Vazquez during his deposition were “about whether he ‘recalls’ which other documents he reviewed in forming the opinion,” and “Dr. Vazquez was unable to do so from memory.” Pet. Opp. 10. Petitioner also alleges Patent Owner’s select quotations from Dr. Vazquez’s testimony are improper because Patent Owner adds bracketed language “[in forming my opinion]” to make it appear as if Dr. Vazquez could not identify documents that he relied on in forming his opinion. *Id.* at 10–11.

We agree with Petitioner that Patent Owner added language to Dr. Vazquez's testimony ("[in forming my opinion]") that makes the overall context misleading. Further, the questions and answers during his deposition do not establish that Dr. Vazquez failed to identify documents that form the bases of his opinions. Dr. Vazquez identifies numerous documents that he reviewed that form the bases for his opinions. See Ex. 1011 ¶¶ 2–6; Ex. 1036 ¶¶ 3–5, 42, 45, 46. Patent Owner has not established that any additional documents, not otherwise cited in the Second Declaration, formed the bases for Dr. Vazquez's opinions. See Ex. 2013, 13:2–25 ("I cannot say exactly that I rely on any particular document. I review many documents. I form an opinion. I reflected that in the declaration.").

5. Conclusion

Patent Owner has not established that any portion of the Second Declaration is inadmissible.

B. Petitioner's Objections to Patent Owner Demonstratives

Petitioner filed objections to Patent Owner's Demonstrative Exhibits alleging that the demonstrative slides contain new arguments not raised in briefing before the Board. See Paper 68 (objections). Patent Owner filed its demonstratives as Exhibits 2015 and 2016, with Paper 70 serving as the notice of filing of the demonstratives. As we stated at the oral hearing, we agree with Petitioner's objections because Patent Owner's demonstratives present new argument and do not comply with our guidelines. Tr. 4:24–5:14; see also *St. Jude Med., Cardiology Div., Inc. v. The Bd. of Regents of the Univ. of Michigan*, Case IPR2013-00041, slip op. at 2–3 (PTAB Jan. 27, 2014) (Paper 65) ("[D]emonstrative exhibits are not evidence; as such, the

exhibits cannot add new evidence to the record of the proceeding. Nor can the exhibits rely on evidence that, although it is in the record, was never specifically discussed in any paper before the Board.”). Accordingly, Exhibits 2015 and 2016 along with Paper 70 are expunged from the record in this proceeding.

C. Claim Interpretation

The Board interprets claims of an unexpired patent using the broadest reasonable construction in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). An inventor may elect to define specific terms used to describe the invention “with reasonable clarity, deliberateness, and precision” such that the definition chosen by the inventor controls. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). As the Federal Circuit has held:

To act as its own lexicographer, a patentee must “clearly set forth a definition of the disputed claim term” other than its plain and ordinary meaning. It is not enough for a patentee to simply disclose a single embodiment or use a word in the same manner in all embodiments, the patentee must “clearly express an intent” to redefine the term.

Thorner v. Sony Comput. Entm’t Am. LLC, 669 F.3d 1362, 1365 (Fed. Cir. 2012) (citations omitted).

The ’628 patent provides a “dictionary of terms” and states expressly that: “The terms used [in the patent] are defined as follows.” Ex. 1001, 10:67–11:6. Thus, we determine that this “dictionary of terms” controls the meaning of the terms “depth selection mask” and “vector field” as discussed

below. We further consider the proper interpretation of the term “distortion” as used in claims 7, 14, 15, and 16.

1. “depth selection mask”

In our Decision on Institution, and based upon the term “depth selection mask” being defined in the ’628 patent’s “dictionary of terms” (Ex. 1001, 11:20–25), we determined “depth selection mask” means: “A set of values in a given range, for example, the range [0.0, 1.0], which is assigned distinctly to each pixel location in a portion of an image by the artist assisted software to determine how the transformation/remapping⁴ will be applied in order to achieve an appropriate depth effect.” Ex. 1001, 11:20–25; Dec. on Inst. 5–6. Petitioner proposed this definition. Pet. 16–17. Patent Owner does not challenge our interpretation of “depth selection mask.”

We do not perceive any reason or evidence that compels any deviation from our original interpretation. Accordingly, we adopt our previous analysis and conclusion as to the interpretation of “depth selection mask” for purposes of this Decision. Dec. on Inst. 5–6.

2. “vector field”

In our Decision on Institution, and based upon the term “vector field” also being defined in the “dictionary of terms,” we determined “vector field” means “[a] mathematical construction which associates a multidimensional vector to each point in a Euclidean space.” Ex. 1001, 12:55–57; Dec. on Inst. 6. Patent Owner does not challenge our interpretation of “vector field.”

⁴ The term “Image Transformation/Remapping” is also defined in the “dictionary of terms” to mean “[a] mapping from one image to another.” Ex. 1001, 11:39–51.

We do not perceive any reason or evidence that compels any deviation from our original interpretation. Accordingly, we adopt our previous analysis and conclusion as to the interpretation of “vector field” for purposes of this Decision. Dec. on Inst. 5–6.

3. “*distort*” and “*distortion*”

Patent Owner requests that the terms “distort” and “distortion” be construed.⁵ PO Resp. 4–11. Patent Owner differentiates claims 7, 14, 15, and 16, from the claims conceded to be unpatentable because, according to Patent Owner, claims 7, 14, 15, and 16 “expressly add in the notion of displacing pixels by ‘distortion’ using a depth selection mask.” *Id.* at 5 (quoting Ex. 1001, 39:15–17 (Claim 14)). Claim 7 requires in pertinent part, “displacing by distortion of the second image a portion of the second image in a direction opposite the displacement of the working image.” Ex. 1001, 37:50–52. Claim 14 similarly claims in relevant part, “the processor further configured to displace in a direction opposite the displacement of the working image a portion of the second image by distortion of the second image.” *Id.* at 39:16–19. Claims 15 and 16 require distorting or removing a distortion from at least part of a selected image “by applying a distortion to the selected image.” *Id.* at 40:1–2, 7. Below, we discuss Patent Owner’s and Petitioner’s proposed interpretations of “distortion” and then we determine the proper interpretation for this term.

⁵ Although Patent Owner’s claim construction section is titled “Claim Construction: ‘distort,’” the majority of Patent Owner’s analysis addresses the proper meaning of “distortion.” We therefore use the term “distortion” throughout our analysis, as does Petitioner, and our analysis encompasses both terms. See Pet. Reply 7 n.1.

Patent Owner notes that the '628 patent “describes two different types of pixel displacement that rely on a depth selection mask, further solidifying the notion that ‘distortion’ is only one specific type of pixel displacement using a depth selection mask.” PO Resp. 5–6 (footnote omitted). The heart of Patent Owner’s argument is that although the '628 patent “teaches depth selection mask displacement both by pulling data and by pushing data,” the use of the term “distortion” in claims 7, 14, 15, and 16, means that the displacement in these dependent claims must occur only by “pulling data.” *Id.* at 6. According to Patent Owner, the prior art combination discussed below admittedly pushes data, but does not pull data for displacement. *Id.* at 12 (“The cited references teach displacement by pushing, not by pulling.”). The claim construction issue is thus whether the use of the word “distortion” in claims 7, 14, 15, and 16 indicates to a person of ordinary skill in the art that the claim scope was meant to be limited to just the pulling data embodiment. *See id.* at 9–10.

The Patent Owner first explains the concept of pulling data. Referring to Figures 10I and 10J of the '628 patent, Patent Owner contends that “the bottom-right pixel pulls the color information *from* the pixel to which the vector points *into* the source pixel.” *Id.* at 7. According to Patent Owner, this operation is pulling data, which the '628 patent describes as “us[ing] the depth selection mask and vector field to determine offsets into the image from which to copy or pull data to the current location.” *Id.* at 7 (quoting Ex. 1001, 30:62–64 (emphasis omitted). Patent Owner explains pulling data as “data moving in the direction opposite that of the displacement vector, *i.e.*, moving upstream towards the source of the vector.” *Id.* Patent Owner points to equation 7 of the '628 patent (Ex. 1001, 30:19) as an example of

pulling data for copying the value from the location indicated by the endpoint of the displacement vector. PO Resp. 7–8; Ex. 1001, 30:14–19; Ex. 2006, 39:19–23.

Patent Owner next explains pushing data. Patent Owner contends that “[t]he other method of displacing pixels using a depth selection mask taught by the Bond Patent is by pushing data.” *Id.* at 8. According to Patent Owner, the ’628 patent describes this type of displacement as the inverse of pulling. *Id.* Patent Owner quotes the ’628 patent’s disclosure:

The current process uses the depth selection mask and vector field to determine offsets into the image from which to copy or **pull** data to the current location; it is also possible to perform the **inverse operation**. In some embodiments, another mask can be used in conjunction with a vector field to **push** image information from the source location in the direction specified by the vector.

Id. (quoting Ex. 1001 at 30:62–31:1 (emphases added by Patent Owner)). Patent Owner argues that “pushing data involves moving data in the same direction as the displacement vector, *i.e.*, moving data downstream towards the tip of the displacement vector.” *Id.* at 9.

According to Patent Owner, “‘distortion’ means ‘pulling data’” because when discussing “[t]he current process’ that pulls data, the Bond Patent describes the results as ‘displacement distortion.’” *Id.* at 10 (quoting Ex. 1001, 29:40 (emphasis omitted)). Patent Owner contends that the ’628 patent “squarely labels the result of the pulling process as ‘distortion.’” *Id.* Patent Owner alleges that the ’628 patent thus defines distortion as the particular type of displacement that requires pulling data. *Id.*; Ex. 2010 ¶ 48. The result, according to Patent Owner, is that the claim 7 limitation of

“displacing by distortion” would require “displacing by pulling data.” PO Resp. 10.

In support of its claim construction position, Patent Owner further relies on deposition testimony of Petitioner’s expert as well as a dictionary definition of “distort.” Patent Owner first quotes the deposition testimony of Dr. Vazquez (Petitioner’s expert):

Q. So claim 15 also teaches distorting images by pulling pixels left or right by a specific amount to create disparity, correct?

A. Teaches distorting the image by applying a distortion.

Q. Which means to pull pixels off the right by a specific amount to create the perception of depth, correct?

A. Yes.

Id. at 10–11 (quoting Ex. 2006, 32:8–16 (emphases and added brackets omitted)); *see also* Ex. 2006, 31:2–7, 31:16–21. Patent Owner contends that the plain meaning of “distort” also encompasses “pulling” based upon a dictionary definition. PO Resp. 11 (quoting Concise Oxford English Dictionary, 413 (“distort” as “pull or twist out of shape”) (Ex. 2007)).

Petitioner disagrees with Patent Owner’s proposed interpretation of “distortion,” which, according to Petitioner, “is inconsistent with the plain and ordinary meaning of the term, excludes embodiments from the specification, and is narrower than the broadest reasonable interpretation.” Pet. Reply 8. Petitioner contends that the claims are broad enough to encompass several forms of distortion, and the claim language does not limit the claim scope to just pulling data as the Patent Owner suggests. *Id.* at 16; Tr. 12:1–20.

Petitioner first argues that the ordinary meaning of the term “distortion” should control because there is no indication the applicant acted as a lexicographer or otherwise intended to limit the term “distortion” to a particular pixel operation.” Pet. Reply at 9–10 (also noting the term “distortion” is not found in the definitions section of the ’628 patent). The ordinary meaning of “distortion,” according to Petitioner, is misshaping, deforming or modifying the shape. *Id.* at 14 (citing Ex. 1036 ¶¶ 16–22). Petitioner contends that pulling data is just one technique described in the ’628 patent for applying distortion and there is no clear intention to limit the claim scope in a manner inconsistent with the ordinary meaning of the term, or in a manner that would exclude other described embodiments for distortion. *Id.* at 10–11.

Petitioner contends that Patent Owner is improperly attempting to import limitations from the Specification into the claims. *Id.* at 15. According to Petitioner, “[t]here is no language in the claims to limit the ‘distortion’ to pulling data by a particular pixel operation.” *Id.* Petitioner argues that the Specification discloses “at least two different types of weighted displacement (i.e., distortion) using a depth selection mask⁶—pushing data and pulling data.” *Id.* at 16. Petitioner also contends that the ’628 patent describes radial distortion as a form of distortion by displacement. *Id.* (citing Ex. 1001, Fig. 1, Step 2; Fig. 2 (208); 15:36–50; 23:5–21). Similarly, Petitioner’s expert testifies that along with radial distortion “[t]he ’628 patent also describes distortion of an image using

⁶ Petitioner also contends that “‘distortion’ in the Disputed Claims is not limited to displacing pixels using a depth selection mask.” Pet. Reply 21.

particular operations for achieving the distortion, which are distortion by pulling pixels and distortion by pushing pixels.” Ex. 1036 ¶ 21 (citing Ex. 1001, 29:55–31:19); *see id.* at ¶ 22 (“I do not believe that one of ordinary skill in the art would read the terms ‘distort’ and ‘distortion’ to be limited to the embodiment of pulling data or to exclude other embodiments like radial distortion.”).

Petitioner argues the Specification describes using both pulling and pushing to achieve distortion. Pet. Reply 19. Petitioner relies on a disclosure from the Specification:

In some embodiments, another [depth selection] mask can be used in conjunction with a vector field to push image information from the source location in the direction specified by the vector.

Id. (quoting Ex.1001, 30:65–31:1 (emphasis added, footnote omitted)).

Petitioner further contends that this embodiment is “one of several approaches that may be used and is illustrative of some embodiments for practicing the invention.” *Id.* at 20 (quoting Ex 1001, 31:1–3 (emphasis omitted)). Petitioner also contends that at least one other section of the Specification describes “distortion by pushing.” *Id.* at 18–19 (citing Ex. 1001, 16:4–24). Further, Petitioner argues that certain figures of the ’628 patent relied upon by Patent Owner, such as figure 9, are not limited to pulling data, and “[i]ndeed, figure 9 can be implemented by pushing data.” *Id.* at 18; Tr. 59:22–60:2; Ex. 1036 ¶ 38 (“Based on my experience in the field, I believe that the example of figure 9 can be implemented using a pushing operation.”).

According to Petitioner, the claim language related to distortion is broad enough to cover radial distortion and Petitioner provides examples of how the language of claims 15 and 16 matches with embodiments described

in the Specification related to radial distortion. *Id.* at 27; Ex. 1036 ¶ 32. Thus, according to Petitioner, claim scope of “distortion” cannot be limited to just pulling data as proposed by Patent Owner.

Petitioner also relies on the deposition testimony of Patent Owner’s expert “that, without reading the ’628 Patent, a POSITA would have understood distortion to mean ‘pretty much any form of modification, change or warping’ or ‘pretty much any other modification or change’ (except for collapsing the image to one pixel).” Pet. Reply 14 (quoting Ex. 1042, 102:1–103:13). Petitioner contends that Dr. Vazquez’s deposition testimony quoted by Patent Owner is taken out of context because Dr. Vazquez did not understand that counsel for Patent Owner had a specific meaning of pulling other than generally moving information from one pixel location to another. Pet. Reply 29 (“Dr. Vazquez states that ‘pulling’ is not a term he would use and he doesn’t understand what is the meaning of ‘pulling’ that counsel is using.”); Tr. 67:22–69:10.

Based on the complete record before us, we do not agree with Patent Owner that “distortion” in claims 7, 14, 15, and 16, is limited to only “pulling data.” We determine that both pulling data and pushing data are encompassed within the meaning of “distortion.” Most convincing is that the Specification suggests that both operations may be used for displacement—either copying or pulling data to the current location or pushing image information from the source location in the direction specified by the vector. As described in the Specification:

The current process uses the depth selection mask and vector field to determine offsets into the image from which to copy or pull data to the current location; it is also possible to perform the inverse operation. In some embodiments, another mask can be

used in conjunction with a vector field to push image information from the source location in the direction specified by the vector. The above detailed approach is one of several approaches that may be used and is illustrative of some embodiments for practicing the invention.

Ex. 1001, 30:62–31:3. Further, the Specification describes that “[h]aving control of the strength of the application of distortion” may allow an artist “[to] push and/or warp the target shape.” *Id.* at 16:4–24 (“the displacement is pushing the slightly warped circle 211 back into a circle 213”). The collective language above indicates that the claims requiring distortion may be implemented using the described pushing operation.

Moreover, the ’628 patent does not require that the “pushing data” embodiment be excluded because the term “distortion” is used. For an embodiment to be excluded from the reach of the claims, there must be a clear indication that the embodiment was deemed to be outside the reach of the claims. *See SciMed Life Sys., Inc. v. Advanced Cardiovascular Sys., Inc.*, 242 F.3d 1337, 1343 (Fed. Cir. 2001). Here, there is no such clear indication. The term “distortion” is not linked to just “pulling data,” as Patent Owner contends, and the Specification does not disparage the “pushing data” embodiment for use in applying a distortion to a selected image.

We also have considered Patent Owner’s contentions with respect to the testimony of Dr. Vazquez and find them unpersuasive because his testimony that the claims cover distorting images by pulling pixels does not preclude the alternative embodiment of pushing pixels. *See* PO Resp. 10–11; Ex. 2006, 32:8–16, 31:2–7, 31:16–21. Indeed, both embodiments

(pulling and pushing data) are captured by the claim language as set forth above.

Based on the final record before us, we determine that the term “distortion” permits both pulling and pushing data to achieve displacing by distortion.

During oral argument, Patent Owner raised a new theory not raised in its Response or in evidence submitted with its Response. The theory is that by using the term “distortion,” a person of ordinary skill in the art would recognize distortion must avoid holes by interpolating, which is filling in potential holes with information already in the image. Tr. 21:12–24:11 (hereafter “hole theory”). Further, under the hole theory, Patent Owner contends that pulling data does not create holes because “[i]nterpolation is an inherent property of pulling.” *Id.* at 23:23–24. Similarly, Patent Owner argues that “[p]ushing does not fill the holes. Pushing creates holes.” *Id.* at 31:11–25. Thus, according to Patent Owner, by use of the term “distortion,” a person of ordinary skill in the art would recognize that claims 7, 14, 15, and 16 exclude the pushing data embodiment because distortion must mean pulling data to avoid holes. *See, e.g., id.* at 33:15–17 (“Only in the four -- the four claims that contain the word distortion is the pixel displacement specifically limited to a pull displacement.”).

First, Patent Owner has waived its arguments concerning the hole theory because they were not presented in its Response. As we stated in our Scheduling Order, “[t]he patent owner is cautioned that any arguments for patentability not raised in the response will be deemed waived.” Paper 14, 3. Patent Owner’s expert—Dr. Forsyth—also did not address the hole theory in his Declaration. *See* Ex. 2010. As noted by Petitioner during oral

argument, Patent Owner had never before taken the position that pulling is the only way to avoid holes. Tr. 60:3–11, 61:10–18; *see also* Paper 68 (Petitioner objecting that Patent Owner’s hearing demonstratives “contain[] new argument relating to holes not raised in briefing before the Board”). Therefore, we consider the arguments made related to the hole theory waived. Oral hearing cannot be the first place a theory is raised during our proceedings.

Second, even if we were to consider these new attorney arguments, we find them unpersuasive on the final record before us. To accept Patent Owner’s hole theory would require us to accept as true facts that are not supported adequately on the final record. For example, the record does not support Patent Owner’s premise that distortion in the claimed invention must always avoid holes by interpolating. *See* Tr. 62:18–64:25. There is no discussion in Patent Owner’s Response related to interpolation. Likewise, Patent Owner’s expert does not mention interpolation in his expert Declaration (Ex. 2010) or even holes in the context of claim construction. During the prosecution of the application leading to the ’628 patent, the claim language “the distortion operating to interpolate image information” was removed from application claim 1 and all other claims. Ex. 1002, 48, 91, 93, 95, 259 (application claim 1), 260 (application claim 9), 262 (application claim 13), 264; Tr. 64:12–18. Patent Owner does not address this amendment. Because the application claim requirement of “the distortion operating to interpolate image information” was purposefully removed, the claims were no longer limited to having the distortion operate to interpolate—as Patent Owner seems to argue here.

The Specification also does not equate distortion with avoiding holes, although the concepts are related. For example, the Specification describes “displacing a portion of a working image by distortion of the working image to create a modified working image,” and “the distortion operating to interpolate image information over a range of the displacement.” Ex. 1001, 5:25–33. The Specification does not, however, discuss the use of interpolation for avoiding holes in the context of pulling versus pushing data. See Tr. 64:1–11 (counsel for Petitioner arguing that the ’628 patent “never ties interpolation to pushing or pulling”).

There is also no persuasive evidentiary support in the final record that interpolation is an inherent property of pulling data as alleged by Patent Owner. The Specification does not link distortion only to pulling data. To the contrary, the Specification suggests that both pulling and pushing data may both be used in “[t]he current process,” which includes the shifting of occlusions that are filled by warping or distortion of the image. Ex. 1001, 30:62–31:3, 29:41–44, Fig. 1 (also depicting use of radial distortion).

There is neither discussion in the ’628 patent of the advantages of pulling data versus pushing data nor any mention of the distinction between the two operations. When asked during oral argument where in the Specification pulling versus pushing was contrasted, counsel for Patent Owner replied that the distinction “was well understood” and “it was well understood in the art that only pulling avoids creating holes.” *Id.* at 25:3–24. This attorney argument is not evidence and also is not persuasive without underlying factual support. See, e.g., *Gemtron Corp. v. Saint-Gobain Corp.*, 572 F.3d 1371, 1380 (Fed. Cir. 2009) (“[U]nsworn attorney argument . . . made for the first time at oral argument on appeal—is not evidence and

cannot rebut . . . other admitted evidence”). We find Patent Owner’s hole theory unpersuasive on the final record before us and therefore maintain our determination as to the meaning of “distortion,” as used in claims 7, 14, 15, and 16.

D. 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, 405 (2007). Petitioner argues that a person of ordinary skill in the art at the time of invention of the ’628 patent would have had “an undergraduate degree in electrical engineering or computer science (or an equivalent subject); a good working knowledge of computer programming, data structures, and image processing; and several years of training or practical working experience.” Pet. 18. Dr. Vazquez agrees with this assessment. *See* Ex. 1011 ¶ 23. Patent Owner does not propose a different level of ordinary skill in the art, and Patent Owner’s expert, Dr. Forsyth, opines “that Petitioner’s description of a person of ordinary skill in the art is generally accurate.” Ex. 2010 ¶ 30.

Having now considered the evidence in the complete record established during trial, based on this record, including our review of the ’628 patent and the types of problems and solutions described in the ’628 patent and cited prior art, we are persuaded by Petitioner’s assessment of the level of ordinary skill in the art and apply it for purposes of this Decision.

*C. Obviousness Ground Based on Sullivan, Tam '868, and Tam '711
(Claims 1–18)*

We instituted trial on the ground that the subject matter of claims 1–18 would have been obvious over Sullivan, Tam '868, and Tam '711. Dec. on Inst. 8–19; see Pet. 23–60. Having now considered the evidence in the complete record established during trial, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that the claims would have been obvious over those references in combination.

1. Sullivan

Sullivan discloses systems for 2D to 3D image conversion, and describes converting a 2D image into a complementary stereoscopic image pair. Ex. 1008, 1:12–13, 1:27–28. Sullivan describes “receiving a first 2D image comprising image data, where the first 2D image is captured from a first camera location,” and “projecting at least a portion of the first 2D image onto computer-generated geometry.” *Id.* at Abst. According to Sullivan, “[t]he image data has depth values associated with the computer-generated geometry” that enable rendering “a second 2-D image that is stereoscopically complementary to the first 2-D image, and infilling image data that is absent from the second 2-D image.” *Id.*

Sullivan describes both parallel and toed-in camera configurations for converting 2D images to 3D images as depicted in Figures 10A and 10B, respectively. *Id.* at 13:8–21. The parallel configuration (shown in Figure 10A) has no keystone distortion and pixels are shifted horizontally. *Id.* The toed-in configuration (shown in Figure 10B) has keystone distortion such that corners of rectangle 1002 are shown shifted both vertically and horizontally, forming trapezoid 1006. *Id.* at 18:24–32.

2. *Tam '868*

Tam '868 describes generating a depth map from a digital monoscopic color image (MCI) composed of pixels. Ex. 1004, Abst. In one embodiment, *Tam '868* describes obtaining a first color component of the MCI and then assigning depth values to pixels of the MCI based on values of the first color component of respective pixels in order to form a depth map for the MCI. *Id.* at 3:47–53, 4:21–24; *see also* Figs. 3A–3G (illustrating different stages of the color-based process of generating a depth map from a source 2D color image). *Tam '868* then uses the depth map (which was derived from a first color component) to displace pixels horizontally to make left and right stereo images. *Id.* at 4:24–27.

Tam '868 describes a technique called depth image based rendering (DIBR). *Id.* at 1:48–53. DIBR involves generating images with new camera viewpoints using information from an original monoscopic source image and its corresponding depth map containing depth values for each pixel. *Id.* at 1:47–53; *see also id.* at 4:11–17 (“utilizing a depth image based rendering (DIBR) algorithm to create at least one deviated image by processing the monoscopic color image based on the depth map, so as to form a stereoscopic image pair”).

Tam '868 identifies Zhang as describing an example of a suitable DIBR algorithm. Ex. 1004, 2:1–14, 7:29–35. Zhang describes a DIBR system for generating stereoscopic images. Ex. 1015, 1 (Abst.).⁷ According to Zhang, “[t]he most significant problem in DIBR is how to deal with

⁷ For articles and prior briefing cited by Petitioner, we rely on Petitioner’s inserted page numbering set forth at the bottom right of each page. *See* 37 C.F.R. § 42.63(d)(2).

newly exposed areas (holes) appearing in the virtual images.” *Id.* at 1. The holes are due to the accretion (disocclusion). *Id.* Zhang discloses a DIBR system with depth maps that are pre-processed using an asymmetric filter to smoothen the sharp changes in depth at object boundaries. *Id.* at Abst. The smoothing addresses disocclusion by reducing or removing newly exposed areas where potential artifacts can arise from image warping that is needed to generate images from new viewpoints. *Id.*

Zhang discloses use of both parallel and toed-in camera configurations. *Id.* at 2. For example, Zhang discloses that a parallel camera configuration is used for simplicity, but it also mentions application of toed-in cameras. *Id.* Zhang describes determining a one-dimensional vector field, and it provides formulas for horizontal displacement for the parallel camera configuration. Zhang describes determining a number, $t_x f$ in formula (3), equivalent to a one-dimensional vector field, where $t_x f$ provides the magnitude of the vector and the direction is either left or right, which constitutes a vector that depends on the camera configuration. *Id.* at 3.

3. *Tam* '711

Tam '711 is a continuation-in-part of *Tam* '868. Ex. 1006, 1:11–19. Petitioner relies on *Tam* '711 for its additional disclosure of graphical user interface elements required by certain dependent claims, as well as its disclosure of depth modification rules. Pet. 20, 42 (citing Ex. 1006, 15:3–17). For example, *Tam* '711 describes a graphical user interface for comparing Region Visualization Image (mask) 330 with Original Depth Map 320 and Modified Depth Map 340. Ex. 1006, Fig. 3. *Tam* '711 also describes ranges and adjustments for the depth map in user input areas 350, 355, and 360 in Figure 3. *Id.*

4. Claims 1–6, 8–13, 17, and 18

In its Response, Patent Owner states: “Patent Owner concedes that, under the Board’s interpretation of ‘depth selection mask’ as laid out in its Institution Decision (Paper No. 13), the other claims [claims 1–6, 8–13, 17, and 18] in the Bond Patent are unpatentable over the references cited in the Petition.” PO Resp. 1; *see also* Mot. to Amend 1 (“Patent Owner elects to cancel these claims and moves to amend them on a non-contingent basis”). Accordingly, we determine that claims 1–6, 8–13, 17, and 18 are unpatentable.

5. Claims 7, 14, 15, and 16

With respect to claims 7, 14, 15, and 16, we have reviewed Petitioner’s analysis and supporting Declarations, as well as Patent Owner’s contentions and supporting Declaration, and are persuaded that Petitioner has proved by a preponderance of the evidence that claims 7, 14, 15, and 16 would have been obvious over Sullivan, Tam ’868, and Tam ’711. We examine the parties’ contentions for each of these claims in turn.

Claim 7 depends from claim 1. Ex. 1001, 37:47–55. Petitioner’s element-by-element analysis demonstrates where each limitation of claim 7 is found in the Sullivan, Tam ’868, and Tam ’711 combination. Pet. 43–44; Ex. 1011 ¶¶ 203–209. Petitioner identifies the claimed “a second image” as being taught by Tam ’868’s “a second deviated image,” and Petitioner identifies the final portion of this claim, “replacing a selected image in a stereo pair of images with the second image” (the “second deviated image”) as being taught by Tam ’868’s use of the second deviated image to form the image pair. Pet. 43 (citing Ex. 1004, 15:33–42); Ex. 1011 ¶¶ 203–206. Petitioner shows that Zhang’s disclosure of “the . . . right-eye images can be

generated from the original center image and its depth map,” (Ex. 1005 ¶ 26) teaches “apply[] the depth selection mask to a second image” limitation of claim 7. Pet. 43 (citing Ex. 1015, 3). Further, Petitioner establishes persuasively that Zhang’s formula (3), and specifically the sign and opposite sign of formula (3), teaches “displace the second image in a direction opposite the displacement of the working image.” *Id.* (emphasis omitted); Ex. 1011 ¶ 207. Petitioner contends that Zhang teaches “displacing by distortion of the second image” because the displacement formula in Zhang warps the image, which distorts the second image with respect to the first image. *Id.* at 43–44; Ex. 1011 ¶ 209.

Claim 14 is a system claim and because claim 14 is similar in scope to method claim 7, Petitioner relies on the analysis of claim 7 set forth above. Ex. 1001, 39:10–21; Pet. 54. Claim 14 depends from claim 13, which depends from claim 12. Petitioner’s element-by-element analysis demonstrates where each limitation of claim 14 is found in the Sullivan, Tam ’868, and Tam ’711 combination. *Id.* at 54–55; Ex. 1011 ¶¶ 253–254. Petitioner identifies the claimed “the processor further configured to, in response to a second input signal” as being taught by Tam ’711’s accepting an input button selection, such as “Add Changes” as depicted in Figure 9. Pet. 54; Ex. 1011 ¶ 254.

Claim 15 depends from claim 12. Ex. 1001, 39:22–40:2. Petitioner’s element-by-element analysis demonstrates where each limitation of claim 15 is found in the Sullivan, Tam ’868, and Tam ’711 combination. Pet. 55–56; Ex. 1011 ¶¶ 258–259. Petitioner identifies the claimed “distort at least part of a selected image from the stereo pair of images by applying a distortion to the selected image” as being taught by Zhang’s generation of a stereo pair of

images by shifting pixels left or right from an original image. Pet. 55. Petitioner contends that Zhang “refers to the shifting of pixels left and right in the stereo pair as ‘image warping,’” and “[i]mage ‘warping’ is synonymous with ‘distortion.’” *Id.*; Ex. 1011 ¶ 256. According to Petitioner, “distortion,” (“3D image warping”) is “applied” by shifting pixels left or right based on the depth map. Pet. 55; Ex. 1011 ¶ 257. Petitioner contends that the “distortion” of claim 15 may include pixel displacement in two opposite directions for left and right images as taught by Zhang because “distortion” describes displacing of pixels to form the left and right images in a stereo pair. Pet. 55. Petitioner further contends that the claimed “processor being further configured, on receiving a command from the input device” is taught by Tam ’711’s “Add Changes” button depicted in Figure 9. *Id.* The “Add Changes” button modifies the depth map resulting in applying a distortion to the selected image because the distortion, or image warping, between left and right images is dependent on the depth map. *Id.*

Claim 16 depends from claim 12 and claim 16 is nearly identical in scope to claim 15, except that the processor is configured to “remove a distortion” instead of to “distort.” Ex. 1001, 40:3–40:7. Petitioner’s element-by-element analysis demonstrates where each limitation of claim 16 is found in the Sullivan, Tam ’868, and Tam ’711 combination. Pet. 56–57; Ex. 1011 ¶¶ 260–261. Petitioner establishes persuasively how applying a distortion by changing a value, such as depicted in Figure 9 of Tam ’711, would allow a distortion to be removed by undoing the change or by changing the value back to the previous value. Pet. 57; Ex. 1011 ¶ 261.

Patent Owner’s contentions with respect to claims 7, 14, 15, and 16 rest on its proposed construction of “distortion” to mean just “pulling data.”

See PO Resp. 12–22. Patent Owner contends “Zhang’s Formula 3 (its ‘displacement formula’) actually teaches only pushing data, whereas the Bond Patent’s ‘distortion’ requires pulling data.” *Id.* at 12. For the reasons set forth above, we determine that “distortion” is not limited to pulling data. Because the claim scope of “distortion” also encompasses pushing data, we find Patent Owner’s contentions unpersuasive. The evidence relied on by Petitioner persuades us that Zhang teaches the “distortion” limitations of claims 7, 14, 15, and 16 as detailed above.

Petitioner also proposes alternatively that “even if Prime’s overly narrow construction were adopted, the prior art still renders the Disputed Claims obvious.” Pet. Reply 31. Specifically, Petitioner contends that Zhang formula (3) teaches either pushing or pulling data. *Id.* at 31–35; Ex. 1015, 3.

Patent Owner contends that Zhang formula (3) teaches only pushing data because the displacement vector for the left eye (x_l) points to the right as evidenced by the “add” operator and such a displacement would be “in the same direction as the displacement vector (i.e., downstream towards the tip of the displacement vector), which is the definition of push displacement” from the ’628 patent. PO Resp. 12–13. Patent Owner relies on cross-examination testimony of Dr. Vazquez where he agreed that the Zhang formula takes a pixel and pushes it to the right by a specific amount. *Id.* at 14–15.

Petitioner contends that Zhang formula (3) teaches how much, and in which direction, the left and right pixels shift from their original position x_c . Pet. Reply 31. The formula, according to Petitioner, shows that the left pixel shifts in a first direction by the described amount in the formula and that the

right pixel shifts the same amount in the opposite direction as indicated by the minus sign. *Id.*; Ex. 1036 ¶ 42. Thus, Petitioner argues that the formula does not mandate pushing, but pulling could also be achieved according to the formula. Petitioner relies on the testimony of Dr. Vazquez, who testified that formula (3) teaches both pushing and pulling data after it was clarified that the pushing was not just referring to generally moving the pixel. Pet. Reply 31–34.

We agree with Petitioner that, even if the meaning of “distortion” were limited to just “pulling data,” Zhang’s displacement formula (3) would still teach “distortion.” Ex. 1015, 3. Specifically, we have weighed Dr. Vazquez’s testimony and we find persuasive his statement that “[o]ne of ordinary skill in the art reading Zhang would understand that the vectors could be assigned to implement the displacement as either a pushing or a pulling operation,” because “[t]he plus and minus signs in the equation indicate that one pixel is shifted to the right and the other is shifted to the left.” Ex. 1036 ¶ 42; Tr. 68:19–70:25. Further, when questioned by counsel for Patent Owner as to how Dr. Vazquez knows that “Zhang is implemented by pulling, according to the definition of pull in by the ’628 [patent],” Dr. Vazquez responded that he knows “[b]ecause I worked on this with them. I know they did it.” Ex. 2006, 44:9–45:4. Patent Owner did not raise any objections to the admissibility of this statement by Dr. Vazquez, we therefore treat it as persuasive as to the operation of Zhang.

For the reasons discussed above, we conclude that Petitioner has proved by a preponderance of the evidence that claims 7, 14, 15, and 16 would have been obvious over Sullivan, Tam ’868, and Tam ’711.

III. MOTION TO AMEND

In its Motion to Amend, Patent Owner cancelled original claims 1–6, 8–13, 17, and 18 and moved, on a non-contingent basis, to substitute amended claims 19–24, 26–31, 35 and 36. Mot. to Amend 1, App’x 23–31. Patent Owner also moves, on a contingent basis, to substitute amended claims 25 and 32–34 in the event that we find claims 7 and 14–16 to be unpatentable. *Id.* We have determined that claims 7 and 14–16 are unpatentable. Accordingly, we consider each proposed substitute claim in Patent Owner’s Motion to Amend.

As the moving party, Patent Owner bears the burden of proof to establish that it is entitled to the relief requested. *See* 37 C.F.R. § 42.20(c). Entry of proposed amendments is not automatic, but occurs only upon the patent owner having met the requirements of 37 C.F.R. § 42.121 and demonstrating the patentability of the proposed substitute claims. *See MasterImage 3D, Inc. v. RealD Inc.*, Case IPR2015-00040 (PTAB July 15, 2015) (Paper 42, “*MasterImage*”) (precedential); *Idle Free Sys., Inc. v. Bergstrom, Inc.*, Case IPR2012-00027, slip op. at 7–8 (PTAB June 11, 2013) (Paper 26, “*Idle Free*”) (informative); *see also Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1307–08 (Fed. Cir. 2015) (upholding the approach established in *Idle Free* of allocating to the patent owner the burden of showing the patentability of any proposed substitute claims). For the reasons explained below, we conclude that Patent Owner has not met its burden with respect to proposed substitute claims 19–36.

A. Proposed Substitute Claims

Patent Owner proposes to substitute independent claims 19 and 30 for independent claims 1 and 12, respectively. Proposed substitute claim 19 is

reproduced below, with underlining showing the subject matter added to claim 1:

19. (Proposed Substitute for Claim 1) A process for creating a three dimensional media projection from a two-dimensional image, comprising:

copying a two-dimensional image to create a working image, that has an imaging plane, of the two dimensional image;

creating a depth selection mask, without determining the numeric distance from a reference to a point off the working image's imaging plane for any pixel in the working image, that is associated with at least one characteristic of only the working image and associated with at least a portion of only the working image, including:

selecting a set of image features, and

determining a real value in a normalized range for the set of selected image features for each pixel location in the portion of the working image;

determining a vector field of each pixel of the portion of the working image;

applying the depth selection mask to the vector field of the portion of the working image to create a weighted displacement mask having a displacement vector associated with each pixel of the portion of the working image, the displacement vector having a magnitude and direction;

displacing each pixel of the portion of the working image in accordance with the magnitude of the vector associated with that pixel to create a modified working image; and

creating a stereo pair of images by pairing the two dimensional image with the modified working image.

Mot. to Amend, App'x 23–24. Proposed independent claim 30 is reproduced below.

30. (Proposed Substitute for Claim 12) system for creating a three-dimensional media projection from a two-dimensional digitized image, comprising:

a video monitor configured to display a stereo pair of images in response to a video signal;

an input device configured to generate input signals, and configured to select a working image from a group of images, the working image being a copy of an image selected from the group of images and having an imaging plane, and configured to select characteristics of the working image;

a control configured to generate control signals, and configured to assign a value to a characteristic selected by the input device; and

a processor in operable communication with the monitor, the input device and the control, the processor configured to displace a portion of the working image by

creating a depth selection mask, without determining the numeric distance from a reference to a point off the working image's imaging plane for any pixel in the working image, that is associated with at least one characteristic of only the working image and associated with at least a portion of only the working image, including

selecting a set of image features and determining a real value in a normalized range for the set of selected image features for each pixel location in the portion of the working image, determining a vector field of each pixel of the portion of the working image,

applying the depth selection mask to the vector field of the portion of the working image to create a weighted displacement mask having a displacement vector associated with each pixel of the portion of the working image, the displacement vector having a magnitude and direction,

displacing each pixel of the portion of the working image in accordance with the magnitude of the vector associated with that pixel to create a modified working image; and

wherein the video monitor, in response to a second input signal, displays the modified working image as part of the stereo pair of images.

Id. at 28–29. Below we examine whether proposed substitute claims 19–36 would have been obvious in light of the prior art cited in the Petition.⁸

B. Claim Construction

Patent Owner contends that “none of the additional claim terms require construction and that they should carry their ordinary and customary meaning.” Mot. to Amend 17. Patent Owner proposes “to clarify” how a person of ordinary skill in the art would understand three claim terms – “numeric,” “reference,” and “only the working image.” *Id.* at 17–18. Petitioner contends that Patent Owner’s proposed clarifications are a “guise,” either to attempt to construe the terms or to distinguish the prior art based on terms not present in the claims. Opp. to Mot. to Amend 3. Petitioner does not, however, offer any counter claim construction positions for these terms. We need only construe terms “that are in controversy, and only to the extent necessary to resolve the controversy.” *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999). We need not construe the claim terms that Patent Owner proposes to clarify because those clarifications are not material to the obviousness dispute. Patent Owner’s arguments with respect to these claim terms do not impact our analysis as set forth below.

⁸ Given our disposition of this issue, we need not address other arguments made by Petitioner, including that the proposed amendments are not supported by the Specification, broaden the substitute claims, and render the claims indefinite. See Opp. to Mot. to Amend 3–10.

C. Obviousness

We deny Patent Owner's Motion to Amend on the basis that proposed substitute claims 19 and 30, the only claims amended substantively by the motion, are unpatentable under 35 U.S.C. § 103(a) as obvious. Petitioner has demonstrated, with supporting testimony from Dr. Vazquez (Ex. 1036), that the subject matter of proposed substitute claims 19 and 30 is unpatentable over the original prior art combination asserted against each claim – Sullivan, Tam '868, and Tam '711.

1. Claims 19 and 30

Patent Owner contends that proposed substitute claims 19 and 30 are patentable over the prior art of record including art Petitioner identified in the Petition. Mot. to Amend 2–17; Reply to Mot. to Amend 10–12. To distinguish that art, Patent Owner relies on the added limitation requiring

creating a depth selection mask, without determining the numeric distance from a reference to a point off the working image's imaging plane for any pixel in the working image, that is associated with at least one characteristic of only the working image and associated with at least a portion of only the working image.

Mot. to Amend 1–2 (underling in original showing added claim limitations). According to Patent Owner, “[t]here are two types of closest prior art: (1) depth maps and (2) disparity maps” and “[t]he proposed amendments are specifically designed to sidestep any arguable overlap between either of these concepts and the claimed invention.” *Id.* at 2. Patent Owner argues the newly added limitations differentiate the prior art containing depth maps with distance values. *Id.* at 9.

As support for the amendment, Patent Owner points to the '628 patent's disclosure of creating a depth selection mask “[u]sing the set of

image features chosen in 3(a) above.” Mot. to Amend 19 (quoting Ex. 1001, 25:31–39). The ’628 patent describes the “set of image features” in 3(a) as “for example, color, optical flow, and the like” and as “one or more of . . . luminance, saturation, and color,” including, for example, “Red, Green, and Blue channels,” and “Hue, Saturation, and Value channels,” and states, “[s]uch additional features could include but are not limited to gradient (edge) information, texture, optical flow, and the like.” Ex. 1001, 25:8–31. In fact, an “image feature” may be “any information that is either present in or can be derived from the image.” *Id.* at 25:10–12.

Petitioner contends that the Board should deny Patent Owner’s Motion because substitute claims 19 and 30 are unpatentable as obvious over Sullivan, Tam ’868, and Tam ’711. Opp. to Mot. to Amend 11–15. Petitioner contends Tam ’868 teaches the newly added limitations of claims 19 and 30. *Id.* at 12. Petitioner relies on Tam ’868 as creating a depth map from a digital monoscopic color image (MCI). *Id.*; Ex. 1036 ¶¶ 47–50. Tam ’868 obtains a first color component of the MCI and then assigns depth values to pixels of the MCI based on values of the first color component of respective pixels in order to form a depth map for the MCI. *Id.* (citing Ex. 1004; 3:47, 4:21–24). Thus, according to Petitioner, Tam ’868 teaches creating a depth selection mask “without determining the numeric distance” by using color instead.

Petitioner contends that Patent Owner’s position that Tam ’868’s depth maps must contain a distance value representing a distance from a reference to a point off of the imaging plane is incorrect. *Id.* at 12–13. Instead, Petitioner contends that Tam ’868’s teaching of assigning a depth value that indicates a relative or absolute distance does not require

“determining” an actual distance. *Id.* at 13. Relying on the testimony of Dr. Vazquez, Petitioner contends that “color (i.e., Chroma) may be used as a ‘substitute for the depth information in order to construct stereoscopic images.’” *Id.* (quoting Ex. 2006 at 54:10–56:3 and citing Ex. 2004, Abst., Figs. 1–3C). Petitioner argues that Tam ’868 teaches the newly added limitations because Tam ’868 “discloses the use of color information to create a depth selection mask without determining a numeric distance.” *Id.*; Ex. 1036 ¶¶ 47–50. Petitioner explained during oral argument that “there are still embodiments in Tam where it never determines a numeric distance,” because, instead, Tam ’868 “simply adopts the chroma component of each of the pixels in a working image, and it creates a depth map based on that.” Tr. 51:3–23.

Petitioner also contends that Tam ’868’s methodology of using color, or Chroma, is similar to that described in the ’628 patent because both teach using color as a feature to create a depth selection mask as an indication of non-numeric distance. Opp. to Mot. to Amend 13 (citing Ex. 1042, 58:7–19; 150:7–11). Thus, according to Petitioner, “Tam ’868 describes an example embodiment of creating a synthetic depth map that maps squarely onto the new limitation added by Patent Owner.” *Id.*; Ex. 1036 ¶¶ 47–50.

Petitioner contends that Tam ’868 teaches an embodiment that uses color as a substitute for depth information and thus creates the mask “without determining the numeric distance from a reference to a point off the working image’s imaging plane for any pixel in the working image” as required by claims 19 and 30. Opp. to Mot. to Amend 13–14. Further, Petitioner argues that Tam ’868’s synthetic depth map is created using Chroma values of a single frame image as described and shown with

reference to Figs. 2–3C. *Id.* at 14 (citing Ex. 1004, 12:56–13:33; 19:10–13). Further, Petitioner argues that Tam ’868’s synthetic depth map is created by determining the Chroma component for pixels, such as in the red circle 55 and/or green triangle 66 of Figure 3A, and the code provided in Tam ’868 establishes “that the synthetic depth map is created ‘without determining the numeric distance from a reference . . . for any pixel in the working image.’” *Id.* (citing Ex. 1004, 12:56–13:33, App’x). Petitioner relies upon this code, and the expert testimony of Dr. Vazquez, to establish that Tam ’868 does not require a numeric distance from a reference to a point off the working image’s imaging plane and “that for each iteration of the process, the Cr component is extracted from the pixels of only a single frame.” *Id.* at 15 (citing Ex. 1036 ¶¶ 47–50).

In response to Petitioner’s arguments, Patent Owner contends that Tam ’868’s depth maps contain depth values, which are numeric distances from a reference to a point. Reply to Mot. to Amend 10 (citing Ex. 1004 at 1:55–60). Further, Patent Owner contends Tam ’868’s depth values are set by direct reference to the color values of the underlying pixel. *Id.* (citing Ex. 1004 at 9:11–16). Patent Owner contends that Tam ’868’s color (or Chroma Cr) is still being used as an indicator of distance—“color values are depth value”—thus Tam ’868 cannot teach the claim requirement of “creating a depth selection mask, without determining the numeric distance from a reference to a point off the working image’s imaging plane for any pixel in the working image.” *Id.* at 11 (citing 1004 at 13:25–28; Ex. 1042, 150:2–6); *see also* Tr. 41:11–42:2.

Based on the complete record before us, we determine that Petitioner has established that the newly added limitations do not patentably

distinguish claims 19 and 30 over the combination of Sullivan, Tam '868, and Tam '711. Specifically, we agree with Petitioner that Tam '868 teaches the newly added claim limitations of claims 19 and 30. Patent Owner's arguments are also not persuasive. Specifically, the disclosures in Tam '868 that Patent Owner cites (Reply to Mot. to Amend 10–11, 18) do not imply that a numeric distance is determined; they are, instead, consistent with Petitioner's contention that Tam '868, like the '628 patent itself, may use color as a *proxy* for numeric distance. Both the '628 patent and Tam '868 allow for the transformation of color, or Chroma, into a depth selection mask. Ex. 1001, 32:7–24, Fig. 4 (“ChromaKeyer1”); Ex. 1004, Abst., 11:64–12:26, 12:56–13:33, 16:40–56; Tr. 37:21–38:11 (“Color could be a feature if it's – if it's distinct to the object, yes.”); *id.* at 51:3–10. The synthetic depth map of Tam '868 is created by determining the Chroma component for pixels and this determination is distinct from the determination of numeric distance. Ex. 1004, Abst., 11:64–12:26, 12:56–13:33. We find particularly persuasive the testimony of Dr. Vazquez that “Tam '868 discloses an embodiment that creates a synthetic depth map based on Chroma characteristic derived from a portion of an individual image frame, without ever determining the numeric distance from a reference to a point off the working image's imaging plane for any pixel in the working image.” Ex. 1036 ¶ 48. Tam '868 details that in one embodiment, “the Cr component is then used as the depth map, i.e. each pixel of the MCI 5 is assigned a depth value equal to the value $Cr(m,n)$ of the Cr component 15 for the corresponding pixel.” Ex. 1004, 9:56–61; *see also* Tr. 52:18–53:12 (“they simply assign the depth as the color value. The -

- the chroma value itself is used. They don't do any scaling or any transforming of it. They just adopt it.”).

We also find persuasive Dr. Vazquez's explanation that “[t]he Chroma characteristic is derived from the pixel information, both associated with only the working image (the subject image frame).” *Id.* Similarly, Dr. Vazquez testifies that “[t]he depth map (depth selection mask) in Tam '868 is represented as a greyscale image in a normalized range (0-255), with no direct relationship to the real depth in the scene.” *Id.*; *see also* Ex. 1004, 12:62–13:5, 12:2–16. In the embodiment of Tam '868 relied on by Petitioner, the origin of the depth information is the chroma component Cr, thus, no direct relationship exists between the value of the generated depth and the real distance between an object and the imaging plane. Further, the synthetic depth map of Tam '868 is a depth selection mask as set forth in the proposed claims. *See* Ex. 1036 ¶ 49. We find persuasive Dr. Vazquez's testimony that Tam '868 describes executing instructions for each new image frame, which teaches that the characteristics used to create the depth map come only from the working image, and are associated with at least a portion of only the working image as further required claims 19 and 30. *Id.*

As for the remaining limitations of claims 19 and 30, Patent Owner has conceded the combination of prior art teaches the claim limitations as found in original claims 1 and 12. PO Resp. 1. Considering that Tam '868 teaches the newly added claim limitations, the combination of references teach each and every limitation of proposed substitute claims 19 and 30, as well as the subject matter of each claim as a whole. Likewise, Petitioner provides persuasive rationales in the Petition as to why a person of ordinary skill in the art would have combined the teachings of Sullivan, Tam '868,

and Tam '711, and these rationales are also not challenged by Patent Owner. *See* Pet. 20–23.

After considering the parties' arguments and evidence, we find that Petitioner has established that the newly added limitations do not patentably distinguish claims 19 and 30 over the prior art. Rather, the evidence in the complete record established during trial demonstrates that claims 19 and 30 would have been obvious to a person of ordinary skill in the art based on Sullivan, Tam '868, and Tam '711.

3. Claims 20–29 and 31–36

Apart from the correction of typographical errors, and changing their dependency, claims 20–29 and 31–36 have not otherwise been substantively amended. *See, e.g.*, Mot. to Amend, 1, n. 1, App'x 25 (claim 23 deleting “characteristic”). Because Patent Owner's amendments to the remaining dependent claims 20–29 and 31–36 simply change the dependency from the original independent claims to the proposed substitute claims, and because Patent Owner makes no separate argument directed to any dependent claim, we likewise deny Patent Owner's Motion to Amend as to these dependent claims. After considering the parties' arguments and evidence, the evidence in the complete record established during trial demonstrates that claims 20–29 and 31–36 would have been obvious to a person of ordinary skill in the art based on Sullivan, Tam '868, and Tam '711.

D. Conclusion

We deny Patent Owner's Motion to Amend on the basis that claims 19–36 are unpatentable under 35 U.S.C. § 103(a) over Sullivan, Tam '868, and Tam '711.

IV. SUMMARY

Petitioner has demonstrated, by a preponderance of the evidence, under 35 U.S.C. § 103(a), that claims 1–18 are unpatentable over Sullivan, Tam '868, and Tam '711.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–18 of the '628 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude the Second Declaration of Carlos Vazquez is *denied*;

FURTHER ORDERED that Patent Owner's Motion to Amend is *denied*;

FURTHER ORDERED that Patent Owner's Demonstratives (Paper 70, Exhibit 2015, and Exhibit 2016) are expunged; and

FURTHER ORDERED that Paper 49 is expunged as a duplicative filing.

This is a final written 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.

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