

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MEDIVIS, INC.,
Petitioner,

v.

NOVARAD CORP.,
Patent Owner.

IPR2023-00045
Patent 10,945,807 B2

Before MIRIAM L. QUINN, *Acting Vice Chief Administrative Patent Judge*,
MICHAEL R. ZECHER and SCOTT RAEVSKY, *Administrative Patent Judges*.

RAEVSKY, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
Dismissing Motion to Exclude
35 U.S.C. § 318(a)

I. INTRODUCTION

Medivis, Inc. (“Petitioner”) filed a Petition to institute an *inter partes* review of claims 1–7 (the “challenged claims”) of U.S. Patent No. 10,945,807 B2 (“the ’807 patent,” Ex. 1001). Paper 3 (“Pet.”). Novarad Corp. (“Patent Owner”) did not file a Preliminary Response. Based on the information presented in the Petition, we instituted an *inter partes* review of claims 1–7 (Paper 7).

Subsequent filings include a Patent Owner Response (Paper 12, “PO Resp.”), a Petitioner Reply (Paper 20, “Reply”), and a Patent Owner Sur-reply (Paper 22, “Sur-reply”). Petitioner also filed a Motion to Exclude (Paper 25, “Mot.”). Patent Owner filed an Opposition to Petitioner’s Motion to Exclude (Paper 26, “Opp.”). Petitioner filed a Reply in Support of Petitioner’s Motion to Exclude (Paper 27). We held an oral hearing on January 30, 2024, a transcript of which has been entered into the record (Paper 35, “Tr.”).

We have jurisdiction over this proceeding under 35 U.S.C. § 6(b). After considering the evidence and arguments of the parties, we determine that Petitioner has proven by a preponderance of the evidence that claims 1–4, 6, and 7 are unpatentable but *has not* proven by a preponderance of the evidence that claim 5 is unpatentable. We also dismiss Petitioner’s Motion to Exclude.

A. *Real Parties in Interest*

Each party identifies itself as the real party in interest. Paper 5, 2¹; Paper 6, 1.

¹ Patent Owner’s Mandatory Notices, filed in accordance with 37 C.F.R. § 42.8, do not include page numbers. Paper 5. We consider the Title page as page 1 and then proceed from there in numerical order.

B. Related Matters

The parties identify *Novarad Corp. v. Medivis, Inc.*, No. 21-1447-GBW (D. Del. 2021) as a related matter. Paper 5, 2; Paper 6, 1. Petitioner also filed IPR2023-00042, requesting review of U.S. Patent No. 11,004,271, which Petitioner describes as listing the same inventors as the '807 patent and is generally directed to similar technology, but which is not part of the '807 patent family. Pet. 3.

C. The '807 Patent

The '807 patent relates to “a system and method for using mixed reality or augmented reality devices to improve surgical, interventional radiologic, cardiac, or other medical procedures.” Ex. 1001, 2:22–25. The '807 patent discloses that “[a]n augmented reality device, such as an augmented reality (AR) headset, may be used to overlay . . . images onto a real world scene (e.g., what user is viewing in the real world) using images projected on lenses or a screen that is partially transparent,” such as overlaying a magnetic resonance image (MRI) in an area where an operation is going to occur. *Id.* at 2:25–30, 3:6–7. According to the '807 patent,

[a] facet of this ability to overlay images is the cameras that exist in the augmented reality headset to create a contextual map of the space in which the patient lies and allows 3D patient data such as a hologram of images obtained prior to surgery to be merged with the real world of patient anatomy.

Id. at 3:10–15.

Figure 1A of the '807 patent is reproduced below.

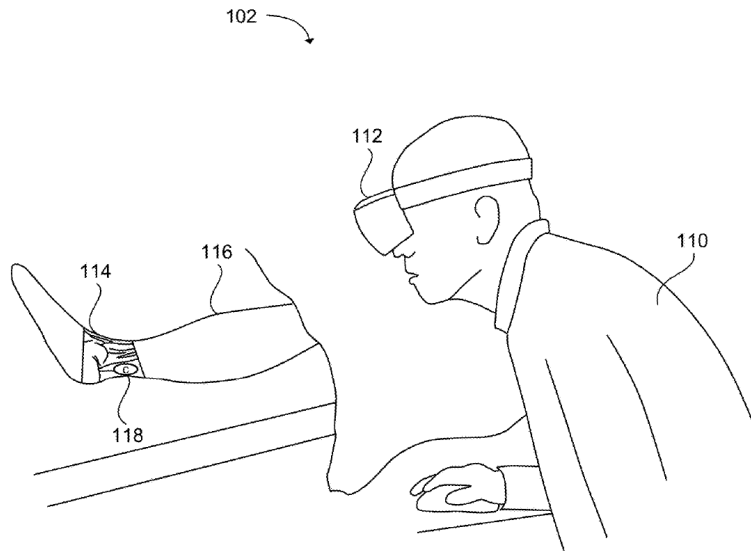


Figure 1A is an illustration of an example use of an augmented reality headset to augment a medical procedure with acquired medical images. *Id.* at 1:46–48. A medical professional sets up AR headset 112 in surgery area 102, and AR headset 112 receives an image of patient anatomy 116 using a visual image camera in AR headset 112. *Id.* at 3:16–21. Acquired medical image 114 associated with patient anatomy 116, such as an MRI or computed tomography (CT) image, is fed via a wireless connection to AR headset 112, and is associated with or anchored to patient anatomy 116 in the real-world scene so that when a doctor moves, “acquired medical image 114 can remain fixed in the correct spot with respect to the patient’s anatomy and does not move around in the doctor’s vision.” *Id.* at 3:21–36.

Augmentation tag 118 “may be configured to conform to a three dimensional (3D) structure in the acquired medical image 114 or radiological image to identify an anatomical structure associated with a medical procedure to be performed.” *Id.* at 3:37–43. The '807 patent discloses that “[t]he augmentation tag may be a simple geometric shape such as a circle, square, triangle, or another more complex shape in two

dimensions or three dimensions, such as an outline of the anatomy in question.” *Id.* at 3:43–46. Acquired medical image 114 and augmentation tag 118 are then “projected onto the lenses of the augmented reality headset 112 to form a single graphical view for the medical professional(s) wearing the AR headset 112” and, as a result, “the acquired medical image 114 and augmentation tag 118 may appear as though the images are overlaid directly on the patient anatomy.” *Id.* at 4:35–41.

D. Challenged Claims

Claim 1 is representative of the challenged claims and is reproduced below.

1. [1a] A method for augmenting medical imaging of a patient, the medical imaging displayed using an augmented reality headset worn by a medical professional, the method comprising:
 - [1b] receiving a visual image of patient anatomy captured by a visual image camera, the visual image comprising a viewable portion of the patient anatomy;
 - [1c] retrieving an acquired medical image associated with the patient anatomy from data storage, the acquired medical image comprising imaging acquired of one or more anatomical structures at a plurality of anatomical layers of the patient anatomy;
 - [1d] associating the acquired medical image to align with the viewable portion of the patient anatomy captured by the visual image camera, wherein the one or more anatomical structures of the medical imaging at the plurality of layers are aligned with the visual image of the patient anatomy;
 - [1e] retrieving an augmentation tag from data storage, the augmentation tag associated with a location in one layer of the acquired medical image, the augmentation tag identifying at least one anatomical structure of the acquired medical image found at the location; and
 - [1f] projecting the acquired medical image and the augmentation tag using the augmented reality headset to form a single graphical

view as an overlay to the patient anatomy viewable through a lens of the augmented reality headset.

Ex. 1001, 15:23–50 (bracketed material added).

E. Asserted Grounds

Petitioner asserts that claims 1–7 would have been unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §²	Reference(s)/Basis³
1–7	102	Jones ⁴
1–7	103	Jones
1–7	102	Doo ⁵
1–7	103	Doo

Pet. 15. Petitioner relies on the Declaration of Peter Kazanzides, Ph.D. (Ex. 1009) in support of its contentions. Patent Owner relies on the declaration of Mahesh S. Mulumudi, M.D. (Ex. 2002).

II. ANALYSIS

A. Level of Ordinary Skill in the Art

Petitioner contends that a person having ordinary skill in the art would have had

a bachelor’s degree in computer science, electrical engineering, or a related field with several years of experience in the design, development, and study of augmented reality devices and either (a) familiar with conventional medical imaging data and

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284 (2011), revised 35 U.S.C. §§ 102 and 103 effective March 16, 2013. Because the earliest claimed priority date of the ’807 patent is February 21, 2017, the AIA versions of §§ 102 and 103 apply.

³ Throughout this Decision, we eliminate the parties’ italicization of reference names from quotations without noting “emphasis omitted.”

⁴ Jones, US 2016/0225192 A1, published August 4, 2016 (Ex. 1007).

⁵ Doo, WO 2015/164402 A1, published October 29, 2015 (Ex. 1008).

visualization of data for medical procedures or (b) working with a team including someone with such familiarity.

Pet. 10 (citing Ex. 1009 ¶¶ 19–24). Patent Owner does not dispute Petitioner’s proposed level of skill. *See generally* PO Resp.

We adopt Petitioner’s proposed level of skill, except that we excise part of Petitioner’s definition to produce the following modified version:

a bachelor’s degree in computer science, electrical engineering, or a related field with several years of experience in the design, development, and study of augmented reality devices and . . . familiarity with conventional medical imaging data and visualization of data for medical procedures

Our edit removes the alternative of “working with a team including someone with such familiarity” because one’s role in a team may be tangential to medical imaging. Regardless, had we adopted Petitioner’s original definition, our decision would not have changed.

B. Claim Construction

We construe each claim “in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b) (2022). Under this standard, claim terms are generally given their plain and ordinary meaning as would have been 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). Only those terms in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019).

The parties propose constructions for the following claim terms.

1. “*acquired medical image*”

Both Petitioner and Patent Owner propose constructions for “acquired medical image” in claim 1. Pet. 11; PO Resp. 9. As the parties argue this term extensively, we discuss it in detail.

a) *Overview of the parties’ arguments*

In this section, we present merely an overview of the parties’ main claim construction arguments. We address the parties’ remaining claim construction arguments in the following sections.

Petitioner proposes the following construction for “acquired medical image”: “an MRI, fMRI, fluoroscopy, mammography, CT, sonography, X-rays, nuclear medicine, ultrasound, computer generated images (CGI), photos, video, or other types of acquired or synthesized medical images.”

Pet. 11. Petitioner notes that the ’807 patent states:

acquired medical images may be MRI (magnetic resonance imaging), fluoroscopy, CT (computed tomography), sonography, . . . or other types of acquired or synthesized medical images. . . . [They] may [also] be . . . acquired using medical imaging techniques such as . . . fMRI (function magnetic resonance imaging, . . . , mammography, . . . , X-rays, . . . or any other medical imaging technique.

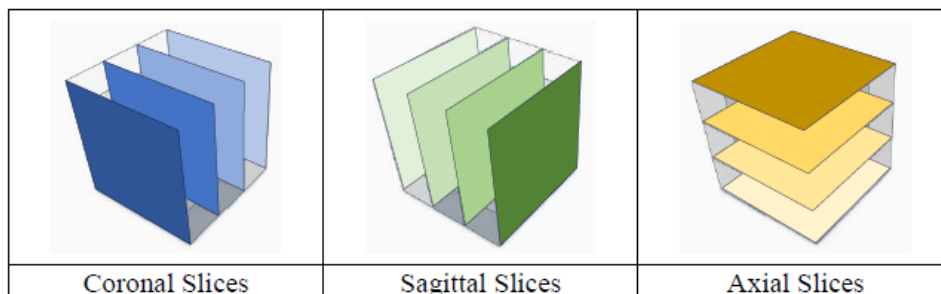
Id. at 10 (quoting Ex. 1001, 2:32–36, then quoting *id.* at 5:16–27).

Patent Owner proposes construing this term as “3D direct-volume rendered medical imaging of the anatomy of a patient, comprising one or more anatomical structures at a plurality of anatomical layers.” PO Resp. 9. Patent Owner describes direct volume rendering (DVR) as “a method for visualizing medical imaging data, including combined CT and MRI scans or ultrasound data, in three-dimensions.” *Id.* at 5 (citing Ex. 2002 ¶ 54). According to Patent Owner, “DVR can offer perspectives that are not

limited to the traditional planes (e.g., axial, sagittal, and coronal),⁶ enabling a view of the anatomical structures within the volume of a patient from any direction.” *Id.* (citing same). In other words, Patent Owner argues, “DVR creates a 3D image by considering every individual voxel [a pixel representing a small volume element] in the dataset allowing for the visualization of internal structures, and not just outer surfaces of a particular anatomical feature.” *Id.* at 6 (citing same), 3 (citing Ex. 2002 ¶ 49 (defining voxel)).⁷

Patent Owner reasons that because the claim refers to “an acquired medical image comprising . . . **a plurality of anatomical layers**” and

⁶ Dr. Mulumudi explains that CT and MRI imaging create “a set of 2D images or slices” that are “conventionally reconstrued along one of three planes: coronal (front to back), sagittal (left to right), or axial (top to bottom),” as shown in the figure below:



Ex. 2002 ¶¶ 48–50. The above figure depicts examples coronal, sagittal, and axial slices. Dr. Mulumudi further explains that such 2D scans “provide[] no information about the patient anatomy between the slices.” *Id.* ¶ 49.

⁷ Dr. Mulumudi testifies that, in contrast to DVR, “surface rendering . . . involves creating a 3D surface model,” which includes “performing a segmentation step to identify the voxels within the original 3D dataset that belong to an anatomical structure of interest.” Ex. 2002 ¶ 52. “After segmentation,” he continues, “a polygonal model of the surface of the identified anatomical structure, *i.e.*, a shell, is generated.” *Id.* Surface rendering “does not provide information about the anatomical areas of interest within the structure to which a modeled surface was rendered,” he explains. *Id.*

“associating the acquired medical image **to align . . . at the plurality of layers,**” the acquired medical image must be three-dimensional (3D) and “not a model” (i.e., DVR). *Id.* at 10 (citing Ex. 2002 ¶¶ 60–62); Sur-reply 7 (citing Ex. 2002 ¶ 61). Patent Owner therefore contends that the acquired medical image “cannot comprise only a single 2D layer such as a conventional X-ray or MRI scan.” PO Resp. 10. Patent Owner also argues that several figures of the ’807 patent show DVR of 3D medical imaging data. *Id.* at 10–12 (citing Ex. 1001, Figs. 1B–1J, 2A, 2B, 3A, 3B; Ex. 2002 ¶¶ 64–69, 104). Further, Patent Owner draws a distinction between DVR and surface-rendered models, arguing that “if the medical image was not direct volume rendered, but was instead a surface model, the claimed augmentation tag would be unnecessary.” *Id.* at 13 (citing Ex. 2002 ¶ 121).

In Reply, Petitioner argues that the plain and ordinary meaning of “acquired medical image” is “not limited to 3D, DVR, or any other rendering that is somehow not a model.” Reply 4. Petitioner further disagrees that the acquired medical image must be 3D and cannot be a 2D X-ray or MRI scan, as the ’807 patent states that “the acquired medical image may be an MRI or CT image.” *Id.* (quoting Ex. 1001, 3:23–25). In addition, Petitioner points to “preferred embodiments” of the ’807 patent that illustrate a 2D acquired medical image. *Id.* at 4–6 (citing, e.g., Ex. 1001, Figs. 2C, 2D). Petitioner also argues that, “if 3D-DVR medical imaging were the ‘thrust of the invention,’ as [Patent Owner] asserts . . . , the ’807 [p]atent should have disclosed that but does not.” *Id.* at 10. Instead, Petitioner argues, the ’807 patent discloses only “graphical[],” “computer,” and “other vague rendering techniques as possibilities.” *Id.* (quoting Ex. 1001, 5:27–29, 12:59–61).

Patent Owner views the Reply as relying on meritless attorney argument and asserts that Dr. Mulumudi's DVR conclusion stands un rebutted. Sur-reply 7–8, 12. Patent Owner further disputes Petitioner's characterization of the '807 patent as identifying any embodiment as “preferred.” *Id.* at 10.⁸

For reasons we explain below, we agree with Petitioner that Patent Owner's 3D DVR concept is not found in the claims or in the specification of the '807 patent. Patent Owner's reliance on Dr. Mulumudi's testimony is also unavailing. We also address Petitioner's proposed construction and adopt it for reasons explained below.

b) Claim language

The plain claim language does not support Patent Owner's construction. Claim 1 does not specify whether the “acquired medical image” is 2D or 3D, nor does it recite how the image is rendered, let alone that it is rendered using DVR. *See* Ex. 1001, 15:23–50. Although Patent Owner relies on claim 1's “acquired medical image comprising . . . a plurality of anatomical layers of the patient anatomy” for its 3D interpretation, Patent Owner does not explain why a plurality of layers implies 3D. *See* PO Resp. 10; Sur-reply 7. Further, Patent Owner's assertion does not square with its admission elsewhere that “[w]ithin the context of the '807 [p]atent, medical imaging ‘may be . . . MRI [or] . . . CT’—which generate 2D images, Dr. Mulumudi testifies. PO Resp. 12

⁸ The Reply raise additional arguments that we need not address. *See* Reply 3–10. We do not need to consider these arguments to decide the parties' proposed claim construction, and therefore we need not address corresponding arguments in the Sur-reply. We address other aspects of the Sur-reply below.

(quoting Ex. 1001, 5:16–23); Ex. 2002 ¶¶ 48–50 (testifying that CT and MRI imaging create “a set of 2D images or slices”). And there is no evidence in this record supporting a finding that a plurality of 2D CT or MRI layers is equivalent to a 3D image, let alone a “direct volume rendered” image as Patent Owner asserts.

Patent Owner also states, but does not explain persuasively, that the following language of claim 1 supports its position: “associating the acquired medical image **to align** with the viewable portion of the patient anatomy . . . wherein the one or more anatomical structures of the medical imaging **at the plurality of layers are aligned** with the visual image of the patient anatomy.” PO Resp. 10 (quoting Ex. 1001, 15:35–40). As neither the Reply nor the Sur-reply address this language, we are left with nothing in the record besides Patent Owner’s bare conclusion that this language supports its position. Nevertheless, we disagree with Patent Owner’s assertion. That the acquired medical image is merely aligned with the viewable portion of the patient anatomy “at” the plurality of layers is insufficient to read claim 1 as requiring 3D or DVR. For instance, the plurality of layers need not be arranged to form a 3D image—and the claim does not specify that they are—in order to align those layers with the visual image. Moreover, only one layer may be visible, leaving all other layers out of view of the medical professional (see our discussion of the “projecting” limitation in the next section). The claim does not say that all the layers must be visible in some 3D arrangement. Further, neither Patent Owner nor Dr. Mulumudi explains how alignment with layers requires a particular form of rendering, such as DVR. *See id.*; Ex. 2002 ¶ 61.

Patent Owner also relies on claim 2 to support its position based on Dr. Mulumudi’s testimony that claim 2 “also requires the ‘medical image’ of

claim 1 to be three-dimensional.” Sur-reply 10; Ex. 2001 ¶ 62. But claim 2’s recitation of “three dimensional (3D) structure in the acquired medical image” means rather that claim 1’s acquired medical image is *not* limited to 3D structure. That is because “[a]n independent claim impliedly embraces more subject matter than its narrower dependent claim.” *Intamin Ltd. v. Magnetar Techs., Corp.*, 483 F.3d 1328, 1335 (Fed. Cir. 2007); *see also Karlin Tech., Inc. v. Surgical Dynamics, Inc.*, 177 F.3d 968, 971–72 (Fed. Cir. 1999) (“[N]ormally, . . . limitations stated in dependent claims are not to be read into the independent claim from which they depend”). Claim 2’s recitation of 3D structure in the acquired medical image therefore suggests that claim 1’s acquired medical image is broader in scope and encompasses *more* than 3D structure, including, for example, 2D structure.

Claim 7 likewise suggests that claim 1’s medical image is not limited to 3D because it recites “further comprising capturing the acquired medical image using a MRI, CT scan, [or] X-ray,” which are imaging techniques that capture sets of 2D images. *See* Ex. 1001, 16:10–13; *see also* Ex. 2002 ¶¶ 48–50 (testifying that CT and MRI output “sets of 2D images or slices”). If the acquired medical image in claim 7 encompasses 2D images—even if at a plurality of layers—the acquired medical image of claim 1 implicitly does also. *See Intamin*, 483 F.3d at 1335.

c) Specification

The specification also does not support Patent Owner’s argument that “acquired medical image” must encompass 3D DVR images. Patent Owner does not argue for lexicography or disavowal, and thus, Patent Owner’s claim construction theory is unclear. *See generally* PO Resp.; *Thorner v. Sony Computer Entm’t Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012) (“There are only two exceptions to this general rule [that claims are given

their plain and ordinary meaning]: 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.”).

Although Patent Owner asserts that the ’807 patent “repeatedly shows that the ‘acquired medical image’ is 3D and direct volume rendered,” Patent Owner merely points to several figures but no guidance in the specification describing a DVR concept. *See* Sur-reply 7–8 (citing Ex. 1001, Figures 1B–1J, 2A, 2B, 3A, and 3B); PO Resp. 10–12 (similar). Nothing in these figures, which are primarily medical images with little or no explanatory text, points to a conclusion that DVR was used to render those figures. Nor does Patent Owner or Dr. Mulumudi adequately explain how those figures show DVR. *See* Ex. 2002 ¶¶ 64–66, 103–104.

For example, Patent Owner asserts that, “[b]ecause the imaging is DVR, it includes both internal and external anatomical structures simultaneously,” so “it provides a complete view of the patient’s anatomy.” PO Resp. 12. But Patent Owner does not elaborate, so it is difficult to tell whether the indicated figures actually include “both internal and external anatomical structures simultaneously.” Figures 3A and 3B, for example, show the following:

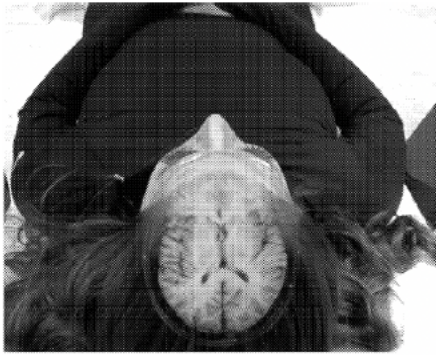


FIG. 3A

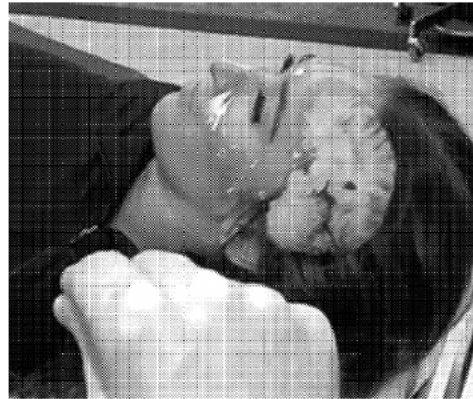


FIG. 3B

Figure 3A shows an acquired medical image overlaid on the top of a patient's head and brain, and Figure 3B shows an acquired medical image overlaid on the side of a patient's head and brain. Ex. 1001, 2:1–5, 6:42–56. There is nothing, however, in the text or the drawings themselves to indicate that these brain cross sections “include both internal and external anatomical structures simultaneously” and so are DVR images. *See* PO Resp. 12. Further, the very term “cross section” suggests a 2D image, not a 3D image. Similar issues exist for the other figures Patent Owner relies on. *See* Sur-reply 7–8 (citing Ex. 1001, Figures 1B–1J, 2A, 2B, 3A, and 3B); PO Resp. 10–12 (similar).

Even if some of the figures do contain DVR images, Patent Owner does not explain why the specification dictates that the claims should be limited to those figures, which are mere examples or embodiments. *E.g.*, Ex. 1001, 1:49–52 (describing, *e.g.*, Figures 1B–C each as “an example”).⁹

⁹ We need not address the parties' dispute over whether the '807 patent discloses “preferred” embodiments. Reply 4–5; Sur-reply 10. The larger point is that Patent Owner relies on mere embodiments, whether preferred or not, and not on lexicography or disavowal. Our reviewing court “has long recognized that particular features recited in the specification merely as

Patent Owner also overlooks that drawings alone are generally not limiting absent a relevant “limitation in the claim or a discussion in the specification,” of which there is none. *See Advanced Cardiovascular Sys., Inc. v. Scimed Life Sys., Inc.*, 261 F.3d 1329, 1339 (Fed. Cir. 2001) (“Without a ‘generally parallel’ limitation *in the claim or a discussion in the specification* about the claimed connecting elements being generally parallel . . . , *the drawings’ depiction* of the connecting elements in parallel relationship . . . *cannot support* the conclusion that such a limitation exists.” (emphasis added)).

We agree with Petitioner, rather, that the ’807 patent explicitly states the “acquired medical image may be an MRI or CT image” (among other image types), which confirms that the acquired medical image encompasses sets of 2D images. *See* Reply 4 (quoting Ex. 1001, 3:23–25); Ex. 2002 ¶¶ 48–50 (testifying that MRI and CT produce a set of 2D images). Patent Owner asserts, without support, that “[t]his excerpt is misleading” because in the context of the ’807 patent, “an MRI or CT image is used to construct a 3D DVR.” Sur-reply 9. This is unpersuasive attorney argument that ignores the ’807 patent’s complete silence about DVR. Patent Owner also points to the ’807 patent’s later disclosure that the “augmentation tag may be configured to conform to **a three dimensional (3D) structure in the acquired medical image**,” asserting that “[s]killed artisans, and even laypersons, would understand that a medical image must be 3D if it has 3D structure within it.” *Id.* at 9–10 (quoting Ex. 1001, 3:39–41). This argument

aspects of embodiments”—whether preferred or not—“and not expressly or even implicitly identifying requirements of the invention, do not narrow a claim term that is otherwise broader in its ordinary meaning.” *See Promptu Sys. Corp. v. Comcast Corp.*, 92 F.4th 1372, 1379 (Fed. Cir. 2024).

is unpersuasive because mere disclosure of a 3D embodiment does not disavow 2D images, and again, says nothing about DVR.

We also disagree with Patent Owner that, “if the medical image was not direct volume rendered, but was instead a surface model, the claimed augmentation tag would be unnecessary.” PO Resp. 13. According to Patent Owner, “[t]here is little need to identify anatomical structure in [a] surface model, because the surface model already identifies the anatomical structure of interest (*i.e.*, the modeled bone).” *Id.* (citing Ex. 2002 ¶ 121). But the specification envisions a broader applicability of augmentation tags, explaining that one issue doctors face is “making sure the correct patient anatomy is being operated on,” because if “the wrong person, wrong appendage or wrong location is being operated[] on then a poor outcome may be the result.” Ex. 1001, 2:46–51. The described solution is using “augmented reality tags to more accurately identify patient anatomical structures.” Ex. 1001, 2:51–53. Patent Owner’s point that a surface model is sufficient to identify anatomical structure overlooks the specification’s concern that the “wrong appendage” may be operated on. For example, even if a surface model clearly depicts a femur, an augmentation tag could still be useful to identify whether it is the right or left femur.

Patent Owner’s 3D DVR interpretation also conflicts with the specification’s broad description of the “projecting” language in claim 1. On one hand, we agree with Patent Owner that because claim 1 recites “the acquired medical image comprising imaging acquired . . . at a plurality of anatomical layers,” the “acquired medical image” cannot comprise only a single 2D layer. PO Resp. 10. But on the other hand, to the extent Patent Owner’s construction requires rendering multiple layers of the image for display as a 3D image, that is not correct. *Id.* at 5 (“DVR is a method for

visualizing medical imaging data . . . *in three-dimensions*.” (emphasis added)). That is because the “projecting” limitation encompasses projecting a single 2D plane from the acquired medical image as an overlay.

In particular, the projecting limitation recites in part, “projecting the acquired medical image and the augmentation tag . . . as an overlay to the patient anatomy.” Ex. 1001, 15:46–50. Parallel language in the specification describes “projecting the acquired medical image and the augmentation tag . . . as an overlay to the patient anatomy in *either 2D, 3D* or holographic form.” *Id.* at code (57) (emphasis added). Elsewhere, the specification also refers to an “overlay” as a 2D plane that is part of the acquired medical image: “FIG. 2C illustrates . . . an *overlay from the acquired medical image* that is a cross sectional view in a partial sagittal *plane* from the acquired medical image.” *Id.* at 6:36–38 (emphasis added). Patent Owner appears to acknowledge this distinction between the acquired medical image and the overlay in the Sur-reply:

The cross-sectional views of the “partial sagittal plane” shown in FIG. 2C and the “transverse plane” shown in FIG. 2D are not the acquired medical image itself. Rather, they are cross-sectional slices from the 3D medical image shown to help the POSITA understand what an augmentation tag is.

Sur-reply 11 (citing Ex. 1001, 6:34–41). Thus, even though the claim requires the acquired medical image to comprise a plurality of anatomical layers, claim 1 also encompasses projecting “an” overlay, which may be a 2D plane, and thus need not be 3D direct volume rendered.

d) *Extrinsic evidence*

Finally, we address Patent Owner’s extensive reliance on extrinsic evidence.¹⁰ Patent Owner’s reading of 3D DVR into the claims rests almost entirely on the testimony of Dr. Mulumudi. *See* PO Resp. 9–14. To be sure, Patent Owner points to some of the ’807 patent’s figures as evidence of DVR, but Patent Owner relies on Dr. Mulumudi’s explanation of those images since the ’807 patent does not mention DVR. *See id.* at 10–12. We find Patent Owner’s reliance on Dr. Mulumudi’s testimony unavailing. Our reviewing court instructs us that “while extrinsic evidence can shed useful light on the relevant art, . . . it is less significant than the intrinsic record in determining the legally operative meaning of claim language.” *Phillips*, 415 F.3d at 1317 (internal quotation omitted). Thus, “a court should discount any expert testimony ‘that is clearly at odds with the claim construction mandated by the claims themselves, the written description, and the prosecution history, in other words, with the written record of the patent.’” *Id.* at 1318 (quoting *Key Pharms. v. Hercon Labs. Corp.*, 161 F.3d 709, 716 (Fed. Cir. 1998)). That is the case here. Dr. Mulumudi’s testimony “limits the claim scope in a manner not contemplated by the intrinsic record,” so “[w]e need not consider it.” *See Weber, Inc. v. Provisur Techs, Inc.*, 92 F.4th 1059, 1070 (Fed. Cir. 2024). We therefore assign little weight to Dr. Mulumudi’s testimony that bears on the proper construction of the claim term “acquired medial image.”¹¹

¹⁰ Neither party addresses the prosecution history of the ’807 patent in their substantive briefs.

¹¹ For similar reasons, Patent Owner’s contention that Petitioner “offers no expert testimony to rebut [Dr.] Mulumudi’s conclusion” is unavailing. Sur-reply 12. Dr. Mulumudi’s opinions are unconvincing on their own and therefore entitled to little weight regardless of whether Petitioner’s expert

Not only is Dr. Mulumudi's testimony requiring DVR untethered from the '807 patent's disclosure, but it also explicitly acknowledges alternative rendering methods that may be used instead of DVR. Dr. Mulumudi testifies that there are "various methods for visualizing CT and MRI scan imaging," including "slice-by-slice viewing," "multiplanar reconstruction (MPR)," "surface rendering," and "direct volume rendering (DVR)." Ex. 2002 ¶¶ 51, 69. That there are several methods for rendering CT and MRI images further undercuts Patent Owner's contention that the acquired medical image *must* be limited to DVR, in light of the '807 patent's lack of expressed preference for any particular rendering technique.

Accordingly, there is no persuasive evidence in the claims, specification, or Dr. Mulumudi's testimony to support Patent Owner's proposed construction.

e) Petitioner's proposal

Having addressed Patent Owner's incorrect construction, we now turn to Petitioner's proposal. Petitioner explains that the '807 patent broadly describes the "acquired medical image" as follows:

acquired medical images may be MRI (magnetic resonance imaging), fluoroscopy, CT (computed tomography), sonography, nuclear medicine, computer generated images (CGI), photos, video, or other types of acquired or synthesized medical images. . . .

[They] may [also] be a radiological image that is acquired using medical imaging techniques such as a MRI (magnetic resonance imaging), magnetic resonance angiography (MRA), fMRI (function magnetic resonance imaging), mammography, CT (computed tomography), fluoroscopy, X-rays, nuclear medicine

rebutted them or not. *See Velander v. Garner*, 348 F.3d 1359, 1371 (Fed. Cir. 2003) (determining that the Board has broad discretion to assign the proper weight to declarations).

(e.g., bone scans, thyroid scans, etc.), PET (positron emission tomography), ultrasound images or any other medical imaging techniques.

See Pet. 10 (quoting Ex. 1001, 2:32–36, then quoting *id.* at 5:16–27).¹²

Although not employing lexicography due to using the term “may,” these passages clarify that “acquired medical image” broadly encompasses at least the recited imaging types.

Hence, we determine that, in the context of the ’807 patent, “acquired medical image” encompasses at least “MRI, fMRI, fluoroscopy, mammography, CT, sonography, X-rays, nuclear medicine, ultrasound, computer generated images (CGI), photos, video, or other types of acquired or synthesized medical images.” *See* Pet. 11. As we explain above, we also determine that “acquired medical image” also encompasses a set of 2D medical images and is not limited to 3D.

2. “augmentation tag”

Petitioner proposes the following construction for “augmentation tag” in claim 1: “any annotation, mark, selection, extraction or highlighting associated with a location in an acquired medical image.” Pet. 13 (citing Ex. 1009 ¶¶ 28–35). Petitioner points to the specification, which discloses that “augmentation tags may be used to pre-label the acquired medical image.” *Id.* at 11 (quoting Ex. 1001, 3:47–48). Petitioner also explains that the specification further discloses that an “augmentation tag may be a simple geometric shape such as a circle, square, triangle *or* another more complex shape in two dimensions or three dimensions, such as an outline of the anatomy in question.” *Id.* at 12 (quoting Ex. 1001, 3:43–46). Moreover,

¹² For context, we reproduce the specification’s text more completely than is reproduced in the Petition.

Petitioner argues, an augmentation tag may have a 3D shape created from a plurality of 2D augmentation tags. *Id.* (citing Ex. 1001, 4:61–63, 4:54–61).¹³

Patent Owner asserts that “augmentation tag” means “[a]n augmented portion of the 3D medical image that identifies 3D anatomical structure within the 3D medical image.” PO Resp. 14–15. Patent Owner first asserts that, because the “acquired medical image” (discussed above) is three-dimensional, the anatomical structure within that image is also 3D. *Id.* at 15. Accordingly, Patent Owner concludes, “the augmentation tag identifies 3D anatomical structure within the 3D medical image.” *Id.* Patent Owner also relies on the specification’s teaching that “[t]he augmentation tag may be configured to conform to a three dimensional (3D) structure in the acquired medical image.” *Id.* (quoting Ex. 1001, 3:29–41). Further, Patent Owner points to Figure 1C, which “illustrates [how] the augmentation tag can be provided in a plurality of anatomical layers of the acquired medical image.” *Id.* (quoting Ex. 1001, 3:63–65).

We disagree with Patent Owner. Patent Owner’s reasoning largely depends on its 3D claim construction of “acquired medical image,” which we have not adopted. *See* PO Resp. 15 (“Because ‘the acquired medical image’ is three-dimensional (3D), as explained above . . . , the augmentation tag identifies 3D anatomical structure within the 3D medical image.”). For this reason alone, Patent Owner’s construction is unsupported.

¹³ In the Reply, Petitioner further construes the phrase “‘identifying’ an anatomical structure” to encompass “identifying a view of that structure from a distance.” Reply 17–18. Patent Owner does not respond to this proposal. *See generally* Sur-reply. We do not find it necessary to address this proposed construction in order to resolve the issues in this proceeding.

The plain claim language also does not support Patent Owner’s construction. Claim 1 does not recite “3D.” *See* Ex. 1001, 15:23–50. Claim 1 recites, in relevant part, “the augmentation tag identifying at least one anatomical structure of the acquired medical image.” *Id.* at 15:43–44. Patent Owner’s construction adds (1) “3D” to the “medical image,” which is incorrect for reasons explained above, and (2) “3D” to the anatomical structure. As the acquired medical image need not be 3D, neither does the anatomical structure of the acquired medical image.

Patent Owner’s reliance on the specification’s teaching that “[t]he augmentation tag *may be* configured to conform to a three dimensional (3D) structure in the acquired medical image” relies on an embodiment that uses non-limiting language (“may be”), and is unpersuasive. PO Resp. 15 (quoting Ex. 1001, 3:29–41) (emphasis added). Patent Owner’s reliance on the non-limiting Figure 1C embodiment is similarly unavailing. *See id.* at 15–16 (citing Ex. 1001, 3:63–65 (“augmentation tags *can be* provided in a plurality of anatomical layers” (emphasis added))).

In the Sur-reply and also in the hearing, Patent Owner further argued that the augmentation tag itself must be 3D. Sur-reply 15 (“the 3D augmentation tag in claim 1”; “That does not mean claim 1 does not recite a 3D augmentation tag.”); Tr. 75:8–9 (“[W]e believe that the augmentation tag in Claim 1 is 3D. The Board can accept that construction or not.”). This construction is incorrect because the plain language of claim 1 does not recite “3D” and because the specification also describes both 2D and 3D augmentation tags. For example, the specification explicitly discloses that an “augmentation tag may be a simple geometric shape such as a circle, square, triangle or another more complex shape in *two dimensions or three dimensions*, such as an outline of the anatomy in question.” Ex. 1001, 3:43–

46 (emphasis added); *see also id.* at 5:34–35 (“FIG. 1E illustrates a two dimensional (2D) augmentation tag for a kidney.”).

Describing what is recited in claim 4, the specification also refers to creating “one or more 2D (two dimensional) augmentation tags” and joining them together to “form a 3D augmentation tag.” Ex. 1001, 4:54–61, 15:59–65 (claim 4: “creating . . . and joining the plurality of 2D augmentation tags to form a three dimensional (3D) augmentation tag”). Patent Owner points to this disclosure as requiring the claimed augmentation tag to encompass “a 3D tag extending across a plurality of layers.” Sur-reply 15–16 (citing, e.g., Ex. 1001, 5:41–44, 15:59–65); *see also* Tr. 75:7–12 (“[T]he augmentation tag in Claim 1 is 3D. . . . But the way that 2D augmentation tags are explained in the Patent, and specifically with Figure 1E as well . . . is to identify it in 2D and then create a 3D augmentation tag in the 3D image.”). But this interpretation essentially reads claim 4 into claim 1, which is improper. Moreover, Petitioner argues, and we agree, that claim 4’s recital of “**two dimensional (2D)** augmentation tags” suggests that claim 1’s broader “augmentation tag” encompasses 2D augmentation tags. Reply 15.

Accordingly, we determine that “augmentation tag” encompasses either a 2D or 3D augmentation tag and that the augmentation tag need not augment a 3D medical image or identify 3D anatomical structure within a 3D image.

Because the parties focus their dispute on whether augmentation tags are 2D or 3D, we find it unnecessary to address Petitioner’s original construction of augmentation tag as “any annotation, mark, selection,

extraction or highlighting associated with a location in an acquired medical image.” See Pet. 13.¹⁴

3. “one layer of the acquired medical image”

The Petition does not construe this term, but Patent Owner asserts that it means “a 3D layer of the acquired medical image.” PO Resp. 16. Patent Owner argues as follows:

Figures 1C and 1D of the ’807 Patent provide exemplary **layers** of the acquired medical image with layers shown there. The artery shown in FIG. 1C is a three-dimensional object split between two layers, each layer having half of the artery therein. As such, a POSITA would understand that a single layer of a 3D “medical image is also 3D.”

Id. at 17 (citing Ex. 2002 ¶¶ 73, 89). Figures 1C and 1D are shown below:

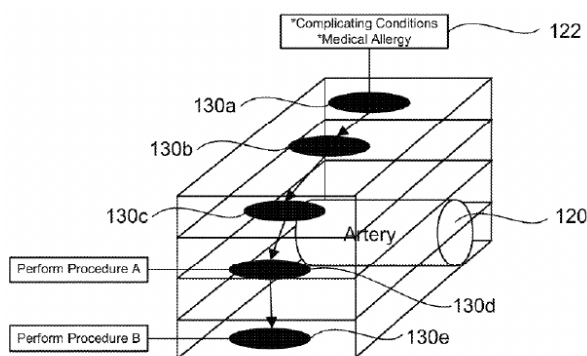


FIG. 1C

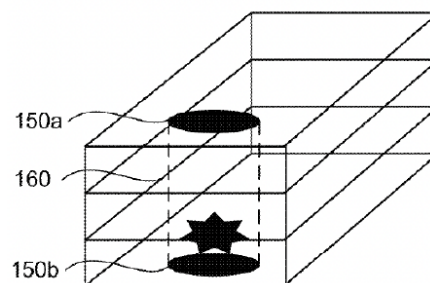


FIG. 1D

Figure 1C illustrates the use of a plurality of augmentation tags, whereas Figure 1D illustrates two dimensional augmentation tags that are automatically made into three dimensional augmentation tags. Ex. 1001, 1:51–55.

¹⁴ At the hearing, Petitioner also argued for the first time that an augmentation tag “may represent an anatomical structure such as a point of incision.” Tr. 58:15–18. We also find it unnecessary to address this argument to resolve the issues in this proceeding.

We find Patent Owner’s construction unavailing. Claim 1 does not recite a “3D” layer, but merely “one layer.” Ex. 1001, 15:41–43. Further, Petitioner argues, and we agree, that Patent Owner’s construction excludes an embodiment, namely that “a medical professional may annotate a 2D slice or layer of an acquired medical image to create an augmentation tag.” Reply 12 (quoting Ex. 1001, 5:35–37). And as Patent Owner itself concedes, the figures it relies upon (Figures 1C and 1D) “provide exemplary layers.” PO Resp. 17. “Exemplary” generally means nonlimiting, and Patent Owner does not show the contrary. Patent Owner also relies on Dr. Mulumudi for the proposition that a POSITA would have understood that “a layer of a 3D volume is also 3D,” but this argument is premised on Patent Owner’s faulty “acquired medical image” construction and is therefore unpersuasive. Sur-reply 13 (citing Ex. 2002 ¶ 89).

Patent Owner further relies on Figure 1C’s corresponding disclosure that “augmentation tags can be provided in **a plurality of anatomical layers of the acquired medical image**,” but Patent Owner overlooks that “can be provided” is nonlimiting language. *Id.* at 14 (quoting Ex. 1001, 3:63–65). Finally, Patent Owner argues that column 4, lines 56 through 57 require the layers of the 3D medical image to be 3D. *Id.* But all this passage states is “(two dimensional) augmentation tags 150a-b each located on one of a plurality of layers of the acquired medical image,” which mentions 2D, not 3D. Ex. 1001, 4:56–57.

Accordingly, we determine that “one layer of the acquired medical image” does not require a 3D layer.

4. Remaining claim terms

We need not construe any other claim terms to resolve the issues presented by the parties in this proceeding. *See Realtime Data, LLC v.*

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

C. Asserted Anticipation by Jones

Petitioner contends that claims 1–7 are anticipated by Jones. Pet. 25–49.

1. Overview of Jones

Jones describes an augmented reality surgical system that includes a head mounted display (HMD) with a see-through display screen, a motion sensor, a camera, and computer equipment. Ex. 1007, code (57). The motion sensor outputs a head motion signal indicating measured movement of the HMD. *Id.* The computer equipment computes the relative location and orientation of reference markers connected to the HMD and to the patient based on processing a video signal from the camera. *Id.* The computer equipment generates a three-dimensional anatomical model using patient data created by medical imaging equipment and rotates at least a portion of the three dimensional anatomical model based on the head motion signal to track measured movement of the HMD. *Id.* The rotated and scaled three dimensional anatomical model is displayed on the display screen. *Id.*

Figure 18 depicts an example graphical image generated on the HMD:

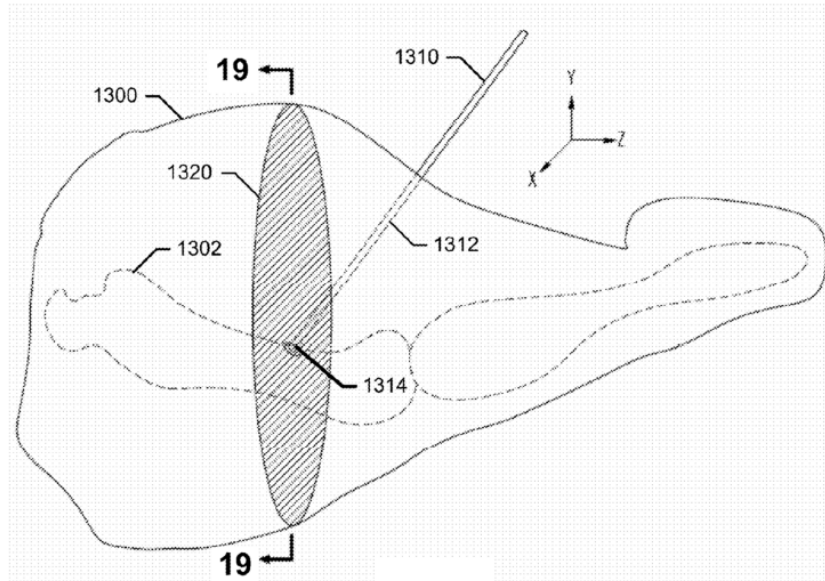


FIG. 18

Id. ¶ 17. The graphical image shows a virtual trajectory of a surgical tool into a patient's anatomy relative to an anatomical model generated from 3D computerized tomography (CT) scan data. *Id.*

2. *Claim 1*

Petitioner contends that Jones discloses all of the limitations of claim

1. Pet. 27–42. We address each limitation in turn.

a. [1a] A method for augmenting medical imaging of a patient, the medical imaging displayed using an augmented reality headset worn by a medical professional, the method comprising:

Petitioner argues that Jones meets the preamble by disclosing, for example, “[a]n augmented reality surgical systems [that] includes a head mounted display (HMD)” and which can be “worn by a surgeon.” Pet. 27–28 (quoting Ex. 1007, code (57), then quoting *id.* ¶ 23; citing Ex. 1009 ¶¶ 59–60).

Patent Owner asserts that Jones does not augment medical imaging because its “anatomical model is a surface model—not a medical image consistent with the meaning of the ’807 patent.” PO Resp. 20 (citing Ex. 2002 ¶¶ 98–106).

We agree with Petitioner that the teachings of Jones highlighted above disclose the preamble because Jones discloses an “augmented reality surgical system [that] includes a head mounted display (HMD),” which displays a “scaled three dimensional anatomical model” to a surgeon. Ex. 1007, code (57). Patent Owner’s argument to the contrary is unavailing because it relies on a construction for “acquired medical image” that we have not adopted. Neither the preamble nor the remainder of the claim requires the 3D DVR concept that Patent Owner distinguishes from surface models.¹⁵

b. [1b] receiving a visual image of patient anatomy captured by a visual image camera, the visual image comprising a viewable portion of the patient anatomy

Petitioner contends that Jones discloses this limitation by describing that “HMD 600 can include a camera 610, or a plurality of the cameras 610, facing away from the user that outputs video and/or other images.” Pet. 28 (quoting Ex. 1007 ¶¶ 46, 59; citing Ex. 1009 ¶¶ 61–62). Petitioner also notes that the camera “record[s] what the user is viewing during the procedure,” including that “the camera 610 view[s] a patient’s anatomy.” *Id.* (quoting Ex. 1007 ¶ 46, then quoting *id.* ¶ 59).

¹⁵ We do not express an opinion on whether the preamble is limiting because Petitioner establishes that Jones discloses it.

Patent Owner does not dispute that Jones discloses limitation [1b].¹⁶
We agree with Petitioner that Jones discloses it.

- c. [1c] retrieving an acquired medical image associated with the patient anatomy from data storage, the acquired medical image comprising imaging acquired of one or more anatomical structures at a plurality of anatomical layers of the patient anatomy*

For this limitation, Petitioner highlights Jones’s teaching that “patient database 642 can retrievably store information relating to a patient’s medical history,” including “patient images from earlier procedures conducted via the imaging equipment 644.” Pet. 29 (quoting Ex. 1007 ¶ 42; citing Ex. 1009 ¶¶ 63–66). Petitioner also argues that Jones discloses that “example file 1100 contains raw 3D CT scan data,” which is “based on a set of parallel slices along planes through the patient’s body.” *Id.* at 30 (quoting Ex. 1007 ¶ 107).

Patent Owner again argues that Jones’s surface bone model and video stream do not disclose the “medical image” of claim 1, which must be a 3D direct volume rendered medical image. PO Resp. 21–22 (citing Ex. 2002 ¶¶ 61–70). This argument depends on a claim construction we have not adopted and is therefore unavailing.

Patent Owner also argues that Jones’s video stream “is not 3D and does not include ‘a plurality of anatomical layers.’” PO Resp. 22. On this point, Petitioner responds that Figure 19 of Jones refutes Patent Owner’s argument that “slice 1320 . . . does not include a plurality of layers of the

¹⁶ Patent Owner uses different limitation labeling for claim 1 than the Petition. *E.g.*, PO Resp. 20 (referring to the next limitation discussed below as limitation 1[B]). We follow the Petition’s labeling for claim 1, not Patent Owner’s.

patient's anatomy.” Reply 19. Petitioner has the better argument, particularly in view of Jones's disclosure that “example file 1100 contains raw 3D CT scan data,” which is “based on a set of parallel slices along planes through the patient's body.” Pet. 30 (quoting Ex. 1007 ¶ 107). Patent Owner overlooks and does not address this disclosure cited in the Petition, which we find persuasive.

We also credit Dr. Kazanzides's testimony based on this disclosure. Ex. 1009 ¶ 65 (citing Ex. 1007 ¶ 107). In particular, we credit Dr. Kazanzides's testimony that “[a] person of ordinary skill in the art at the relevant time would [have understood] that a patient's medical images created by [Jones's] imaging equipment 644 typically consist of one or more anatomical structures at a plurality of anatomical layers of the patient anatomy.” *Id.* We agree with Petitioner that Jones's CT scan data based on a set of parallel slices along planes through the patient's body discloses the claimed “the acquired medical image comprising imaging acquired of one or more anatomical structures at a plurality of anatomical layers of the patient anatomy.”

Accordingly, Petitioner persuades us that Jones discloses limitation [1c].

d. [1d] associating the acquired medical image to align with the viewable portion of the patient anatomy captured by the visual image camera, wherein the one or more anatomical structures of the medical imaging at the plurality of layers are aligned with the visual image of the patient anatomy

For this limitation, Petitioner points to Jones's “reference markers,” which can “assist with performing correlations between virtual locations in the patient model and physical locations on the patient's body.” Pet. 31–32

(quoting Ex. 1007 ¶ 83). Accordingly, Petitioner argues, “[s]ome or all of the transformed patient model can then be displayed on the HMD 100 to provide the surgeon with a graphical overlay that is precisely oriented and scaled on the surgical site 804 or other target location on the patient.” *Id.* at 32 (quoting Ex. 1007 ¶ 83). Petitioner further contends that Jones “allows for aligning the acquired medical image with the patient view” because

[t]he computer system 820 may display on the display screen 110 an indicia (e.g., a crosshair or color marker) *aligned* with an identified object within the video from the HMD camera In one embodiment, the computer system 820 displays a graphical indicia on the display screen 110 *aligned with one of the anatomical objects* displayed on the display screen 110

Id. (quoting Ex. 1007 ¶ 86 (emphasis added); citing Ex. 1009 ¶ 71).

Patent Owner again argues that “Jones discloses only a surface model, not 3D medical imaging,” which is unavailing because this argument depends on a claim construction for “acquired medical image” that we have not adopted. PO Resp. 23. Patent Owner also argues that “Jones does not ‘align medical imaging at the plurality of layers’” but instead “specifically references a ‘patient model.’” *Id.* at 24 (citing Ex. 1009 ¶¶ 70, 83, 86). Patent Owner’s argument is unclear, but it appears to attempt to further distinguish Jones’s patient model from its 3D DVR interpretation, which we find unavailing.

Instead, we agree with Petitioner that Jones discloses the claimed associating when it states, “[s]ome or all of the transformed patient model can then be displayed on the HMD 100 to provide the surgeon with a graphical overlay that is precisely oriented and scaled on the surgical site 804 or other target location on the patient.” Ex. 1007 ¶ 83, *cited in* Pet. 31–32. As we explain above, Jones discloses that the medical imaging includes

a plurality of layers “based on a set of parallel slices along planes through the patient’s body.” *Id.* ¶ 107, *cited in* Pet. 30. Limitation [1d] requires that “the one or more anatomical structures of the medical imaging *at* the plurality of layers are aligned with the visual image of the patient anatomy” but does not specify that each of those layers is aligned with the visual image.

Because Jones discloses precisely orienting and scaling the patient model on the surgical site and that the patient model has a plurality of parallel slices, we find that Jones discloses an “anatomical structure[] of the medical imaging *at* the plurality of layers [is] aligned with the visual image of the patient anatomy.” *See* Ex. 1007 ¶¶ 83 (“patient model . . . precisely oriented and scaled on the surgical site”), 107 (“3D model . . . based on a set of parallel slices”); *see also id.* ¶ 86 (“aligned with one of the anatomical objects”).

Accordingly, Petitioner persuades us that Jones discloses limitation [1d].

- e. [1e] retrieving an augmentation tag from data storage, the augmentation tag associated with a location in one layer of the acquired medical image, the augmentation tag identifying at least one anatomical structure of the acquired medical image found at the location*

For the retrieving limitation [1e], Petitioner relies on Figure 18 of Jones. Pet. 33–34. For reference, we again reproduce Figure 18 of Jones:

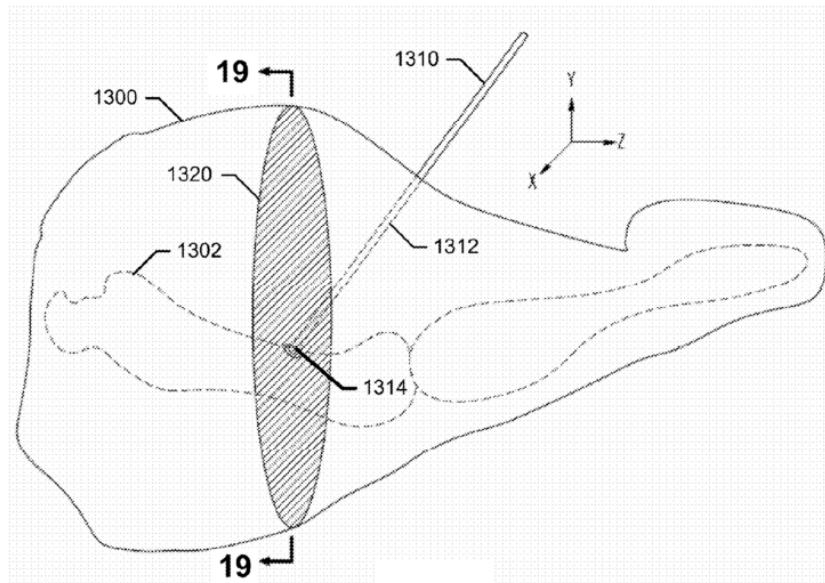


FIG. 18

Petitioner notes that “FIG. 18 illustrates a graphical image . . . that shows a virtual trajectory 1312 of a drill bit 1310 extending from a drill or other surgical tool . . . into a patient[']s anatomical bone model 1302 and other selected intervening structure.” *Id.* (quoting Ex. 1007 ¶ 115).

“In the example of FIG. 18,” Petitioner continues, “the target location 1314 corresponds to a point where the drill bit 1310 would impact the graphically displayed bone model 1302.” *Id.* at 34 (quoting Ex. 1007 ¶ 117). Petitioner further argues that Jones discloses accessing a stored file that includes both raw medical image data and an associated 3D model for display on Jones’s HMD. *Id.* (citing Ex. 1007 ¶ 107; Fig. 16).

“Importantly,” Petitioner adds, “Jones also discloses ‘[t]he video sources may include an embedded marker that indicates a location within an object that is of interest to the surgeon.’” *Id.* (quoting Ex. 1007 ¶ 59). Under limitation [1]f below, Petitioner clarifies that “Jones’s virtual trajectory 1132 ending at target location 1314 is an example of an augmentation tag.” *Id.* at 40 (citing Ex. 1009 ¶¶ 86–87).

Patent Owner’s first argument is that Jones does not disclose a 3D “medical image.” PO Resp. 25. Later, Patent Owner similarly argues that Jones only displays its medical image data in “video streams” on “virtual 2D displays.” *Id.* at 27. We address this argument above and find it unpersuasive, as it depends on an incorrect construction for “acquired medical image.”

Patent Owner next identifies four teachings in Jones that it believes Petitioner maps to the claimed “augmentation tag.” *See id.* at 25–27. Patent Owner first argues that Jones’s “virtual trajectory 1312 of a drill bit 1310” in Figure 18 is not an augmentation tag because a drill bit trajectory is not “anatomical structure.” *Id.* at 25. Patent Owner next argues that Jones’s “target location 1314 correspond[ing] to a point where the drill bit would impact the graphically displayed bone model 1302” is also not an augmentation tag because it “is also not anatomical structure.” *Id.* Further, Patent Owner contends that Jones’s bone model is not an augmentation tag but rather a “3D model . . . generated (block 1112) based on . . . selections.” *Id.* at 26 (quoting Ex. 1007 ¶ 110). Finally, Patent Owner argues that Jones’s “embedded marker that indicates a location within an object” is also not an augmentation tag because it is made in reference to the “video streams” display on virtual 2D displays. *Id.* at 27.

The Reply and Sur-reply only briefly address this limitation. Reply 21 (focusing on Jones’s bone model 1302 as an augmentation tag); Sur-reply 19 (arguing that Jones’s bone model 1302 is not an augmentation tag because it already identifies anatomical structure, so there is no need to identify structure twice). However, the parties discussed this limitation in detail at the hearing. For example, Petitioner argued that Jones’s virtual

trajectory of a drill bit 1310 and the target location 1314 are each augmentation tags:

But you have figure 18 that shows a *virtual trajectory of a drill bit 1310* extending from a drill or other surgical tool into a patient's anatomical bone model 1302. So that is pointing to and identifying it's some sort of marker that is projected onto the medical image that is identifying a particular point, and then all of that is overlaid onto the patient so that the surgeon is seeing this graphical overlay onto the patient.

....

And then Figure 18 is also showing *[target] location 1314*, which corresponds to a point where the drill bit would impact the graphically displayed bone model. *So that is very specifically the point that is identifying the anatomical structure of interest*. So that would be one example in Jones of an augmentation tag, Your Honor.

Tr. 64:24–65:3, 82:3–8 (emphasis added). Petitioner further clarified that the augmentation tag of Jones is “a combination of [virtual trajectory] 1312 and [target location] 1314” in Figure 18, or “either one.” *Id.* at 82:11–12. When asked, “doesn’t claim 1 require it to identify at least one anatomical structure of the required medical image found at that location,” Petitioner responded, “it is identifying the bone 1302.” *Id.* at 82:22–26.

At the hearing, Patent Owner disagreed that the target location for the drill trajectory identifies anatomical structure, asserting that “[t]he drill trajectory is not anatomical structure at all.” *Id.* at 78:7–8. Further, Patent Owner argued that “Petitioner does not clearly identify its theory with regard to Jones about what an augmentation tag is. It argues that the drill bit, or the drill trajectory and the target are augmentation tags I think at one moment it argues that the bone model is an augmentation tag.” *Id.* at 85:11–15.

After reviewing the record in its entirety, we agree with Petitioner that Jones discloses an augmentation tag. Specifically, we agree with Petitioner,

as argued in the Petition and emphasized at the hearing, that Jones’s virtual trajectory 1312 and target location 1314 are each an augmentation tag that identifies anatomical structure, namely bone model 1302. *See id.*; Pet. 40. Dr. Kazanzides highlights the following disclosure of Jones: “In the example of FIG. 18, the target location 1314 corresponds to a point where the drill bit 1310 would impact the graphically displayed bone model 1302.” Ex. 1009 ¶ 74 (quoting Ex. 1007 ¶ 117). Target location 1314 is indicated by what appears to be an oval in Figure 18, which is an example of a “simple geometric shape” described in the ’807 patent as an augmentation tag. *See* Ex. 1007, Fig. 18; Ex. 1001, 3:43–46. Further, target location 1314 identifies a point on bone model 1302, which is indisputably anatomical structure. Ex. 1007 ¶ 117. Similarly, virtual trajectory 1312 is a simple geometric shape that points to bone model 1302 and therefore also identifies anatomical structure.

Patent Owner’s assertion that neither virtual trajectory 1312 nor target location 1314 is anatomical structure is inapposite, as the claimed augmentation tag need only “identify[] at least one anatomical structure,” not be anatomical structure itself. *See* PO Resp. 25. Patent Owner also asserts that “there would be no need to identify anatomical structure in Jones’s bone model because Jones’s bone model is already a graphical representation of selected anatomical structure and contains no other internal or external anatomical structure.” *Id.* at 29 (citing Ex. 2002 ¶ 137 (internal quotations omitted)) (discussing limitation [1f]). This argument is unpersuasive because Petitioner is not proposing that Jones’s target location 1314 identifies structure “in” Jones’s bone model, but rather, that the target location 1314 identifies the bone model itself, which is anatomical structure.

Pet. 40; Tr. 64:24–65:3, 82:3–8, 82:22–26. We therefore also find this argument unavailing.

Accordingly, Petitioner establishes that Jones discloses limitation [1e].

f. [1f] projecting the acquired medical image and the augmentation tag using the augmented reality headset to form a single graphical view as an overlay to the patient anatomy viewable through a lens of the augmented reality headset

Petitioner raises several arguments for this limitation. Pet. 34–42. We highlight the following. First, Petitioner relies on Jones’s disclosure of an HMD apparatus with semitransparent display screen that displays video and other images to a user. *Id.* at 34–36 (citing, e.g., Ex. 1007 ¶¶ 26, 44, Fig. 1). Petitioner further points to Jones’s image generator 918, which “provides video generated based on the transformed patient model to the HMD 100 for display as a visual model that is dynamically oriented and scaled as a graphical overlay on the surgical site 804.” *Id.* at 37 (quoting Ex. 1007 ¶ 94; citing Ex. 1007 ¶¶ 83, 96). Jones also discloses the surgeon seeing “the skin surface of the leg through the semitransparent display screen 110 of the HMD 100 with a[] graphically illustrated representation of the leg bone model overlaid thereon,” Petitioner argues. *Id.* at 38 (quoting Ex. 1007 ¶ 97; citing Ex. 1007, Fig. 14). Petitioner concludes, “Jones’s slice of CT data 1320 represents an acquired medical image in two dimensions and the target location 1314 at the intersection of the virtual trajectory 1312 and bone model 1302 on that slice represents an augmentation tag identifying an anatomical structure in a layer of the acquired medical image (i.e., a location on bone).” *Id.* at 42 (citing Ex. 1009 ¶ 89).

We agree with Petitioner that Jones discloses this limitation. For example, we agree that Jones's HMD teaches the claimed augmented reality headset. We further agree with Petitioner that Jones's slice of CT data represents an acquired medical image and that virtual trajectory 1312 and target location 1314 on bone model 1302 each represents an augmentation tag, and that Jones's system displays a graphical model of the bone and augmentation tag through a lens (semitransparent display screen) of the HMD.

Patent Owner reiterates its argument that Jones does not disclose an augmentation tag. PO Resp. 28–29. Patent Owner also reiterates that Jones's bone model is not a (3D DVR) medical image, but instead is a surface model. *Id.* We address these arguments above and find them unavailing.

Patent Owner further contends that “[t]he claims require augmentation of the 3D medical image itself,” and “[n]ot the combination of a model from one set of data combined with some other image.” *Id.* at 29–30. We disagree, as Patent Owner's assertion is not commensurate with the scope of claim 1. Limitation [1f] does not recite “augmentation of the 3D medical image itself,” but instead “projecting the acquired medical image and the augmentation tag . . . to form a single graphical view as an overlay.” Ex. 1001, 15:46–50. The claim does not preclude combining a model from one set of data combined with some other image, as Patent Owner claims.

Patent Owner also views Petitioner as contending that Jones's bone model is both the medical image and augmentation tag of claim 1. PO Resp. 30. Regardless of whether Petitioner maps Jones's bone model to the augmentation tag, as we explain above, Petitioner also maps the claimed augmentation tag to Jones's virtual trajectory 1312 and to target location

1314 in Figure 18. *See* Tr. 64:24–65:3, 82:3–8, 82:11–12, 82:22–26; Pet. 40.¹⁷ Thus, even if Petitioner’s argument could be construed to also consider bone model 1302 as an augmentation tag, we need not reach this argument because virtual trajectory 1312 and target location 1314 are both augmentation tags for reasons we explain above. For similar reasons, Patent Owner’s argument explaining why Jones’s slice model 1320 shown in Figure 18 is not an augmentation tag lacks merit. *See* PO Resp. 30–31.

Patent Owner again argues that “Jones’[s] slice 1320 is also not 3D and does not include a plurality of layers of the patient anatomy,” *id.* at 31, but as we explain above for limitation [1c], Jones does disclose a plurality of layers of patient anatomy. *See* Pet. 30 (citing Ex. 1007 ¶ 107) (discussing Jones’s disclosure that “example file 1100 contains raw 3D CT scan data,” which is “based on a set of parallel slices along planes through the patient’s body”).

Accordingly, Petitioner establishes that Jones discloses limitation [1f].

g. Summary as to Claim 1

We determine that Petitioner has proven by a preponderance of the evidence that Jones anticipates claim 1.

3. Dependent Claims 2–7

Petitioner contends that Jones discloses all of the additional limitations of claims 2–7, which directly depend from claim 1. Pet. 42–49. We address each dependent claim in turn.

¹⁷ Patent Owner is partially correct that Petitioner identifies bone model as an augmentation tag, but Petitioner only raises that argument for dependent claim 2. Pet. 43 (“so bone model 1302 is an augmentation tag”). We find it unnecessary to reach this argument when discussing claim 1 because we agree with Petitioner that target location 1314 is an augmentation tag. *See* Pet. 40.

a. Claim 2

Claim 2 recites, “The method as in claim 1, further wherein augmentation tag conforms to a three dimensional (3D) structure in the acquired medical image to identify an anatomical structure associated with a medical procedure to be performed.” Ex. 1001, 15:51–54.

For claim 2, Petitioner relies on Jones’s bone model 1302 being a “3D structure to identify the bone associated with the bone surgery, and so bone model 1302 is an augmentation tag.” Pet. 42–43. Petitioner also relies on target location 1314 and virtual trajectory 1312 as augmentation tags. *Id.* at 43. Based on these disclosures, Petitioner concludes that Jones meets the claim. *Id.* (citing Ex. 1009 ¶¶ 90–91).

Patent Owner argues that Petitioner “fail[s] to identify any 3D medical imaging in Jones that its bone model identifies, augments, and ‘conforms’ to.” PO Resp. 32. Patent Owner further contends that Petitioner “fail[s] to explain how Jones’s trajectory 1312 identifies and ‘conforms’ to 3D structure in an acquired 3D medical image.” *Id.*

In Reply, Petitioner merely asserts that, “[a]s illustrated in Figures 18 and 19, Jones’s bone model 1302 conforms to bone 1302 in slice 1320, as Claim 2 requires.” Reply 21. Patent Owner views this as a new argument and improper because Jones’s model “cannot be both a ‘medical image’ and an ‘augmentation tag.’” Sur-reply 20.

We agree with Patent Owner that the Petition does not explain how any of the items Petitioner identifies as the augmentation tag “conforms to a three dimensional (3D) structure in the acquired medical image,” as claimed. The Petition does not even advance a theory as to what in Jones “conforms to a three dimensional (3D) structure.” The Petition asserts that Jones’s bone model 1302 is a 3D structure, and then in a non-sequitur, asserts “so

bone model 1302 is an augmentation tag.” Pet. 43. Even assuming that bone model 1302 is a 3D structure, it does not follow that it is therefore an augmentation tag, nor does Petitioner explain why this is so.

Petitioner’s Reply argument that “bone model 1302 conforms to a bone 1302 in slice 1320” is also unpersuasive because the Reply does not explain why a bone model is both an augmentation tag and a 3D structure in the acquired medical image, nor how bone model 1302 “conforms” to bone 1302. *See* Reply 21.

Petitioner’s arguments are conclusory, and Dr. Kazanzides’s declaration merely repeats the Petition. Ex. 1009 ¶¶ 90–91. Thus, Petitioner does not persuade us by a preponderance of the evidence that Jones anticipates claim 2.

b. Claim 3

Claim 3 recites, “The method as in claim 1, wherein a plurality of augmentation tags are provided in a plurality of layers of the acquired medical image and the plurality of augmentation tags are associated to form a tag group to guide a surgeon.” Ex. 1001, 15:55–58.

For claim 3, Petitioner points to “another visualization mode” in Jones that displays a “sequence of cross-sectional slices that are spaced apart along the virtual trajectory 1312 of the drill bit 1310.” Pet. 43 (quoting Ex. 1007 ¶ 121). Petitioner points to an example display for this visualization mode in Figure 21, reproduced below:

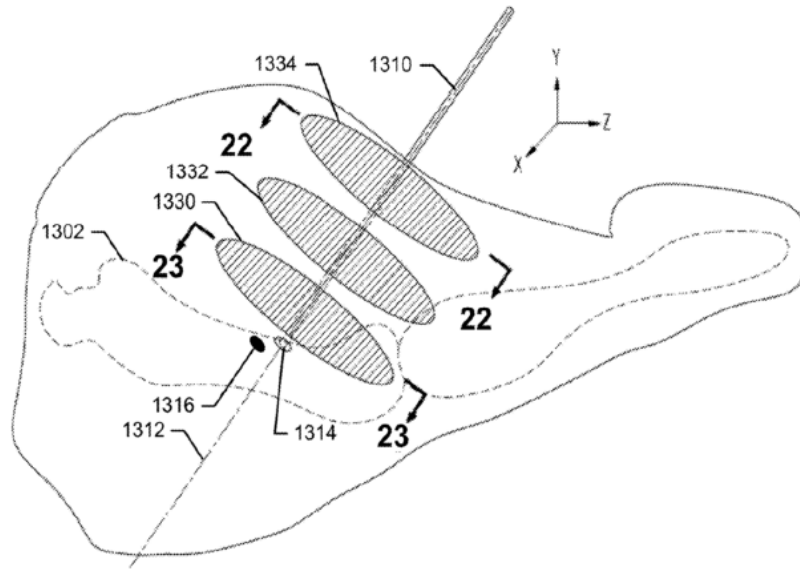


FIG. 21

Id. at 43–44. According to Petitioner, Jones discloses that, “[i]n the non-limiting example of FIG. 21, three slices 1330, 1332, 1334 are parallel to one another and spaced apart and each centered along the virtual trajectory 1312. . . . The surgeon can control how many slices are simultaneously displayed and can control where a slice is generated and displayed along the virtual trajectory 1312.” *Id.* at 44 (quoting Ex. 1007 ¶ 121). In the Reply, Petitioner further argues that “[b]it 1310, trajectory 1312, target location 1314, and bone model 1302 form a tag group to guide a surgeon, as [c]laim 3 requires.” Reply 21.

After considering Patent Owner’s arguments, which we discuss below, we agree with Petitioner that Jones discloses claim 3. As we explain in detail above, we agree with Petitioner that at least virtual trajectory 1312 and target location 1314 are augmentation tags. As claim 3 requires, these augmentation tags are “provided in a plurality of layers of the acquired medical image,” including virtual trajectory 1312 in slices 1330, 1332, 1334

of Figure 21. *See* Ex. 1007 ¶¶ 121–122. As can be seen in examples slices shown in Figures 22 and 23 below, target location (renumbered to 1316 in these figures) and virtual trajectory (renumbered to 1314 in these figures) are depicted in multiple slices:

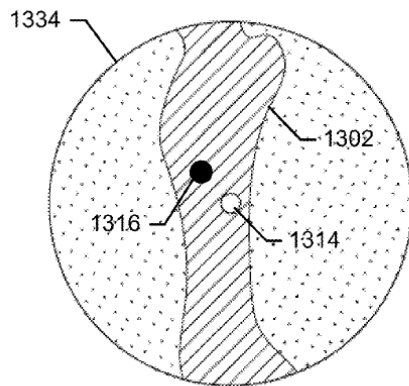


FIG. 22

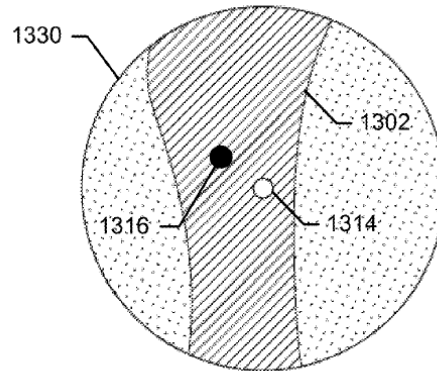


FIG. 23

Id. ¶ 123. Jones explains that Figure 22 illustrates slice 1334 along plane 22–22 in Figure 21 rotated to provide a front view, and Figure 23 illustrates slice 1330 along plane 23–23 in Figure 21 rotated to provide a front view.

Id. Note that when describing Figures 22 and 23, Jones refers to target location 1314 as “tool impact location 1314” and changes the number of target location to 1316. *Id.* ¶ 122. Tool impact location 1314 refers to the location “where the drill bit 1310 is projected to make contact with the bone if the surgeon proceeded to drill while maintaining the present orientation of the drill bit 1310.” *Id.* In other words, tool impact location 1314 corresponds to virtual trajectory 1312 in Figure 21.

Claim 3 further requires that the augmentation tags “are associated to form a tag group to guide a surgeon.” Claim 3 places no restrictions on this how this grouping is formed—so merely associating tags is sufficient, so long as the formed tag group guides a surgeon. We agree with Petitioner

that at least virtual trajectory 1312 and target location 1314 are augmentation tags that are associated in the same views or slices to form a tag group to guide a surgeon. Pet. 44–45; Reply 21. Jones explains that these tags guide a surgeon as follows: “virtual trajectory 1312 can be recomputed and dynamically displayed . . . to provide real-time feedback to a surgeon who is repositioning and reorienting the drill bit 1310 . . . so that the virtual trajectory 1312 will intersect a target location 1314.” Ex. 1007 ¶ 117; *see also id.* ¶ 124 (“provides real-time guidance and feedback to a surgeon”). In other words, virtual trajectory 1312 and target location 1314 guide the surgeon to drill at target location 1314. Moreover, Figures 21, 22, and 23 each show these tags associated together. Accordingly, we agree with Petitioner that virtual trajectory 1312 and target location 1314 meet all the requirements of the augmentation tags of claim 3.

Patent Owner first argues that slices 1330, 1332, and 1334 in Figure 21 are not CT scan images—they are models generated from iso-surfaces. PO Resp. 34. The best we can tell, this argument refers to Patent Owner’s 3D DVR interpretation discussed previously and is therefore unavailing. Claim 3 refers to the same “acquired medical image” of claim 1, which does not preclude models.

Patent Owner next argues that Jones does not augment the slices in Figure 21 or bone model 1302 to identify anatomical structure or to form a tag group of anatomical structures to guide a surgeon. *Id.* We find this argument unpersuasive because, as we explain above for claim 1, both virtual trajectory 1312 and target location 1314 identify anatomical structure. Moreover, claim 3 recites “a plurality of augmentation tags” without limiting those tags to identifying anatomical structure, so Patent Owner’s argument is not commensurate with the scope of claim 3.

Lastly, Patent Owner argues that Jones does not disclose what the specification discloses:

The specification of the '807 Patent explains that “the augmentation tags may guide a surgeon through a safe path to avoid structures, such as an artery 120, which may be delicate or cause problems if the structures are damaged.” Ex. 1001, 4:[13-16]. Jones does not disclose this. Jones does not project a 3D medical image with a **group of augmentation tags** identifying anatomical structure within the 3D medical image. Jones'[s] “virtual trajectory” does not identify anatomical structure within a 3D medical image. Nor does it identify anatomical structures to be avoided within a 3D medical image.

Id. at 35. The specification's concept of guiding the surgeon through a safe path to avoid structures is not claimed, so Patent Owner's argument attempts to improperly import a limitation from the specification into the claim. This argument is unconvincing. *See SuperGuide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004) (noting that “it is important not to import into a claim limitations that are not a part of the claim”).

Accordingly, Petitioner has established by a preponderance of the evidence that Jones anticipates claim 3.

c. Claim 4

Claim 4 recites,

4. The method as in claim 1, further comprising:

creating a plurality of two dimensional (2D) augmentation tags each located on one of a plurality of layers of the acquired medical image; and

joining the plurality of 2D augmentation tags to form a three dimensional (3D) augmentation tag that extends through multiple layers of the acquired medical image.

Ex. 1001, 15:59–65.

For this claim, Petitioner relies on similar arguments it made for claim 3, including that Figure 21 discloses multiple layers of medical images 1330, 1332, and 1334, each of which “is augmented with a 2D representation of a virtual trajectory 1312.” Pet. 46. Petitioner further argues, “Jones discloses that, as illustrated in FIG. 18, the 2D representations of a virtual trajectory 1312 are joined to form a three dimensional (3D) augmentation representation of the virtual trajectory 1312 . . . extending through multiple layers of the acquired medical image,” thus teaching the claim. *Id.* (citing Ex. 1009 ¶¶ 95–97); *see also* Reply 21 (similar).

We agree with Petitioner for similar reasons as claim 3 that Jones discloses claim 4’s limitations. For this claim, Petitioner does not rely on target location 1314 as an augmentation tag and instead relies on 2D representations of virtual trajectory 1312 as the augmentation tags. We agree with Petitioner that the 2D representations of virtual trajectory 1312 extending through multiple layers discloses a plurality of 2D augmentation tags. We further agree that Jones joins these representations to form a 3D augmentation tag that extends through multiple layers of the acquired medical image. *See* Ex. 1007, Figs. 21–23, ¶¶ 122–123; *see also id.* ¶ 121 (“The surgeon may furthermore control whether the graphical display renders a three dimensional or orthographic projection view.”).

Patent Owner argues that “Jones’[s] virtual trajectory does not identify anatomical structure within 3D medical imaging.” PO Resp. 36. We have already determined otherwise as set forth above. Not only that, but like claim 3, claim 4 does not require the plurality of augmentation tags to identify anatomical structure, so Patent Owner’s argument is not commensurate with the scope of claim 4.

Patent Owner adds, “[n]or does FIG. 18 disclose more than one slice that could even be interpreted as being more than one ‘augmentation tag.’” *Id.* This argument is inapposite because Petitioner relies on Figure 21, not just Figure 18. Pet. 46. Petitioner also does not rely on slices as augmentation tags but instead maps the virtual trajectory 1312 in each of those slices to augmentation tags. *Id.* (citing Ex. 1009 ¶ 97).

Finally, Patent Owner argues that Figure 21 of Jones does not teach claim 4 because, “[a]t best, Jones discloses three 2D slices from a surface model that are ‘spaced apart’ from one another along a virtual trajectory.” PO Resp. 36–37 (quoting Ex. 1007 ¶ 19). This argument overlooks that the ’807 patent discloses 3D augmentation tags in the same way, such as is shown in Figure 1C below:

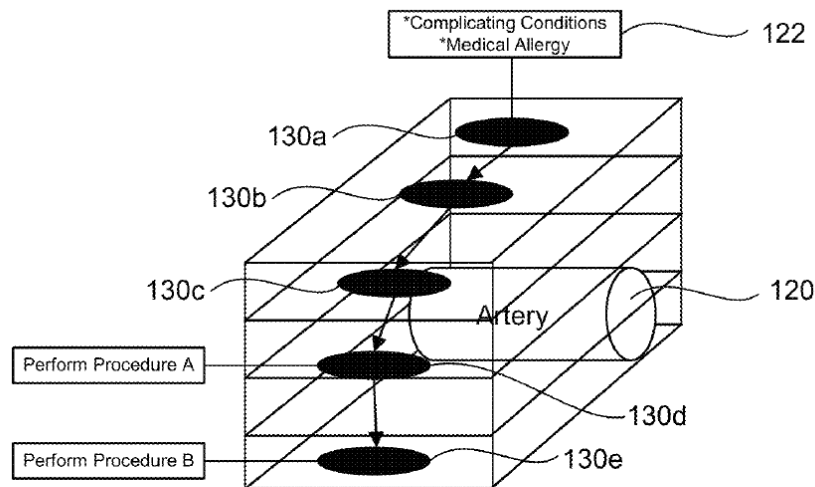


FIG. 1C

As the ’807 patent explains, Figure 1C “illustrates that the augmentation tags can be provided in a plurality of anatomical layers of the acquired medical image.” Ex. 1001, 3:63–65. The ’807 patent further explains that “the

augmentation tags can be associated to form a tag group 130a–e to guide a surgeon.” *Id.* at 4:1–3. Figure 1C’s tag group 130a–e depicts “spaced apart” augmentation tags, similar to the images of the virtual trajectory in the slices of Jones’s Figure 21–23. Similarly, Figure 1D depicts a 3D augmentation tag formed from spaced-apart 2D augmentation tags:

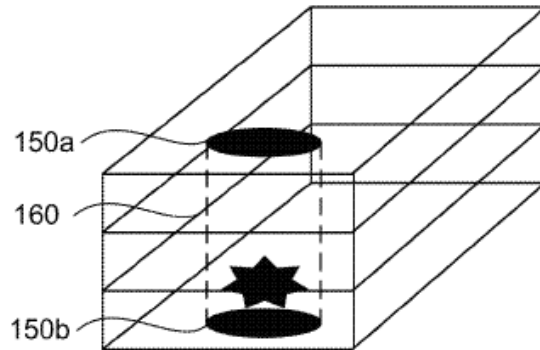


FIG. 1D

Id. at 4:56–63. As explained by the ’807 patent, “[t]he plurality of 2D (two dimensional) augmentation tags 150a-b [in Figure 1D] can be automatically joined together by an application to form a 3D augmentation tag[.]” *Id.* at 4:58–60. Accordingly, Patent Owner’s argument that “spaced apart” slices do not disclose the claimed 3D augmentation tag overlooks the breadth of the term “3D augmentation tag” in light of the ’807 patent specification and is without merit.

Thus, Petitioner has established by a preponderance of the evidence that Jones anticipates claim 4.

d. Claim 5

Claim 5 recites, “The method as in claim 1, wherein retrieving an augmentation tag further comprises retrieving a plurality of augmentation

tags that are linked together to represent an anatomical structure in independent layers of the acquired medical image.” Ex. 1001, 15:66–16:3.

Petitioner asserts that a POSITA “would have understood that retrieving 3D bone model 1302 . . . includes retrieving a plurality of 2D representations of bone model 1302 associated with layers of the acquired medical image,” thus disclosing this claim. Pet. 47 (citing Ex. 1009 ¶ 99; Ex. 1007 ¶ 121).

Patent Owner argues, for example, that “Jones does not use its bone model . . . to identify anatomical structure within a projected 3D medical image.” PO Resp. 38. The Reply does not address this argument (only addressing Patent Owner’s other argument based on its 3D DVR construction, which we do not reach). *See* Reply 22.

We agree with Patent Owner for similar reasons as with claim 2. Petitioner’s terse argument does not explain why a bone model is both an augmentation tag and an anatomical structure in independent layers of the acquired medical image.

Accordingly, Petitioner does not persuade us by a preponderance of the evidence that Jones anticipates claim 5.

e. Claim 6

Claim 6 recites, “The method as in claim 1, wherein retrieving an augmentation tag further comprises retrieving a plurality of augmentation tags that are linked together to show a surgical path of an incision through the patient anatomy with respect to the one or more anatomical structures at the plurality of layers of the acquired medical image.” Ex. 1001, 16:4–9.

Petitioner notes that Jones’s “surgeon can control how many slices are simultaneously displayed . . . along the virtual trajectory 1312,” and that “[t]he surgeon may furthermore control whether the graphical display

renders a three dimensional or orthographic projection view of the graphical anatomical model and/or slices thereof.” Pet. 48 (quoting Ex. 1007 ¶ 121). Petitioner further asserts that a POSITA “would have understood that retrieving virtual trajectory 1312 of FIGS. 18 and 19 further includes retrieving a plurality of 2D representations of virtual trajectory 1312 that are linked together to show a surgical path of an incision through the patient anatomy.” *Id.* (citing Ex. 1009 ¶ 101).

We agree with Petitioner for similar reasons as explained above for claims 3 and 4, that Jones discloses this limitation. Further, we agree with Petitioner that Jones’s teaching that the surgeon may control what is displayed discloses the “retrieving an augmentation tag” aspect of claim 6. We further agree that one of ordinary skill in the art would have understood that retrieving Jones’s virtual trajectory 1312 includes retrieving a plurality of 2D representations of virtual trajectory 1312 that are linked together to show a surgical path of an incision through the patient anatomy, as shown in Figures 18–19, for example. *Id.*

Patent Owner relies on the same arguments as previously discussed, including that Jones’s virtual trajectory does not identify anatomical structure and that the tags are not linked together because they are “spaced apart.” PO Resp. 38. Patent Owner also relies on the specification’s disclosed but unclaimed “guide a surgeon through a safe path to avoid structures, such as an artery,” which we previously found unavailing. *Id.* at 38–39 (quoting Ex. 1001, 4:13–16). None of these arguments overcome Petitioner’s persuasive showing.

Accordingly, Petitioner has established by a preponderance of the evidence that Jones anticipates claim 6.

f. Claim 7

Claim 7 recites, “The method as in claim 1, further comprising capturing the acquired medical image using a MRI, CT scan, X-ray, ultrasound, or photographic images internal to a human body.” Ex. 1001, 16:10–13.

As Petitioner explains for claim 1, “Jones also discloses that ‘imaging equipment 644 may include endoscope cameras, magnetic resonance imaging equipment, computed tomography scanning equipment, three-dimensional ultrasound equipment, endoscopic equipment, and/or computer modeling equipment which can generate multidimensional (e.g., 3D) model based on combining images from imaging equipment.’” Pet. 29 (quoting Ex. 1007 ¶ 42) (citing Ex. 1007 ¶ 82), 49 (referring back to claim 1 discussion). Dr. Kazantzides therefore opines that Jones discloses “capturing the acquired medical image using a MRI, CT scan, X-ray, ultrasound, or photographic images internal to a human body,” as required by claim 7. *Id.* at 49 (citing Ex. 1009 ¶¶ 102–103).

Patent Owner does not dispute this limitation. We agree with Petitioner that Jones discloses capturing the acquired medical image using at least a CT scan or ultrasound, which is sufficient to disclose claim 7’s disjunctive limitation. *See* Ex. 1007 ¶ 42.

Accordingly, Petitioner has established by a preponderance of the evidence that Jones anticipates claim 7.

D. Asserted Obviousness over Jones

Petitioner contends that “to the extent that Jones somehow fails to disclose any element of Claims 1-7, Claims 1-7 would have been obvious to a POSA over Jones in view of what was known in that art.” Pet. 49. In Petitioner’s view, “a POSA would have been motivated to augment medical

imaging of a patient using an augmented reality headset at the relevant time and would have had a reasonable expectation that it would be successful in doing so.” *Id.* (citing Ex. 1009 ¶¶ 104–105). Referring back to its “Scope and Content of the Prior Art” section of the Petition, Petitioner then enumerates several things that a skilled artisan would have known, such as “how to retrieve medical images and display them,” “how to annotate such medical images,” “that an acquired medical image must be captured before it can be stored or retrieved,” and “[d]isplaying annotated medical images and overlaying them onto patients during surgery via HMDs.” *Id.* at 50 (citing *id.* § IV.C (“The Scope and Content of the Prior Art”). Because all of these things were known, Petitioner concludes, “a POSA would have been motivated to combine Jones with the knowledge in the art and would have a reasonable expectation of success in doing so.” *Id.* (citing Ex. 1009 ¶¶ 104–105); *see* Reply 23–24 (similar).

Patent Owner argues that Petitioner “fails to provide any articulated reasoning why the POSITA would be motivated to combine, ‘what was known in the art at the relevant time,’ whatever that may be.” PO Resp. 42. We agree. “[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). “Obviousness requires more than a mere showing that the prior art includes separate references covering each separate limitation in a claim under examination.” *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011) (citation omitted). Rather, “obviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the

combinations or modifications of prior art to arrive at the claimed invention.” *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (emphasis omitted).

Petitioner articulates no rationale to combine the knowledge of the skilled artisan with Jones. Instead, Petitioner merely asserts that many things were known in the art and summarizes, “[a]s such, a POSA would have been motivated to combine Jones with the knowledge in the art and would have a reasonable expectation of success in doing so.” Pet. 50. This is conclusory and insufficient to support a finding of obviousness. Essentially, Petitioner urges us to find obviousness because it was allegedly known to perform each element of the claim in the prior art, with no reason as to why one of ordinary skill in the art would modify Jones to perform such limitations. *See Unigene Labs.*, 655 F.3d at 1360.

Not only that, but Petitioner does not articulate which limitation(s) are taught by what art, but merely asserts that several elements were known without quoting any claim language or citing any specific evidence. Petitioner’s general callback to its “Scope and Content of the Prior Art” section, which is nine pages long, urges us to hunt and peck for citations to support Petitioner’s assertions. *See* Pet. 50. Petitioner’s decision not to quote any claim language results in an exercise of trying to match nine pages of citations in the Petition’s “Scope and Content of the Prior Art” section to claim language puzzle pieces with no shape or form. We decline to construct an argument from Petitioner’s skeletal assertions because we “are not like pigs, hunting for truffles buried in briefs.” *SmithKline Beecham Corp. v. Apotex Corp.*, 439 F.3d 1312, 1320 (Fed. Cir. 2006). As we noted above, it is Petitioner’s burden to identify “with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that

supports the grounds for the challenge to each claim,” and Petitioner fails to meet that burden here. 35 U.S.C. § 312(a)(3).

Accordingly, Petitioner has not shown by a preponderance of the evidence that claims 1–7 would have been obvious over Jones.

E. Asserted Anticipation by Doo

Petitioner also contends that claims 1–7 are anticipated by Doo. Pet. 51–69.

1. Overview of Doo

Doo describes “an intra-operative medical image viewing system that can allow the surgeon to maintain a viewing perspective on the patient while concurrently obtaining relevant information about the patient.” Ex. 1008 ¶ 11. Doo’s system “can present a selectively or variably transparent image of an anatomical feature of a patient” to a surgeon during surgery as the surgeon views, or maintains a viewing perspective generally toward, the actual anatomical feature of the patient. *Id.* ¶ 30.

Figure 2 of Doo is reproduced below.

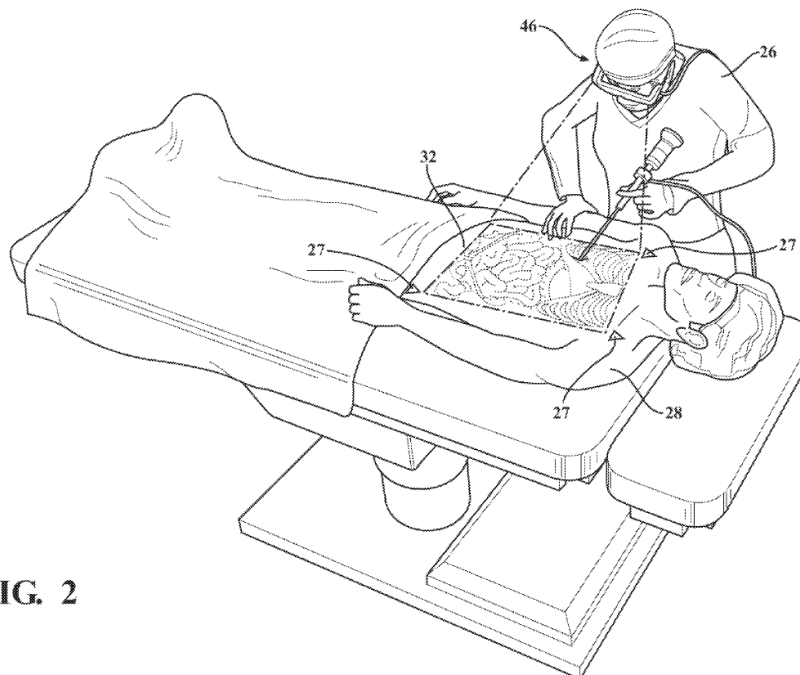


FIG. 2

Figure 2 is a perspective view of an embodiment described in Doo in a first surgical environment. *Id.* ¶ 17. Surgeon 26 wears display 30 suitable for implementing intra-operative medical viewing system while operating on patient 28. *Id.* ¶ 38. The viewing system allows surgeon 26 to maintain a viewing perspective on patient 28 while concurrently obtaining relevant image-based information about patient 28 on demand. *Id.* Display 30 is positioned between surgeon 26 and patient 28, and is “configured to exhibit at least one medical image 32 to the surgeon 26 that is overlaid on the patient 28 [as shown in Figure 2] or that is positioned in an adjacent hovering location as perceived by the surgeon 26.” *Id.* “[D]isplay 30 can be a component of a head mountable unit 46 . . . worn by the surgeon 26 while the surgeon 26 is operating on the patient 28.” *Id.* ¶ 44.

2. Claim 1

Petitioner contends that Doo discloses all of the limitations of claim 1. Pet. 51–65. We address each limitation in turn.

a. [1a] A method for augmenting medical imaging of a patient, the medical imaging displayed using an augmented reality headset worn by a medical professional, the method comprising:

For the Preamble, Petitioner relies on Doo’s “intra-operative medical image viewing system [that] can allow a surgeon to maintain a viewing perspective on the patient while calling up visual images on the fly.” Pet. 53 (quoting Ex. 1008, code (57)). Petitioner also relies on Doo’s teachings that “[a] display is worn by the surgeon . . . during surgery,” and “[t]he display is selectively transparent, and exhibits to the surgeon an image derived from the image file.” *Id.* (quoting Ex. 1008, code (57)). Petitioner further points to Doo’s description of display 30 as “a goggle-type system worn by the surgeon 26.” *Id.* (quoting Ex. 1008 ¶ 38). Petitioner also relies on Doo’s

teaching that “the image can be overlaid on the patient’s actual anatomical feature and . . . sized to match the actual anatomical feature, thus creating the visual impression of a ‘true registration’ and a form of augmented reality.” *Id.* at 54–55 (quoting Ex. 1008 ¶ 37).

Patent Owner contends that “Doo does not disclose a method of augmenting 3D ‘**medical imaging** of a patient’” because Doo does not display or augment 3D medical imaging. PO Resp. 43 (citing Ex. 2002 ¶ 175). Patent Owner asserts that Doo’s image shown in Figure 2 is “clearly two-dimensional” and “does not augment any medical image at all.” *Id.* at 44 (citing Ex. 1008 ¶ 39; Ex. 2002 ¶ 177); *see also* Sur-reply 25–26 (arguing against 2D construction of “acquired medical image”). Petitioner responds that its argument is not limited to Doo’s Figure 2 and that Patent Owner’s “3D-DVR” construction contradicts the ’807 patent. Reply 24–25.

We agree with Petitioner that Doo’s image that is “overlaid on the patient’s actual anatomical feature” constitutes an acquired medical image under the claim because the image is generated, for example, using a CT or MRI. *See* Pet. 54 (citing Ex. 1008 ¶ 37), 57 (addressing limitation [1c], citing Ex. 1008 ¶ 40 (“the system 34 can utilize images generated by . . . computer-aided tomography, . . . MRI”); Ex. 1009 ¶ 117). In contrast, Patent Owner’s 3D medical imaging argument relies on a claim construction position we have not adopted. As we explain above, “acquired medical image” encompasses a set of 2D medical images, so Doo’s CT or MRI images disclose the “acquired medical image.” *See* Ex. 1008 ¶ 40; Ex. 1009 ¶¶ 117–119. Further, we agree with Petitioner that Doo discloses the display of medical imaging “using an augmented reality headset worn by a medical professional” because Doo discloses a “display is worn by the surgeon,” which displays “a form of augmented reality.” Pet. 53–55 (citing Ex. 1008

¶¶ 37–38). The Reply asserts that Patent Owner does not dispute this, and the Sur-reply does not challenge this assertion. Reply 25; *see generally* Sur-reply.

The Patent Owner Response also asserts that Doo “does not augment any medical image at all” and does not “augment 3D medical imaging to identify anatomical structure.” *See* PO Resp. 43–44. This argument is conclusory and therefore unavailing. Regardless, we agree with Petitioner that Doo’s augmented reality headset discloses augmenting medical imaging as claimed. *See* Pet. 54–55 (citing Ex. 1008 ¶ 37; Ex. 1009 ¶¶ 108–111). The phrase “identify anatomical structure” in Patent Owner’s argument does not appear in the preamble but does appear in limitation [1e], so Patent Owner’s argument is not commensurate with the preamble. Nevertheless, for reasons set forth under limitation [1e] below, we determine that Doo discloses “identifying at least one anatomical structure” as claimed. *See infra* Section II.E.2.e.

Accordingly, Petitioner persuades us that Doo discloses the preamble.¹⁸

b. *[1b] receiving a visual image of patient anatomy captured by a visual image camera, the visual image comprising a viewable portion of the patient anatomy*

For limitation [1b], Petitioner relies on Doo’s description of one or more cameras in head mountable unit 46 that “can be configured to generate a streaming image or video signal” and “can be oriented to generate a video signal that approximates the field of view of the surgeon 26 wearing the head mountable unit 46.” Pet. 55 (quoting Ex. 1008 ¶ 46). Petitioner further

¹⁸ We do not express an opinion on whether the preamble is limiting because Petitioner establishes that Doo discloses it.

relies on Doo’s teaching that “[f]orward-facing cameras may stream image data for pattern-recognition logic to determine anatomical features . . . and use those for alignment.” *Id.* (quoting Ex. 1008 ¶ 48). Petitioner also points to Doo’s teaching that “[p]rocessing of the one or more forward-facing video signals can also be applied to determine the identity of the object.

Determining the identity of the object, such as the identity of an anatomical or landmark feature of the patient 28, can be executed by the processor 48.” *Id.* at 56 (quoting Ex. 1008 ¶ 48; citing Ex. 1009 ¶¶ 112–115).

Patent Owner does not dispute this limitation. We agree with Petitioner that Doo discloses it.

c. [1c] retrieving an acquired medical image associated with the patient anatomy from data storage, the acquired medical image comprising imaging acquired of one or more anatomical structures at a plurality of anatomical layers of the patient anatomy

For limitation [1c], Petitioner states that, “according to Doo, ‘[t]he intra-operative medical image viewing system 34 can also include an image control unit 38 configured to retrieve the image file from the image source 44.’” Pet. 56–57 (quoting Ex. 1008 ¶ 41; citing *id.* ¶¶ 11–13, 41, 44).

Petitioner asserts that Doo discloses several different image sources:

Doo discloses “[t]he inter-operative medical image viewing system 34 can include a plurality of image sources 44. . . . By way of example and not limitation, the system 34 can utilize images generated by radiography, computer-aided tomography, positron emission tomography, single-phase emission tomography, magnetic resonance imaging (MRI), ultrasound, . . . and spectroscopy.”

Id. at 57 (quoting Ex. 1008 ¶ 40; citing Ex. 1009 ¶ 117).

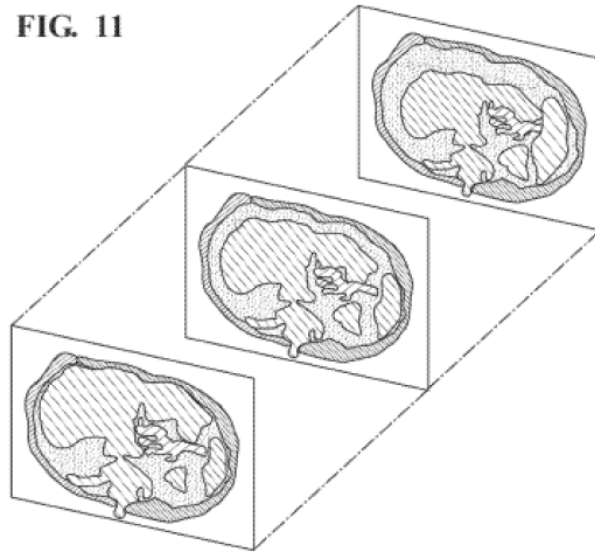
After considering Patent Owner’s arguments, which we address below, we agree with Petitioner that Doo discloses this limitation. In

particular, we agree with Petitioner that Doo's system retrieves images from digital image files generated by, for example, CT scans, MRI, and the like, which Dr. Kazanzides testifies include images at different layers of the patient anatomy. Ex. 1008 ¶ 40; Ex. 1009 ¶ 119.

Patent Owner asserts that a POSITA would have understood that the claimed "medical image" is 3D and direct volume rendered, which Patent Owner asserts Doo's CT and MRI images are not. PO Resp. 44–45 (citing Ex. 2002 ¶¶ 107–113). This contention is unavailing because it depends on a construction of "acquired medical image" that we have not adopted. As we explain above, the phrase "acquired medical image" encompasses the types of 2D medical images generated by Doo's CT and MRI.

Patent Owner also argues that Dr. Kazanzides offers no evidentiary support for his testimony that Doo's images "would **typically** include a plurality of images of different layers of the patient anatomy." *Id.* at 45 (citing Ex. 1009 ¶ 119). Patent Owner's argument lacks credibility because Patent Owner's own declarant testifies that CT and MRI scans include "a set of 2D images or slices." Ex. 2002 ¶¶ 48–50. And as Petitioner persuasively explains in the Reply, "each cross-sectional tomographic slice in Doo's Figure 11 (copied below) illustrates structures at a plurality of anatomical layers."

FIG. 11



Reply 26. As Doo explains, Figure 11 illustrates example three-dimensional tomographic slices, each being a distinct image. Ex. 1008 ¶ 78.

Finally, Patent Owner argues that “Doo’s surface model . . . does not process the entire volume of data.” PO Resp. 46 (citing Ex. 2002 ¶ 104). This argument is unavailing because the claim does not recite “process[ing] the entire volume of data.” Nor does Patent Owner explain how the claim should be interpreted as such.

Accordingly, Petitioner persuades us that Doo discloses limitation [1c].

d. [1d] associating the acquired medical image to align with the viewable portion of the patient anatomy captured by the visual image camera, wherein the one or more anatomical structures of the medical imaging at the plurality of layers are aligned with the visual image of the patient anatomy

For limitation [1d], Petitioner relies on Doo’s description of forward-facing cameras that stream image data to determine anatomical features in the patient field and then use those features for alignment. Pet. 58 (citing Ex. 1008 ¶ 48). Petitioner further relies on Doo’s teaching that “video

signals generated by the camera 50 can be processed by the landmark detector 80 to identify an anatomical feature of the patient 28,” and that landmark detector 80 “can be configured to determine the identity of an object within the field of view of the surgeon 26.” *Id.* (quoting Ex. 1008 ¶ 65). Petitioner also relies on Doo’s description of registering or locking an image to an actual anatomical feature of the patient, such as by overlaying the image on the patient’s actual anatomical feature and matching the size of the image to the anatomical features, “thus creating the visual impression of a ‘true registration’ and a form of augmented reality.” *Id.* at 59 (quoting Ex. 1008 ¶ 37).

After considering Patent Owner’s arguments, which we address below, we agree with Petitioner that Doo discloses this limitation. In particular, we agree with Petitioner that Doo’s system discloses the claimed associating by teaching, for example, that

The exemplary embodiment can provide an intra-operative medical image viewing system 34 that *maintains the registration* of an image to an actual anatomical feature of the patient 28 despite head movement by the surgeon 26. The system 34 can allow the surgeon 26 to *selectively register, i.e., lock, an image to an actual anatomical feature of the patient 28* or to some other fiducial marker associated with the patient 28. For example, the image can be *overlaid on the patient’s actual anatomical feature* and, by using commands in a selected user-interface modality, the image can be sized to *match the actual anatomical feature*, thus creating the visual impression of a “true registration” and a form of augmented reality.

Ex. 1008 ¶ 37 (emphasis added). This paragraph’s explanation of registering or locking an image to an actual anatomical feature, such as by overlaying the image on the anatomical feature to “match” the anatomical

feature, disclose the claim limitation, including the claimed alignment. *See* Ex. 1009 ¶¶ 123–125.

Patent Owner again argues that Doo does not project the 3D “medical image” of claim 1 and that Doo’s surface model “does not include any additional internal or external anatomic structure and therefore does not comprise a ‘plurality of layers.’” PO Resp. 47 (citing Ex. 2002 ¶ 184). Patent Owner further argues that Doo’s “image is 2D and is only aligned to the anatomy of the patient along 2 axes,” and as such is not aligned at the plurality of layers. *Id.* (citing Ex. 2002 ¶ 185). Along those lines, Patent Owner contends, those layers “require alignment of a 3D image projected direct[ly] onto the patient.” *Id.* at 47–48. Much of Patent Owner’s argument relies on Patent Owner’s 3D DVR construction of the “acquired medical image,” which we have not adopted.

Regarding the claimed “plurality of layers,” Doo discloses “three-dimensional images” that “[a]s will be described in greater detail below, . . . can be defined in different formats.” Ex. 1008 ¶ 36.¹⁹ Some of these formats include three-dimensional modalities shown in Figures 6 and 11, which include “an amalgam or fusion of several tomographic slices that have been stitched together so as to create a 3D image.” *Id.* ¶ 74; *see also id.* ¶ 78 (similar, describing Figure 11). Thus, Patent Owner’s contention that Doo’s medical images are not 3D and do not have a plurality of layers (e.g., slices) overlooks Doo’s disclosure to the contrary.

Thus, Petitioner persuades us that Doo discloses limitation [1d].

¹⁹ Both paragraph 36 and 37 of Doo refer to the same “exemplary embodiment.” Ex. 1008 ¶¶ 36–37.

- e. *[1e] retrieving an augmentation tag from data storage, the augmentation tag associated with a location in one layer of the acquired medical image, the augmentation tag identifying at least one anatomical structure of the acquired medical image found at the location*

For limitation [1e], Petitioner relies on Doo's teaching "that '[t]he image can include portions indicating a three-dimensional nature of the anatomical feature of the patient 28'" and "that the image can be displayed 'in any one of a plurality of different two-dimensional, 2-1/2 dimensional, or three-dimensional modalities.'" Pet. 60 (quoting Ex. 1008 ¶ 73). Petitioner asserts that "Doo also discloses 'treatment guide 1232 can be overlaid on (i.e., combined or rendered with) the image 332 that is visible to the surgeon 26 so that the two images 332, 1232 are aligned in true registry,'" and "the treatment guide 1232 could take many different forms including that of a scale (FIGS. 7 and 12), a radiologic study, pre-operative sketches or notes made by the surgeon 26." *Id.* at 61 (quoting Ex. 1008 ¶ 74). Dr. Kazanzides testifies that "[t]he treatment guide is a type of augmentation tag, as described in the '807 patent." Ex. 1009 ¶ 131. Petitioner further asserts that Doo's treatment guide identifies heart 332, which is an anatomical structure. Reply 28–30 (citing Ex. 1008 ¶ 74).

After considering Patent Owner's arguments, which we address below, we agree with Petitioner that Doo discloses this limitation. We refer again to Figure 6 of Doo, reproduced below:

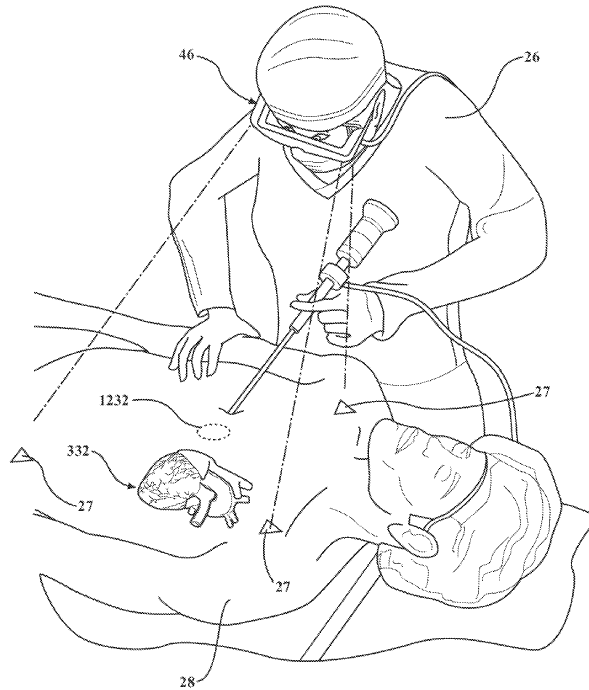


FIG. 6

Figure 6 illustrates a “three-dimensional anatomical view,” in which heart image 332 “appears to the surgeon 26 as three-dimensional” because it is an “amalgam or fusion of several tomographic slices.” Ex. 1008 ¶ 74. Also shown is treatment guide 1232, which “can be overlaid on (i.e., combined or rendered with) the [heart] image 332 . . . so that the two images 332, 1232 are aligned in true registry.” *Id.* In Figure 6, “treatment guide 1232 represents a tumor boundary.” *Id.*

We find that Doo’s treatment guide 1232 is an augmentation tag. Treatment guide 1232 in Figure 6 appears as an oval, which is a “simple geometric shape” described in the ’807 patent as an example of an augmentation tag. *See* Ex. 1001, 3:43–46. Treatment guide 1232 also identifies at least one anatomical structure, namely the heart (image 332), because “treatment guide 1232 can be overlaid on (i.e., combined or rendered with) the [heart] image 332.” Ex. 1008 ¶ 74. We further find that,

because Doo's treatment guide is aligned with the heart image, which is made of tomographic slices, that the treatment guide is associated with a location in one layer of the image. *See id.* ("The [heart] image 332 can be an amalgam or fusion of several tomographic slices that have been stitched together so as to create a 3D image."). We therefore agree with and credit Dr. Kazanzides's testimony that "[t]he treatment guide is a type of augmentation tag, as described in the '807 patent." Ex. 1009 ¶ 131.

Patent Owner contends that Doo's treatment guide is not an augmentation tag because "Figures 7 and 12 only show 2D imaging." PO Resp. 48. This argument is not responsive to the Petition, which argues based on Doo's Figure 6 (which discloses 3D imaging), not Figures 7 and 12. Pet. 61; Reply 30 ("Although [Patent Owner] also tries to distinguish Doo based on its proposed 3D-DVR limitation . . . , Doo discloses a holographic 3D modality" (citing Ex. 1008 ¶ 74)). Regardless, as discussed at length previously, claim 1 does not require 3D imaging.

Patent Owner next contends that Doo's heart model in Figure 6 is not an augmentation tag because it is a surface model, not a 3D medical image. PO Resp. 48–49. Setting aside Patent Owner's 3D argument, this argument is also not responsive to the Petition, which argues that Doo's treatment guide 1232, not the heart image 332, is the augmentation tag. Pet. 61; Reply 28.

Later, under the ground of obviousness over Doo, Patent Owner asserts that Doo's "treatment guide . . . does not identify anatomical structure within a projected 3D medical image." PO Resp. 58. We disagree because Doo discloses that "treatment guide 1232 represents a tumor boundary" and is "overlaid on (i.e., combined or rendered with) the [heart] image 332." Ex. 1008 ¶ 74. We therefore agree with Petitioner that Doo's

treatment guide 1232 identifies the heart image 332, which is indisputably anatomical structure. *See* Reply 30.²⁰

The Sur-reply again argues for a 3D interpretation, including that Doo’s treatment guide 1232 “does not identify anatomical structure **within** the heart image 332.” Sur-reply 27. This argument is unavailing because the claim only requires the augmentation tag to identify an anatomical structure “of the acquired medical image,” not “*within* the acquired medical image.” “Of” is broader than “within,” and accordingly, we agree with Petitioner that Doo’s treatment guide 1232 overlaid on the heart image 332 identifies an anatomical structure “of the acquired medical image.” Ex. 1008 ¶ 74.

Thus, Petitioner persuades us that Doo discloses limitation [1e].

f. [1f] projecting the acquired medical image and the augmentation tag using the augmented reality headset to form a single graphical view as an overlay to the patient anatomy viewable through a lens of the augmented reality headset

For limitation [1f], Petitioner points to Doo’s teaching that the displayed image is overlaid directly on, or projected inside, the patient’s body, and sized to match the actual anatomical feature to create a form of augmented reality. Pet. 62–63 (citing Ex. 1008 ¶¶ 11–13, 30, 35, 37, 39). Petitioner also relies on Doo’s description of treatment guide 1232, discussed for the previous limitation [1e], which is overlaid with heart image 332, and Doo’s example of a radiologist “draw[ing] guiding lines or

²⁰ The Reply raises an alternative argument for how the treatment guide identifies the heart image, which we need not consider. Reply 28–29 (comparing Doo Figure 6 with Figure 1C of the ’807 patent); *see also* Sur-reply 27 (addressing same).

annotations pre-operatively for a surgeon to study.” *Id.* at 64–65 (quoting Ex. 1008 ¶ 74).

Patent Owner argues that Doo does not disclose “augmentation of a first DVR medical image projected onto a patient forming a single graphical view.” PO Resp. 49. This argument is unavailing because the claim does not require DVR, as explained above.

We agree with Petitioner’s analysis. As we explain above, we agree that Doo’s treatment guide 1232 is an augmentation tag, and this is overlaid on the patient anatomy (heart image 332). Ex. 1008 ¶ 74, Fig. 6; *see also id.* ¶ 11 (“The display can . . . exhibit and position at least one image to the surgeon overlaid on or above the patient.”), *quoted in* Pet. 62. As shown in Figure 6 (reproduced above), the medical professional wears head mountable unit 46 to view augmented reality images. *See id.* ¶ 44–46; *see also id.* ¶¶ 37 (“[T]he image can be sized to match the actual anatomical feature, thus creating the visual impression of a ‘true registration’ and a form of augmented reality.”), 39 (“[T]he image 32 may appear (to the surgeon 26) to be projected directly onto the body surface of the patient 28 or projected inside the patient’s body.”).

Thus, Petitioner persuades us that Doo discloses limitation [1f].

g. Summary as to Claim 1

For the foregoing reasons, Petitioner has proven by a preponderance of the evidence that claim 1 is anticipated by Doo.

3. Dependent Claims 2–7

Petitioner contends that Doo discloses all of the additional limitations of claims 2–7, which directly depend from claim 1. Pet. 65–69. We address each dependent claim in turn.

a. Claim 2

Claim 2 recites, “The method as in claim 1, further wherein augmentation tag conforms to a three dimensional (3D) structure in the acquired medical image to identify an anatomical structure associated with a medical procedure to be performed.” Ex. 1001, 15:51–54.

Petitioner contends that, “[a]s discussed above with respect to the steps of [c]laim 1 involving an augmentation tag, Doo discloses elements conforming to a 3D structure in the acquired medical image.” Pet. 65. Relying on Figure 6 of Doo and its corresponding description, Petitioner argues that “Doo discloses a 3D image of a heart 332, which image is created from an amalgam of tomography slices and used to identify an anatomical structure involved in a procedure on a patient 28.” *Id.* (citing Ex. 1008 ¶ 74, Fig. 6). Petitioner further argues that Doo discloses “a fusion of several tomography slices can be stitched together to create a 3D image.” *Id.* at 65–66 (quoting Ex. 1008 ¶ 78; citing Ex. 1009 ¶ 141).

In response, Patent Owner contends that the testimony of Petitioner’s declarant, Peter Kazanzides, Ph.D., “appears to argue that Doo’s heart model [332] satisfies both the augmentation tag and the 3D medical image elements of [dependent claim 2].” PO Resp. 50. According to Patent Owner, Dr. Kazanzides’s testimony in this regard “lacks merit” because Doo’s heart image 332 cannot disclose both the “medical image” and “augmentation tag” required by dependent claim 2. *Id.* at 50–51 (citing Ex. 1008, Figs. 1B, 1F, 1H). Patent Owner asserts that Dr. Kazanzides “does not explain how Doo’s heart model [332] conforms to any 3D structure **in the acquired medical image.**” *Id.* That is, Patent Owner argues that Doo’s heart model 332 “is a separate model and therefore cannot ‘conform’ to an existing portion of the acquired medical image required by [dependent] claim 2.” *Id.*

Petitioner counters that Doo states, “in the case of a . . . tumor boundary, the two displayed images 332, 1232 will be rendered in full registry.” Reply 31 (quoting Ex. 1008 ¶ 74). Petitioner then asserts that, “from the surgeon’s perspective, tumor boundary 1232 conforms to the boundary of the tumor in 3D anatomical structure 332 to identify the tumor associated with a medical procedure to be performed,” as required by dependent claim 2. *Id.*

Patent Owner then counters by arguing, “for the first time on reply and without support,” Petitioner asserts that “‘tumor boundary 1232’ satisfies [dependent] claim 2.” Sur-reply 28 (citing Reply 31). Patent Owner argues that Petitioner’s reply argument is “unsupported attorney argument” because “Doo does not state anywhere that the tumor boundary 1232 is itself 3D or that it conforms to a 3D structure in a projected 3D medical image that identifies anatomical structure **within** the 3D medical image.” *Id.*

Based on the fully developed trial record, we agree with Petitioner that Doo discloses the limitation of dependent claim 2. We refer again to Figure 6 of Doo, reproduced below. Ex. 1008 ¶ 21.

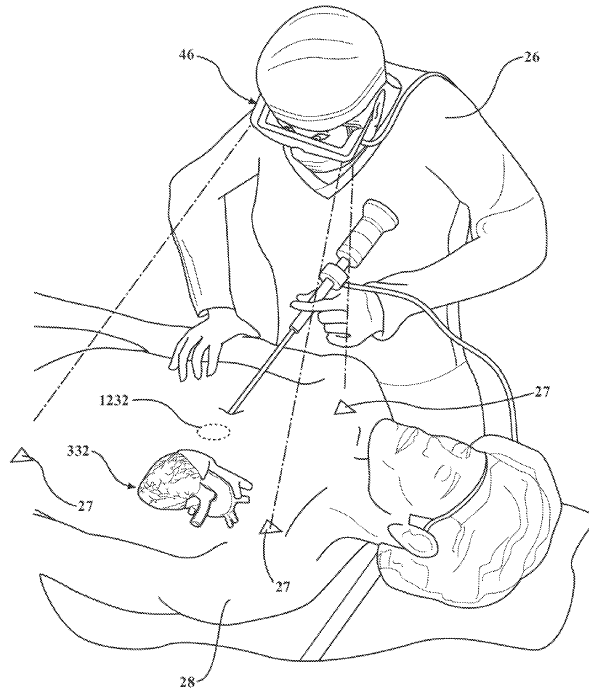


FIG. 6

Figure 6 illustrates surgeon 26 using head mountable unit 46 to perform a procedure “on or near” the heart of patient 28. *Id.* ¶ 74. According to Doo, heart image 332 “appears to the surgeon 26 as three-dimensional” because it is an “amalgam or fusion of several tomographic slices.” *Id.* Treatment guide 1232 “can be overlaid on (i.e., combined or rendered with) the [heart] image 332 . . . so that the two images 332, 1232 are aligned in true registry.” *Id.* In an example where “treatment guide 1232 represents a tumor boundary,” “the two displayed images 332, 1232 will be rendered in full registry with one another so that any panning, zooming, rotating, or titling of the one image 332 will be accompanied by a corresponding manipulation of the other image 1232.” *Id.* Based on this example, we find that Doo discloses the limitation of dependent claim 2 because treatment guide 1232 conforms to 3D heart image 332 because of their alignment in true registry, and with this arrangement treatment guide 1232 identifies a tumor boundary

while surgeon 26 performs a procedure to remove the tumor located on or near the heart of patient 28.

Contrary to Patent Owner's assertions, we do not understand Petitioner to argue that Doo's 3D heart image 332 discloses both the "augmentation tag" and "a three dimensional (3D) structure in the acquired medical image" required by dependent claim 2. *See* PO Resp. 50–51. Instead, because Petitioner begins its argument for dependent claim 2 by stating that "[a]s discussed above with respect to the steps of [c]laim 1 involving an augmentation tag," we understand Petitioner to rely on its arguments and evidence presented for limitation [1e] where Petitioner first takes the position that Doo's treatment guide 1232 discloses the "augmentation tag."²¹ With this in mind, it is reasonable to conclude that Petitioner's remaining arguments for dependent claim 2 focus on how Doo's 3D heart image 332 discloses "a three dimensional (3D) structure in the acquired medical image," which is a claimed feature that first appears in dependent claim 2 and is not otherwise required by independent claim 1.

We do not agree with Patent Owner that Petitioner's reply argument that "tumor boundary 1232 conforms to the boundary of the tumor in 3D anatomical structure 332 to identify the tumor associated with a medical procedure to be performed" (Reply 31) constitutes a new, belated argument. *See* Sur-reply 28. Instead, in our view, Petitioner's argument in reply

²¹ Petitioner's argument and evidence presented for dependent claim 3 only bolsters our view that Petitioner continues to rely on Doo's treatment guide 1232 to disclose the "augmentation tag" required by dependent claim 2 because, tracking its analysis of limitation [1e], Petitioner argues that Doo's treatment guide 1232 discloses the "plurality of two dimensional (2D) augmentation tags" required by dependent claim 3. Pet. 66 (citing Ex. 1008 ¶ 74, Fig. 6).

reinforces its initial reliance on two separate features from Doo (i.e., treatment guide 1232, which represents a tumor boundary, and 3D heart image 332) to disclose the two separate claimed elements required by dependent claim 2 (i.e., the “augmentation tag” and “a three dimensional (3D) structure in the acquired medical image”).

Petitioner has therefore shown by a preponderance of the evidence that Doo anticipates claim 2.

b. Claims 3–6

Claims 3–6 recite generally similar limitations. Petitioner does not establish by a preponderance of the evidence that Doo discloses any of the additional limitations of claims 3–6.

Claim 3 recites, “The method as in claim 1, wherein a plurality of augmentation tags are provided in a plurality of layers of the acquired medical image and the plurality of augmentation tags are associated to form a tag group to guide a surgeon.” Ex. 1001, 15:55–58.

Petitioner argues that “Doo discloses a plurality of augmentation tags associated to form a tag group to guide a surgeon,” pointing to Doo’s “treatment guide 1232 . . . that can take many forms.” Pet. 66 (citing Ex. 1008, Fig. 6, ¶ 74). Petitioner adds, “Doo discloses that treatment guide 1232 may represent, for example, a tumor boundary, a scale, preoperative sketches, guiding lines, or pre-operative sketches.” *Id.* (citing Ex. 1008 ¶ 74). The treatment guide can show a surgical path of an incision, Petitioner argues. *Id.* (citing Ex. 1009 ¶ 143).

Patent Owner argues that “Petitioner has failed to demonstrate how Doo’s treatment guide discloses ‘a plurality of augmentation tags.’” PO Resp. 52; *see also* Sur-reply 28–29. In response, Petitioner contends that Doo’s “treatment guide 1232 may represent a plurality of the same things,

such as ‘preoperative sketches’ and ‘guiding lines.’” Reply 31 (citing Ex. 1008 ¶ 74). Petitioner asserts that “[e]ither plurality would be understood to form a group to guide a surgeon.” *Id.*

We agree with Patent Owner that Petitioner has failed to demonstrate how Doo’s treatment guide 1232 discloses this limitation. In particular, Petitioner fails to demonstrate that Doo discloses a plurality of augmentation tags “provided in a plurality of layers of the acquired medical image.” In other words, even if Doo’s “preoperative sketches” and “guiding lines” represent a plurality of augmentation tags, Petitioner does not sufficiently explain how those tags are “provided in a plurality of layers of the acquired medical image.” In fact, Petitioner presents no theory at all for how Doo’s treatment guide is provided in a plurality of layers of the acquired medical image.

At most, Doo discloses that “treatment guide 1232 can be overlaid on (i.e., combined or rendered with) the [heart] image 332.” Ex. 1008 ¶ 74. Doo’s disclosure therefore falls short of disclosing “a plurality of augmentation tags are provided in a plurality of layers of the acquired medical image.”

Accordingly, Petitioner has not established by a preponderance of the evidence that Doo anticipates claim 3.

Claim 4 recites,

4. The method as in claim 1, further comprising:
 - creating a plurality of two dimensional (2D) augmentation tags each located on one of a plurality of layers of the acquired medical image; and
 - joining the plurality of 2D augmentation tags to form a three dimensional (3D) augmentation tag that extends through multiple layers of the acquired medical image.

Ex. 1001, 15:59–65.

The parties’ arguments for this claim are similar to their arguments for claim 3. *See* Pet. 67; Reply 31; PO Resp. 53; Sur-reply 29. Although Petitioner asserts that Doo’s 3D image is “created from an amalgam of tomography slices and extending through multiple layers of the slices,” Petitioner merely mentions “that augmentation tags may be created” and does not explain how those augmentation tags “extend[] through multiple layers of the acquired medical image” as claimed. Pet. 67. The Reply asserts, unconvincingly, that Doo’s “guiding lines would be understood to be 3D.” Reply 31. Petitioner provides no support for this assertion.

Thus, for similar reasons as we explain above for claim 3, Petitioner fails to establish by a preponderance of the evidence that Doo discloses “joining the plurality of 2D augmentation tags to form a three dimensional (3D) augmentation tag that extends through multiple layers of the acquired medical image.”

Claim 5 recites, “The method as in claim 1, wherein retrieving an augmentation tag further comprises retrieving a plurality of augmentation tags that are linked together to represent an anatomical structure in independent layers of the acquired medical image.” Ex. 1001, 15:66–16:3.

The parties’ arguments for this claim are similar to their arguments for claim 3. *See* Pet. 67 (“The discussion above with respect to augmentation tags is incorporated by reference.”); Reply 31; PO Resp. 54; Sur-reply 29. For similar reasons as we explain above for claims 3 and 4, Petitioner fails to establish by a preponderance of the evidence that Doo discloses “retrieving a plurality of augmentation tags that are linked together to represent an anatomical structure in independent layers of the acquired medical image.”

Claim 6 recites, “The method as in claim 1, wherein retrieving an augmentation tag further comprises retrieving a plurality of augmentation tags that are linked together to show a surgical path of an incision through the patient anatomy with respect to the one or more anatomical structures at the plurality of layers of the acquired medical image.” Ex. 1001, 16:4–9.

The parties’ arguments for this claim are similar to their arguments for claim 3. *See* Pet. 68 (“The discussion above with respect to augmentation tags to guide a surgeon, including the discussion regarding [c]laim 3, is incorporated by reference.”); Reply 32; PO Resp. 54–56; Sur-reply 30.

There are a few differences between claim 6 and claims 3–5. Unlike claims 3–5, claim 6 recites “*at* the plurality of layers of the acquired medical image,” instead of “*in* a plurality of layers” (claim 3) or “*extends through* multiple layers” (claim 4) or “*in* independent layers” (claim 5). We therefore take a closer look at the additional requirements of claim 6. Those requirements include “a plurality of augmentation tags that are linked together to show a surgical path of an incision through the patient anatomy.” Ex. 1001, 16:5–7. Petitioner relies on its claim 3 argument (Pet. 68), where Petitioner asserts that Doo’s treatment guide 1232 may represent preoperative sketches or guiding lines. Pet. 66 (citing Ex. 1008 ¶ 74). Dr. Kazanzides testifies that a POSITA “would [have understood] that such treatment guides could be used to show a surgical path of an incision.” Ex. 1009 ¶ 143, *cited in* Pet. 66.

We find Dr. Kazanzides’s testimony insufficient because (1) it is unsupported by the teachings of Doo and because (2) he testifies that a POSITA would have understood that Doo’s treatment guides merely “could” be used to show a surgical path of an incision. This testimony acknowledges that Doo does not explicitly teach the “show a surgical path of an incision”

portion of claim 6. Yet this testimony is also insufficient to show that Doo inherently discloses this claim language because “*could* be used to show a surgical path of an incision” indicates a mere possibility, not necessity. *See In re Oelrich*, 666 F.2d 578, 581 (CCPA 1981) (“Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.”) (citation omitted). And although the knowledge of one skilled in the art can be relevant to an anticipation analysis, Dr. Kazantzides does not rely on any inference that the ordinarily skilled person would have drawn from Doo. *See Eli Lilly and Co. v. Los Angeles Biomedical Res. Inst. at Harbor-UCLA Med. Ctr.*, 849 F.3d 1073, 1074–75 (Fed. Cir. 2017) (“[T]he dispositive question regarding anticipation is whether one skilled in the art would reasonably understand or infer from a prior art reference that every claim element is disclosed in that reference.”).

Accordingly, Petitioner fails to establish by a preponderance of the evidence that Doo anticipates claim 6.

c. Claim 7

Claim 7 recites, “The method as in claim 1, further comprising capturing the acquired medical image using a MRI, CT scan, X-ray, ultrasound, or photographic images internal to a human body.” Ex. 1001, 16:10–13.

Petitioner argues that Doo discloses that “images [can be] generated by radiography, computer-aided tomography, positron emission tomography, single-phase emission tomography, magnetic resonance imaging (MRI), ultrasound, elastography, . . . and spectroscopy.” Pet. 68 (quoting Ex. 1008 ¶ 40). Patent Owner does not dispute this limitation. We agree with Petitioner that Doo discloses capturing the acquired medical image using at

least a CT scan or MRI, which is sufficient to disclose claim 7's disjunctive limitation. *See* Ex. 1008 ¶ 40. Accordingly, Petitioner has established by a preponderance of the evidence that Doo discloses claim 7.

F. Asserted Obviousness over Doo

Similar to the ground of obviousness over Jones, Petitioner contends for this ground that, “[t]o the extent that Doo somehow fails to disclose any element of [c]laims 1–7, [c]laims 1–7 would have been obvious to a POSA in view of what was known in that art at the relevant time.” Pet. 69.

Referring back to its “Scope and Content of the Prior Art” section of the Petition, Petitioner then enumerates several things that a skilled artisan would have known, without citation to any specific references. *Id.* at 69–70 (citing Ex. 1009 ¶¶ 152–153).

Patent Owner again argues that Petitioner's rationale to combine is conclusory. PO Resp. 56–57. We agree. For similar reasons we explain above for the ground of obviousness over Jones, Petitioner articulates no rationale to combine the knowledge of the skilled artisan with Doo. Petitioner therefore fails to meet its burden to identify “with particularity . . . the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim.” 35 U.S.C. § 312(a)(3).

Accordingly, Petitioner has not shown by a preponderance of the evidence that claims 1–7 would have been obvious over Doo.

III. MOTION TO EXCLUDE

Petitioner filed a motion to exclude arguing that Patent Owner's declaration by Dr. Mulumudi “should be excluded because it lacks the relevance and reliability required for admission.” Mot. 1. For example,

Petitioner contends that Dr. Mulumudi does not qualify as a POSITA under Petitioner’s definition of a POSITA because Dr. Mulumudi “lacks both (a) a degree in computer science, electrical engineering, or a related field, and (b) years of experience in the design, development, and study of augmented reality (AR) devices.” *Id.* Petitioner also points, for example, to Dr. Mulumudi’s assertion that he is “qualified to provide expert opinions on **some aspects** of the technology described in the ’807 patent.” *Id.* at 4 (citing Ex. 2002 ¶ 29).

Patent Owner opposes, arguing that Dr. Mulumudi is “an actual medical doctor with over two decades of ‘experience in imaging, virtual reality, augmented reality with biofeedback, and treating peripheral vascular and coronary artery diseases from 2000 through today.’” Opp. 1 (citing Ex. 2002 ¶ 13). Patent Owner also asserts that Petitioner improperly reargues the merits in its motion to exclude. *Id.* at 2.

We need not decide Petitioner’s motion to exclude because in each instance where we find for Patent Owner above, this finding is due to Petitioner’s own failure of proof. For instance, as we explain above, Petitioner makes conclusory arguments for claims 2 and 5 in the Jones grounds and similarly unsupported arguments for claims 3–6 of the Doo grounds. *Cf. Mantissa Corp. v. First Financial Corp.*, No. 2022-1963, slip. op. at 5–6 (Fed. Cir. Feb. 14, 2024) (nonprecedential) (“On appeal, both parties devote consideration attention to the arguments of whether Dr. Rhyne qualifies as a POSA and whether the district court erred in relying on his testimony to determine that ‘transaction partner’ was indefinite. We do not need to address this because in this case the issue of indefiniteness can be resolved based on the intrinsic evidence alone, as both parties agree.”).

Thus, we do not rely on Patent Owner's declarant to support a finding that Petitioner did not meet its burden for those arguments. Accordingly, Petitioner's motion to exclude is dismissed as moot.²²

Regardless, Petitioner's objections go more to the weight and sufficiency of the declarants' testimony, rather than their admissibility. *See Liquid Dynamics Corp. v. Vaughan Co.*, 449 F.3d 1209, 1221 (Fed. Cir. 2006). We have broad discretion to assign the proper weight to declarations. *Velandier*, 348 F.3d at 1371. There is also no requirement of a perfect match between the expert's experience and the field of the patent. *See SEB S.A. v. Montgomery Ward & Co.*, 594 F.3d 1360, 1373 (Fed. Cir. 2010). We therefore find in the alternative that Dr. Mulumudi's alleged lack of expertise in all aspects of the technology of the '807 patent is an insufficient reason to exclude Dr. Mulumudi's testimony. To the extent portions of our decision may be read to rely on Dr. Mulumudi's testimony, we assign sufficient weight to that testimony because that testimony is supported by the teachings of the asserted reference, and Petitioner's countervailing declarant testimony is correspondingly unsupported by the teachings of the asserted reference.

²² For similar reasons, we do not reach Petitioner's Reply argument that Patent Owner's declarant is not qualified. Reply 2.

IV. CONCLUSION²³

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–7	102	Jones	1, 3, 4, 6, 7	2, 5
1–7	103	Jones		1–7
1–7	102	Doo	1, 2, 7	3–6
1–7	103	Doo		1–7
Overall Outcome			1–4, 6, 7	5

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–4, 6, and 7 of the '807 patent are unpatentable;

ORDERED that Petitioner has not shown by a preponderance of the evidence that claim 5 of the '807 patent is unpatentable;

ORDERED that Petitioner's Motion to Exclude is dismissed as moot; and

²³ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

FURTHER ORDERED that, because 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.

IPR2023-00045
Patent 10,945,807 B2

FOR PETITIONER:

Kia Freeman
John Curran
McCARTER & ENGLISH, LLP
kfreeman@mccarter.com
jcurran@mccarter.com

FOR PATENT OWNER:

Joseph Harmer
Jed Hansen
THORPE NORTH WESTERN LLP
joseph.harmer@tnw.com
hansen@tnw.com