

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MEDIVIS, INC.,
Petitioner,

v.

NOVARAD CORP.,
Patent Owner.

IPR2023-00042
Patent 11,004,271 B2

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

RAEVSKY, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision on Remand
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

This proceeding is on remand from the U.S. Court of Appeals for the Federal Circuit. The court issued its decision in *Medivis, Inc. v. Novarad Corp.*, No. 2024-1794, 2026 WL 587294 (Fed. Cir. Mar. 3, 2026) (“*Medivis*”) (Paper 40),¹ affirming-in-part, reversing-in-part, and remanding our Final Written Decision (Paper 35) for further proceedings.

In its opinion, the Federal Circuit reversed our “determination of no motivation to combine Doo and Amira” and remanded for further proceedings to evaluate whether claims 1–6 and 11–20 (“the Remanded Claims”) of U.S. Patent No. 11,004,271 B2 (“the ’271 patent,” Ex. 1001) are unpatentable in view of Petitioner’s obviousness challenge over Doo and Amira. *Medivis*, slip op. at 9–10.

We have jurisdiction under 35 U.S.C. § 6(b). We issue this Final Written Decision on Remand pursuant to 35 U.S.C. §§ 144, 318 and 37 C.F.R. § 42.73 in an *inter partes* review involving Medivis, Inc. (“Petitioner”) and Novarad Corp. (“Patent Owner”). For the reasons discussed below, after considering the entirety of the record in light of the Federal Circuit’s directives in *Medivis*, we hold that Petitioner has demonstrated, by a preponderance of the evidence, that claims 1–6, 11, and 20 are unpatentable; however, Petitioner has not demonstrated, by a preponderance of the evidence, that claims 12–19 are unpatentable.

¹ This decision references the slip opinion at Paper 40.

II. BACKGROUND

A. Procedural Posture

Petitioner filed a Petition requesting to institute an *inter partes* review of claims 1–6 and 11–20 of the ’271 patent. Paper 3 (“Pet.”). Patent Owner did not file a Preliminary Response. Based on the information presented in the Petition, we instituted an *inter partes* review of claims 1–6 and 11–20 (Paper 7, “Institution Decision” or “Dec.”).

Following institution, Patent Owner filed a Patent Owner Response (Paper 12, “PO Resp.”), Petitioner filed a Reply (Paper 20, “Reply”), and Patent Owner filed a Sur-reply (Paper 22, “Sur-reply”), among other papers. We held an oral hearing and entered a transcript into the record. Paper 34 (“Tr.”).

We issued a Final Written Decision holding that Petitioner had not shown that claims 1–6 and 11–20 were anticipated or obvious over the prior art. Paper 35. Petitioner appealed the Final Written Decision to the Federal Circuit. Paper 38. The Federal Circuit issued an opinion affirming as to anticipation but reversing as to obviousness, and remanding “for further proceedings consistent with this opinion.” *Medivis*, slip op. at 2, 10.²

B. The ’271 Patent

The ’271 patent relates to augmenting real-time views of a patient with three-dimensional (3D) data. Ex. 1001, code (57). The ’271 patent explains that conventional medical imaging systems can create 3D data for a

² The Federal Circuit did not address our holding that Petitioner also failed to establish the obviousness of claims 1–6 and 11–20 over the combination of Chen, 3D Visualization, and 3D Slicer. See Paper 35, 25–31; Pet. 54–69. We accordingly do not address Petitioner’s challenge over these references in this decision.

patient that can be viewed on a computer display, detached from the patient, which may cause some problems. *Id.* at 2:49–55. For example, a surgeon may view an image of a patient’s brain on a computer display to determine the location of a tumor, and then shift his view to the actual patient and attempt to identify the approximate location on the actual patient of the tumor inside the patient’s brain. *Id.* at 2:56–63. The surgeon, however, may accidentally identify the left side of the brain in the image as having the tumor when in reality the tumor is in the right side of the brain, which may lead to the surgeon erroneously making an unnecessary incision on the left side of the patient’s skull. *Id.* at 2:63–3:3. To avoid such errors, the ’271 patent describes methods of automatically aligning or registering the 3D data with a real-time view of the actual patient so that images derived from the 3D data may be projected onto the real-time view of the patient. *Id.* at 3:21–27.

Figure 1 of the ’271 patent is reproduced below.

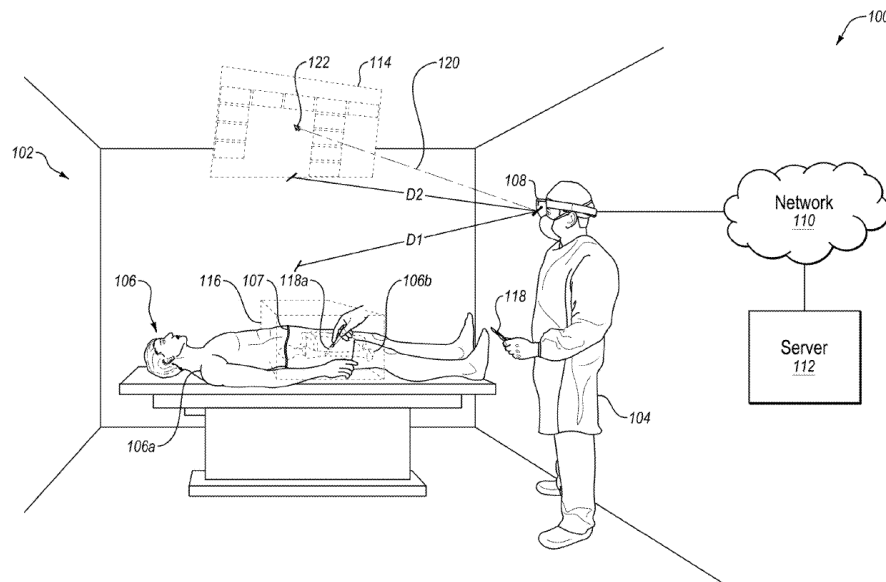


FIG. 1

Figure 1 illustrates an augmented reality (AR) environment in which real-time views of a patient may be augmented with 3D data. *Id.* at 2:26–28.

Environment 100 includes 3D space 102, user 104, patient 106, and AR headset 108 in communication with server 112 over network 110. *Id.* at 3:63–67. AR headset 108 may be employed by the user 104 in order to augment a real-time view of the patient 106 with one or more inner layers of the patient 106 including, for example, bones 106*b* (as illustrated in FIG. 1), muscles, organs, or fluids. *Id.* at 4:42–46.

C. Illustrative Claim

Claim 1 is representative of the challenged claims and is reproduced below.³

1. A method for augmenting real-time, non-image actual views of a patient with three-dimensional (3D) data, the method comprising:
 - [A] identifying 3D data for the patient, the 3D data including an outer layer of the patient and multiple inner layers of the patient; and
 - [B] displaying, in an augmented reality (AR) headset, one of the inner layers of the patient from the 3D data projected onto real-time, non-image actual views of the outer layer of the patient,
 - [C] the projected inner layer of the patient from the 3D data being confined within the volume of a virtual 3D shape.

Ex. 1001, 18:54–65.

D. Remanded Ground of Unpatentability

We reconsider the following challenges set forth in the Petition in view of the Federal Circuit’s directives in *Medivis*:

³ We refer to Patent Owner’s limitation numbering for convenience. *See* PO Resp. 8–9.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis ⁴
1–6, 11–20	103	Doo, ⁵ Amira ⁶

Petitioner relies on two Declaration by Peter Kazanzides, Ph.D. (Exs. 1012, 1021) in support of its contentions. Patent Owner relies on declarations by Mahesh S. Mulumudi, M.D. (Ex. 2002) and Craig Rosenberg, Ph.D. (Ex. 2004).

III. ANALYSIS

A. Level of Ordinary Skill in the Art

We made the following findings in our Final Written Decision, which we repeat here for completeness. Paper 35, 7–8.

Petitioner contends that a person having ordinary skill in the art (“POSITA”) 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) familiarity with conventional medical imaging data and visualization of data for medical procedures or (b) working with a team including someone with such familiarity.

Pet. 10 (citing Ex. 1012 ¶ 25). 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:

⁴ Throughout this decision, we eliminate the parties’ italicization of reference names from quotations without noting “emphasis omitted.”

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

⁶ Excerpt of Amira 5 User’s Guide, title through Chapter 2 (Visual Imaging 2009) (Ex. 1005).

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 their personal experience with 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). 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).

The parties propose constructions for the claim terms “three-dimensional (3D) data,” “inner layer(s) of the patient,” “confined within a virtual 3D shape,” and “being having.” Pet. 11–14; PO Resp. 11–18. In our Final Written Decision, we found it unnecessary to construe any of these claim terms in order to resolve the disputed issues. Paper 35, 8. However, on remand, we find it necessary to construe each of these terms, except “being having.”

1. “three-dimensional (3D) data”

a) *Proposed constructions*

Both Petitioner and Patent Owner propose constructions for “three-dimensional (3D) data” (hereafter “3D data”) in claim 1. Pet. 11–13; PO Resp. 11–14.⁷

Petitioner proposes the following construction for “3D data”:

the 3D data includes one or more of MRI images, Computerized Tomography (CT) scan images, X-ray images, Positron Emission Tomography (PET) images, ultrasound images, fluorescence images, Infrared Thermography (IRT) images, and Single-Photon Emission Computer Tomography (SPECT) scan image.

Pet. 12–13 (citing Ex. 1012 ¶ 32 (Dr. Kazanzides opining that “the person of ordinary skill in the art would understand that ‘3D data’ may be one or more of any of the foregoing types of images.”)).

Patent Owner proposes construing “3D data” as “Direct-volume-rendered [(“DVR”)] CT, MRI, PET, and SPECT imaging (and also ultrasound and fluorescence imaging, depending on the methods used).” PO Resp. 11. Later in the same brief, Patent Owner rewords its proposed construction as “direct-volume-rendered three-dimensional (3D) imaging of the anatomy of a patient, including an outer layer of the patient and multiple inner layers of the patient.” *Id.* at 14 (citing Ex. 2002 ¶ 70).

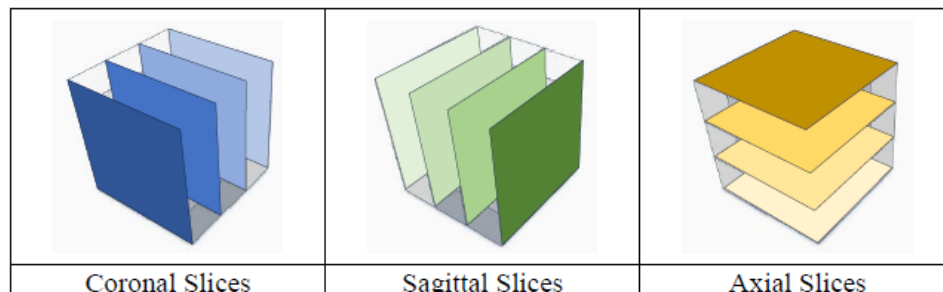
⁷ Patent Owner’s proposed construction for “3D data” is very similar to its proposed construction for the term “acquired medical image” in IPR2023-00045, which we declined to adopt. *See Medivis, Inc. v. Novarad Corp.*, IPR2023-00045, Paper 36 at 7–21 (PTAB Apr. 12, 2024), *aff’d*, 2025 WL 3537315 (Fed. Cir. Dec. 10, 2025) (nonprecedential) (applying FED. CIR. R. 36).

In the Reply, Petitioner restates Patent Owner’s position on DVR as follows—DVR means “non-feature-specific, unsegmented image of the entire volume of the patient anatomy.” Reply 3; *see also id.* n.1 (asserting that Patent Owner’s summary tables “do not fairly summarize the constructions that [Patent Owner] applies when seeing to distinguish the prior art”). The Sur-reply does not dispute this characterization. *See* Sur-reply 6–10, 25 (“the 3D dataset of the ’271 Patent is not segmented”); *see also* PO Resp. 54 (arguing that Chen teaches only “‘feature-specific’ surface models”).⁸

Patent Owner describes DVR as “a method for visualizing medical imaging data, including combined CT and MRI scans or ultrasound data, in three-dimensions.” PO Resp. 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),”⁹ which “enabl[es] a view of the

⁸ We need not resolve the apparent inconsistency in Patent Owner’s multiple construction positions because, as we explain below, Patent Owner’s DVR proposal is unsupported, and hence all versions of Patent Owner’s proposed construction are incorrect.

⁹ 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:



anatomical structures within the volume of a patient from any direction.” *Id.* (citing Ex. 2002 ¶ 54). Patent Owner further explains, “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 pre-selected outer surfaces of a particular anatomical feature.” *Id.* (citing Ex. 2002 ¶ 55), 3 (citing Ex. 2002 ¶ 49 (defining voxel)).

For the reasons set forth below, we find Petitioner’s proposed construction more persuasive.

b) Claim language

We begin our analysis with the claim language. *Interactive Gift Exp., Inc. v. Compuserve Inc.*, 256 F.3d 1323, 1331 (Fed. Cir. 2001). Petitioner argues, and we agree, that the plain language of the claim does not support Patent Owner’s proposed DVR construction. Reply 3–4. Nothing in the claim recites rendering the 3D data using DVR or even mentions “rendering” at all.

Patent Owner points to the preamble of claim 1 as requiring DVR because it recites “real-time” augmentation of “non-image actual views of a patient with [3D] data.” PO Resp. 13. Patent Owner further notes that claim 1 recites the “3D data include[s] an outer layer of the patient and multiple inner layers of the patient” and that the 3D data must be “confined within a volume of [a] virtual 3D shape.” *Id.* Based on these recitations (and the specification, which we discuss below), Patent Owner argues that a POSITA “would understand that this 3D data must have height, width, and

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.

depth” and that DVR “is the only visualization method that is: three dimensional (3D), includes an outer layer of the patient and multiple inner layers of the patient (where the layers also have depth as well as height and width), and is capable of being confined[] within a virtual 3D shape.” *Id.* at 13–14 (quoting Ex. 2002 ¶ 69; citing Ex. 1001, 6:17–21).

We do not see any connection between the reproduced claim language and “direct volume rendering.” Of the words “direct volume rendering,” only one of these words appears in the claim—volume. But no “rendering,” direct or otherwise, is recited. Patent Owner does not adequately explain why a “volume” implies any particular rendering, apart from relying on Dr. Mulumudi’s testimony that it must be so. We address his testimony below.

c) Specification

Turning to the ’271 patent’s specification, Petitioner argues, and we agree, that specification support for “DVR” is equally scant. Reply 3–4. DVR is simply not mentioned in the specification, and Patent Owner does not argue otherwise.

Instead, Patent Owner relies on the specification’s description of “3D slices,” arguing that “the inner layers of the patient also ‘have depth as well as height and width.’” PO Resp. 13 (quoting Ex. 1001, 6:17–21 (“3D slices may include . . . slices that have a depth as well as a height and width.”)). Based on this, Patent Owner contends that “a POSITA would understand that direct volume rendering” is required by the claim. *Id.* at 14 (citing Ex. 2002 ¶¶ 60, 69). Petitioner argues that Patent Owner conflates “slices” and “layers” and asserts that Patent Owner’s own expert admitted that “slices” and “layers” are different. Reply 4 (citing Ex. 1022, 32:7–16). In response,

Patent Owner reiterates its “3D slices” position but does not rebut the Reply arguments. *See* Sur-reply 7, 9.

We agree with Petitioner that the term “3D slices” has no apparent connection to the phrase “direct volume rendering.” Patent Owner’s argument appears to be that DVR “requires an image of the *entire* anatomical volume that is neither feature-specific nor segmented, [which] would seemingly require that all inner layers be displayed.” Reply 4; *see* Sur-reply 6–10 (not disputing Petitioner’s characterization). But, as Petitioner notes, the specification directly undermines this by teaching “display [of] a slice of the 3D data **instead of a volume** of the 3D data.” *See* Reply 4 n.2 (quoting Ex. 1001, 5:34–35). In other words, to the extent DVR would depict an image of the *entire* anatomical volume, displaying 3D slices “instead of a volume of the 3D data” implies the *opposite* of DVR.

Even if “3D slices” somehow implied DVR, Patent Owner’s position is still untenable. Claim 1 does not recite “3D slices.” Instead, claim 1 recites “3D data” and “inner layers.” Ex. 1001, 18:54–65. Patent Owner fails to clarify the relationship between “slices,” “3D data,” and “layers,” and its expert even admits that slices and layers are two different things. *See* PO Resp. 13; Ex. 1022, 32:7–16 (agreeing that the words “slice” and “layer” are not “synonyms”), *cited in* Reply 4. We also agree with Petitioner that dependent claim 3 distinguishes slices and layers by reciting “slices of the projected inner layer.” Reply 4 (quoting Ex. 1001, 19:3–10). Thus, even if 3D slices somehow implied DVR, the language of claim 1 does not support limiting the claim this way.

Patent Owner’s claim construction theory is also unclear because Patent Owner fails to explain its legal basis. *See generally* PO Resp.; Tr. 26:7–15 (failing to articulate a legal theory for limiting the claim apart

from relying on Dr. Mulumudi's testimony). For example, Patent Owner does not argue for explicit lexicography or disavowal. *Thorner v. Sony Computer Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012) (finding lexicography and disavowal as exceptions to plain and ordinary meaning). Nor does Patent Owner argue for implied definition or disclaimer. *See Info-Hold, Inc. v. Applied Media Techs. Corp.*, 783 F.3d 1262, 1267 (Fed. Cir. 2015) (finding that a term may be defined "by implication"). Thus, we are left with the task of determining the plain and ordinary meaning (as would be understood by a person of ordinary skill in the art at the time of the invention) and in the context of the entire patent disclosure, under *Phillips*. *See Phillips*, 415 F.3d at 1303. And following the rubric of *Phillips*, Patent Owner has not persuaded us that the plain and ordinary meaning of "3D data" should be construed to incorporate DVR.

Moreover, the specification describes 3D data quite broadly. For example, Petitioner points out that the specification teaches that 3D data may even include 2D images that have 3D significance. Reply 5 ("3D data may include a 2D image, such as an X-ray image, because when the 2D image is projected into a 3D space **the 2D image has 3D significance.**") (citing Ex. 1001, 12:4–7). Patent Owner disputes this, arguing that "[a] 2D X-ray is not 3D." *See* Sur-reply 6. But the specification states "3D data . . . may *include* a 2D image" projected onto a patient, not that "a 2D X-ray is 3D." *See* Ex. 1001, 12:4–7 (emphasis added). We cannot read into the claim a DVR construction when the specification's 3D data includes mere projected 2D images having 3D significance.

Thus, there is no support in the specification for Patent Owner's proposed construction.

d) *Extrinsic evidence*

As neither party relies on the prosecution history, we now turn to Patent Owner's reliance on extrinsic evidence. Patent Owner's proposed DVR construction relies heavily on the testimony of Dr. Mulumudi. *See* PO Resp. 11–14. But this reliance is unavailing because the intrinsic record fails to mention DVR and because Dr. Mulumudi's testimony of multiple rendering techniques undermines his opinion that DVR is required.

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 asserts that “[a]fter review of the specification and the claims, a POSITA understands that ‘3D data’ means direct volume rendered medical imaging because direct volume rendering is the only visualization method that is consistent with the language of the ’271 Patent and the claims.” Ex. 2002 ¶ 69. But as we explain above, DVR is inconsistent with the specification and claims. Thus, 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).

Not only is Dr. Mulumudi's testimony untethered from the ’271 patent's disclosure, but it also explicitly acknowledges alternative rendering

techniques 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 “DVR.” Ex. 2002 ¶ 51. That there are several methods for rendering CT and MRI images (which the ’271 patent explicitly includes in 3D data, Ex. 1001, 11:45–47) undercuts Dr. Mulumudi’s opinion that 3D data *must* be limited to DVR. In other words, the ’271 patent’s lack of expressed preference for any particular rendering technique suggests that we should not limit the claims to just one of those techniques.

Finally, we note that Dr. Mulumudi’s testimony that a POSITA would have understood that “3D data must have height, width, and depth,” even if true, does not help Patent Owner. Ex. 2002 ¶ 69. Dr. Mulumudi fails to persuasively explain *why* height, width, and depth would mandate a specific rendering technique that must be read into the claim.

Accordingly, Dr. Mulumudi’s testimony also fails to support Patent Owner’s proposed construction.¹⁰

e) Petitioner’s proposed construction

Having declined to adopt Patent Owner’s proposed construction, we now turn to Petitioner’s proposal. As we note above, Petitioner explains that the ’271 patent broadly describes “3D Data” as follows:

the 3D data includes one or more of MRI images,
Computerized Tomography (CT) scan images, X-ray images,

¹⁰ Patent Owner also “call[s] into question [Dr. Kazanzides’s] objectivity and the reliability of his testimony” based on his “relationship with Petitioner and Johns Hopkins University, a competitor of Patent Owner.” PO Resp. 12 n.2. The proper vehicle to challenge the qualifications of a witness is through a motion to exclude. 37 C.F.R. § 42.64(c) (“A motion to exclude must be filed to preserve any objection.”). As Patent Owner did not file that motion, we do not address this argument further.

Positron Emission Tomography (PET) images, ultrasound images, fluorescence images, Infrared Thermography (IRT) images, and Single-Photon Emission Computer Tomography (SPECT) scan image.

Pet. 12–13 (citing Ex. 1012 ¶ 32; Ex. 1001, 11:45–51). Petitioner primarily relies on a specification passage that mirrors this language. *Id.*; *see also* PO Resp. 12 (acknowledging this passage). Although that passage does not employ lexicography because it recites “3D data of the patient 106 *may* include,” this passage underscores that “3D data” broadly encompasses at least the listed imaging types. *See* Ex. 1001, 11:45–46 (emphasis added).

Hence, we determine that, in the context of the ’271 patent, “3D data” encompasses at least Petitioner’s listed imaging types reproduced above. We also note that, as we explain above, the specification explicitly contemplates that “3D data may include a 2D image, such as an X-ray image, because when the 2D image is projected into a 3D space the 2D image has 3D significance.” *See* Ex. 1001, 12:4–7. In so stating, we emphasize that we are not finding that a single 2D image, on its own, constitutes “3D data,” but rather, that 3D data may “include” a *projected* 2D image because it “has 3D significance.” *See id.*

2. *“inner layer(s) of the patient”*

Patent Owner contends that “inner layer(s) of the patient,” appearing in claims 1 and 11, should be construed as “[a] 3D direct volume rendering of the anatomy of the patient at a certain depth below the outer layer, or skin, of the patient.” PO Resp. 14. Patent Owner’s incorporation of DVR into this claim construction mirrors its proposed construction of “3D data,” and the parties’ arguments are similar. *See id.* at 14–15; Reply 6–10; Sur-reply 10–12. Petitioner asserts that plain meaning applies. Reply 6.

For reasons similar to our “3D data” construction above, we find Patent Owner’s proposal unsupported and apply the plain meaning of “inner layer(s) of the patient.” In so finding, we note that Petitioner does not offer a definition for the plain and ordinary meaning, and we find it unnecessary to supply one here to resolve the disputed issues.

3. *“confined within a virtual 3D shape”*

Petitioner initially proposes construing just part of this term, “virtual 3D shape.” Pet. 13–14. Petitioner proposes that, based on the ’271 patent’s specification, “virtual 3D shape” may be “as simple as box and as complex as the outer layer of the patient, all of which would confine a projected inner layer of the patient.” *Id.* (citing Ex. 1012 ¶ 33).

Patent Owner initially offers the following construction for “confined within a virtual 3D shape”: “The virtual 3D shape controls what portion of the projected inner layer(s) are visible to the user. The virtual 3D shape confines the projected inner layer(s), it does not merely surround them.” PO Resp. 15–16. Then Patent Owner adds that “confinement” of the 3D data within the virtual 3D shape “requires a navigational or orientation function that allows the user to manipulate and view 3D slices of the patient’s anatomy along multiple axes,” and that the “virtual 3D shape” is a “virtual

user interface or virtual control.” *Id.* at 17–18 (citing Ex. 2004 ¶¶ 83, 85; Ex. 1001, 3:50–54). Thus, Patent Owner argues, the “virtual 3D shape” is “not simply an outer boundary.” *Id.* at 18.

Patent Owner’s proposal relies on incorporating material from the specification. For example, Patent Owner points to disclosure of “virtual spatial difference box 116,” which “may be generated by the AR headset 108 *to confine within a volume*” and which “*may . . . assist the user when navigating the projected 3D data.*” *Id.* at 16 (citing Ex. 1001, 6:5–8, 11–13). Patent Owner also asserts that “virtual 3D shape,” like the specification’s “virtual spatial difference box,” is a virtual user interface or virtual control “for altering the [3D data] projected onto the real-time view of the patient.” *Id.* at 17 (citing Ex. 1001, 3:50–54).

Petitioner responds that “confined within a volume” simply means “kept within a volume.” Reply 10 (citing Exs. 1025, 1026, 1027). Petitioner also contends that nothing in the specification limits “virtual 3D shape” to a user interface control. *Id.* at 11. Rather, Petitioner argues, Figure 1 depicts “virtual user interface 114” and “virtual cursor 122” as the virtual control elements, both of which are distinct from “virtual spatial difference box 116.” *Id.* at 11–12 (citing Ex. 1001, Fig. 1, 3:63–4:7, 5:18–49, 7:18–31). Accordingly, Petitioner contends, a “virtual 3D shape” is better understood in the context of the specification as a “virtual 3D shape (i.e., form) as simple as a box and as complex as the outer layer of the patient,” not a user interface control. *Id.* at 13.

In the Sur-reply, Patent Owner refers to dependent claim 3 as further implying a “navigational or orientation function.” Sur-reply 12 (“the virtual 3D shape **is configured to be controlled** to reposition . . . slices”).

We agree with Petitioner. Patent Owner points to no lexicography or disclaimer (expressed or implied) in the specification that would permit us to read Patent Owner’s narrow construction into the claim term “confined within a virtual 3D shape.” Instead, the specification language Patent Owner relies on includes permissive, not restrictive, language. For instance, Patent Owner quotes the specification as stating, “virtual spatial difference box 116 *may* . . . assist the user when navigating the projected 3D data,” but the word “may” here is non-limiting. *See* PO Resp. 16 (quoting Ex. 1001, 6:11–13) (emphasis changed); *cf. ATOS, LLC v. Allstate Insurance Company*, No. 2023-1621 (Fed. Cir. May 23, 2025) (nonprecedential) (“The term ‘can’ is non-limiting.”) (citation omitted). Patent Owner also admits that the disclosed “‘virtual spatial difference box’ . . . *is an example* of the ‘virtual 3D shape’ of claim 1.” PO Resp. 17 (emphasis added).

Moreover, the Sur-reply’s theory that dependent claim 3 implies a navigational or orientation function is unclear, at best, and irrelevant, at worst. Sur-reply 12; *Karlin Tech., Inc. v. Surgical Dynamics, Inc.*, 177 F.3d 968, 971–72 (Fed. Cir. 1999) (Normally, “limitations stated in dependent claims are not to be read into the independent claim from which they depend.”) (citation omitted). Finally, to the extent Patent Owner relies on declarant testimony that conflicts with the plain meaning of the claims and the specification, we again give it little weight. *See* PO Resp. 17–18 (citing Ex. 2004 ¶¶ 83, 85, 90; Ex. 2002 ¶¶ 64, 73).

We give the term “confined within a virtual 3D shape” its plain and ordinary meaning, which Petitioner persuasively asserts encompasses being confined within a “virtual 3D shape (i.e., form) as simple as a box and as complex as the outer layer of the patient.” Reply 13.

No other terms require construction. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368 (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 Obviousness over Doo and Amira

Petitioner contends that claims 1–6 and 11–20 would have been obvious over the combined teachings of Doo and Amira. Pet. 31 (Ground 2), 41–54.

In our Final Written Decision, we determined that Petitioner failed to articulate a sufficient rationale to combine Amira with Doo and, hence, failed to prove, by a preponderance of the evidence, that claims 1–6 and 11–20 would have been obvious over the combination of Doo and Amira. Paper 35, 25. The Federal Circuit in *Medivis* held that “the record requires finding that a [person of ordinary skill in the art] would have been motivated to combine Doo and Amira.” *Medivis*, slip op. at 9. Accordingly, we take this determination as to motivation to combine to be established.

Because we determined in our Final Written Decision that Petitioner failed to articulate a sufficient rationale to combine Amira with Doo, we did not address the parties’ other arguments. We now address these disputed issues.

1. Independent Claim 1

a. Public Accessibility of Amira

We first address Patent Owner’s argument on a threshold issue, whether Petitioner has shown that Amira was publicly accessible. PO Resp. 19. Patent Owner contends that “Petitioner offers no proof in its papers” that Amira was publicly available. *Id.* For example, Patent Owner

contends, “Petitioner’s apparent reliance on a copyright notice on several of the asserted documents is not enough.” *Id.*

The Petition asserts that Amira is prior art for the following reasons:

In 2009, Visual Imaging published the Amira 5 User’s Guide. Ex. 1005, Excerpt of Amira 5 User’s Guide title through Chapter 2 (Visual Imaging 2009) (“Amira”). Amira is prior art because its publication date predates the earliest priority date recited in the ‘271 Patent.

Pet. 29.

In response to Patent Owner’s argument disputing Amira’s public accessibility, Petitioner adds in the Reply that Amira “is a user guide that was [publicly] available in 2009” and “was available on the internet on October 4, 2012.” Reply 19 (citing Ex. 1005, 4; Ex. 1024 ¶¶ 5, 6).

Petitioner cites to a declaration by Nathaniel E. Frank-White (Ex. 1024), a Records Request Processor at the Internet Archive, which maintains the Wayback Machine. *Id.*; Ex. 1024 ¶ 1. Exhibit B of Mr. Frank-White’s declaration purports to be a true and accurate copy of the Wayback Machine’s “records of the archived files for the [uniform resource locators (“URLs”)] and the dates specified in the attached coversheet of each file.” Ex. 1024 ¶ 6. Exhibit B includes a URL, <https://web.archive.org/web/20121004141444/http://www.amira.com/images/stories/pdf/522/AmiraUsersGuide.pdf>, followed by a copy of Amira.

As Mr. Frank-White explains, the Internet Archive assigns a URL to the Wayback Machine’s archived files in the format, “[http://web.archive.org/web/\[Year in yyyy\]\[Month in mm\]\[Day in dd\]\[Time code in hh:mm:ss\]/\[Archived URL\]](http://web.archive.org/web/[Year in yyyy][Month in mm][Day in dd][Time code in hh:mm:ss]/[Archived URL]).” *Id.* ¶ 5. He then testifies that an example URL, <http://web.archive.org/web/19970126045828/http://www.archive.org/>, “would be the URL for the record of the Internet

Archive home page HTML file (<http://www.archive.org/>) archived on January 26, 1997 at 4:58 a.m. and 28 seconds (1997/01/26 at 04:58:28).” *Id.* Based on this explanation, we find that the URL for Amira in Exhibit B (which contains the number 20121004141444) refers to a date of October 4, 2012, which is the date Petitioner asserts that Amira “was available on the internet.” *See id.*, Exhibit B; Reply 19.

Patent Owner responds that Exhibit 1024 “should be disregarded” because “Medivis cannot rely on additional prior art that was submitted after its Petition to carry its burden without leave from the Board.” Sur-reply 4.

The determination of whether a document was publicly accessible “involves a case-by-case inquiry into the facts and circumstances surrounding the reference’s disclosure to members of the public.” *Medtronic, Inc. v. Barry*, 891 F.3d 1368, 1380 (Fed. Cir. 2018). For instance, courts routinely rely on the Wayback Machine to determine when a reference was first made available to the public. *Valve Corp. v. Ironburg Inventions Ltd.*, 8 F.4th 1364, 1374 (Fed. Cir. 2021) (“District courts have taken judicial notice of the contents of webpages available through the Wayback Machine ‘as facts that can be accurately and readily determined from sources whose accuracy cannot reasonably be questioned.’”).

We disagree with Patent Owner’s argument that “Medivis cannot rely on additional prior art”—Exhibits 1023 and 1024—“that was submitted after its Petition to carry its burden without leave from the Board.” Sur-reply 4. As Patent Owner did not file a motion to exclude these exhibits, we decline Patent Owner’s invitation to disregard them. We also find Petitioner’s Reply argument proper because it directly responds to Patent Owner’s contention that Petitioner did not prove the public accessibility of Amira. *See Chamberlain Grp., Inc. v. One World Techs., Inc.*, 944 F.3d, 919, 925

(Fed. Cir. 2019) (“Parties are not barred from elaborating on their arguments on issues previously raised.”). Petitioner’s Reply argument appropriately elaborates on the Petition’s contention that Amira was publicly accessible.

Patent Owner also does not dispute the substance of Petitioner’s evidence. For example, Patent Owner does not address the substance of Mr. Frank-White’s declaration. We find that this evidence, including Mr. Frank-White’s declaration testimony, persuasively supports the public availability of Amira as of the date shown in the Wayback Machine URL. *See* Ex. 1024.

b. Overview of Merits Arguments

We now turn to the parties’ arguments on specific claim limitations. Petitioner’s Doo and Amira challenge relies on Amira solely for limitation 1[C] and relies on Doo for the remaining limitations of claim 1. *See* Pet. 41–43 (Ground 2), 31–30 (Ground 1). Against Petitioner’s challenge over Doo and Amira, Patent Owner only challenges whether Amira discloses limitation 1[C]. PO Resp. 36–40.

Our Final Written Decision solely addressed limitation 1[C] because our finding of no anticipation rested on Petitioner’s failure to establish that Doo teaches this limitation. *See* Paper 35, 21. We therefore did not reach the parties’ arguments over Doo for other limitations.

To fully address Petitioner’s challenge over Doo and Amira, we now analyze the parties’ arguments over Doo alone (for the preamble and limitations 1[A] and 1[B]), as well as the parties’ arguments over Amira (for limitation 1[C]).

c. A method for augmenting real-time, non-image actual views of a patient with three-dimensional (3D) data, the method comprising

Petitioner contends that Doo discloses the preamble of claim 1. Pet. 31–32 (citing Ex. 1012 ¶¶ 63–64). Petitioner points to Figure 2 of Doo, reproduced below:

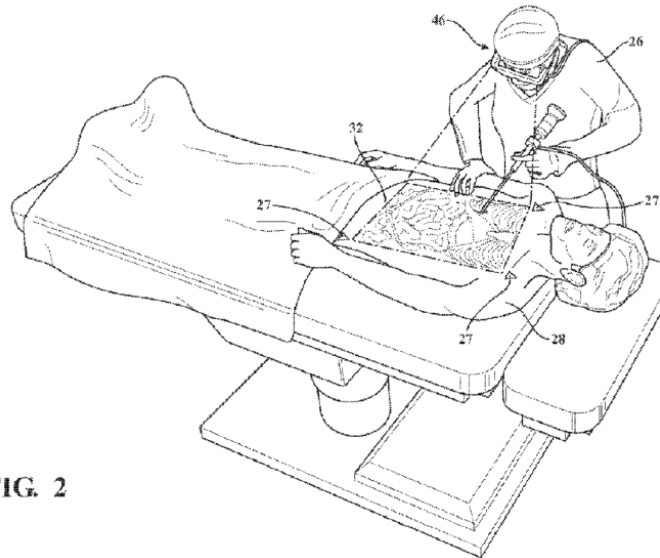


FIG. 2

Id. at 32. According to Petitioner, Figure 2 illustrates Doo’s surgical environment, in which a surgeon wears a display that exhibits an image. *Id.* (citing Ex. 1008, Abstract). Petitioner cites Doo’s disclosure that “[t]he image can include portions indicating a three-dimensional nature of the anatomical feature of the patient 28.” *Id.* (quoting Ex. 1008 ¶ 73).

Petitioner later explains that Doo’s “image can be overlaid on the patient’s actual anatomical feature and, . . . sized to match . . . , thus creating the visual impression of a ‘true registration’ and a form of *augmented* reality.”

Reply 14 (quoting Ex. 1008 ¶ 37).

Patent Owner first argues, without further explanation, that Doo’s projected image in Figure 2 “is two-dimensional, not three-dimensional.” PO Resp. 26. We find Petitioner’s argument persuasive and Patent Owner’s

assertion conclusory. Petitioner cites, and Patent Owner does not address, Doo's disclosure that the image indicates "a three-dimensional nature" of the patient feature. Pet. 32 (quoting Ex. 1008 ¶ 73). Further, to the extent Patent Owner implicitly relies on its DVR construction for 3D data, which we have not adopted, we find this argument unpersuasive. As we explain above, "3D data" also "may include a 2D image, such as an X-ray image that may be projected onto . . . the patient" because it "has 3D significance." See Ex. 1001, 12:4–7. Doo's image in Figure 2 is part of Doo's 3D data that is projected onto a patient, which has 3D significance. See Ex. 1008 ¶¶ 40 (describing "images generated by . . . computer-aided tomography [and] MRI"), 73 ("The image can include portions indicating a three-dimensional nature of the anatomical feature of the patient 28.").

Patent Owner next argues that the image in Figure 2 hovers directly over the patient, which means that "the images are not projected onto the body of the patient," as Patent Owner believes the preamble requires. PO Resp. 26. But this argument is not commensurate with the scope of the preamble, which does not require images to be projected onto the patient. The term "projected" appears in limitations 1[B] and 1[C], which we address in more detail below. Thus, even if the preamble would be understood to require that the image be "projected" onto the patient, we find that Doo meets this requirement for the same reasons as discussed below for limitations 1[B] and 1[C].

Accordingly, we agree with Petitioner that Doo discloses the preamble of claim 1, whether or not it is limiting.

d. 1[A] identifying 3D data for the patient, the 3D data including an outer layer of the patient and multiple inner layers of the patient

Petitioner contends that Doo discloses limitation 1[A]. Pet. 33–34 (citing Ex. 1012 ¶¶ 65–68). Citing Doo’s disclosure of various imaging techniques such as tomography and MRI, Petitioner argues that a POSITA would have understood that Doo’s images generated by these techniques would have included an outer layer and multiple inner layers of the patient. *Id.* at 33 (citing Ex. 1008 ¶ 40); Ex. 1012 ¶ 65.

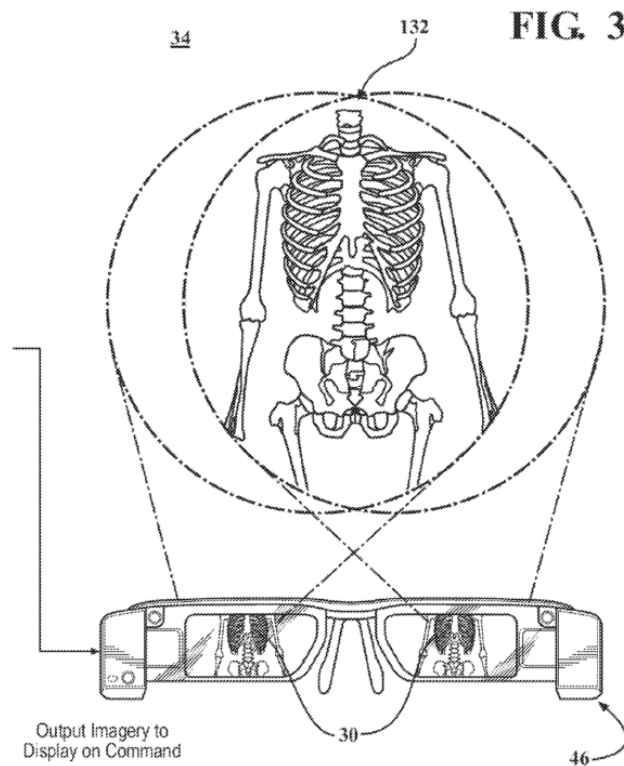
Patent Owner responds that imaging techniques such as tomography and MRI, as disclosed in Doo, generate 2D images, not the “direct volume rendered data” of claim 1. PO Resp. 26–27 (citing Ex. 2002 ¶ 101; Ex. 1008 ¶ 40). Patent Owner also argues that Doo does not disclose 3D inner layers “that can be confined (i.e., navigated) and viewed along any axis.” *Id.* at 27.

Petitioner’s argument is more persuasive because Patent Owner relies on its proposed constructions for “3D data” and “confined” that we have not adopted. *See id.* The correct construction of 3D data encompasses “one or more of MRI images [and] Computerized Tomography (CT) scan images,” which is precisely what Doo discloses. *See* Ex. 1011, 11:45–51; Ex. 1008 ¶ 40. Further, Patent Owner’s “confined” argument is misplaced because this term appears in limitation 1[C], not 1[A]. We also agree with Dr. Kazantzides that a POSITA would have understood that Doo’s images generated by CT and MRI techniques would have included an outer layer and multiple inner layers of the patient because his testimony on this issue is consistent with Doo’s disclosure. Ex. 1012 ¶ 65 (citing Ex. 1008 ¶ 40).

Accordingly, we agree with Petitioner that Doo discloses limitation 1[A].

e. 1[B] displaying, in an augmented reality (AR) headset, one of the inner layers of the patient from the 3D data projected onto real-time, non-image actual views of the outer layer of the patient

Petitioner asserts that Doo discloses limitation 1[B]. Pet. 34–36 (citing Ex. 1012 ¶¶ 69–73). Petitioner contends that Doo discloses a head mountable “display . . . worn by the surgeon . . . during surgery.” *Id.* at 34–35 (citing Ex. 1008, Abstract, ¶ 44). Figure 3 of Doo, reproduced below, depicts an example of head mounted display 30:



Id. at 35.

Petitioner explains that in Figure 3 above, “display 30 can be selectively and/or variably transparent and configured to exhibit at least one medical image 32 to the surgeon 26 that is overlaid on the patient.” *Id.* (quoting Ex. 1008 ¶ 38). Petitioner further argues that Doo’s “image 32 may appear (to the surgeon 26) to be . . . projected inside the patient’s body.” *Id.*

at 36 (quoting Ex. 1008 ¶ 39). Moreover, Petitioner cites to Doo's disclosure that "the image can be overlaid on the patient's actual anatomical feature." *Id.* at 36 (quoting Ex. 1008 ¶ 37). Petitioner notes that Figures 2 and 6 of Doo also disclose the projected display of internal organs, such as bones and a heart, of a patient from the 3D data. *Id.*

Patent Owner contends that Figures 2 and 3 of Doo fail to disclose limitation 1[B]. PO Resp. 27–28. Patent Owner states, "Figure 2 shows only a two-dimensional 'x-ray of the chest of the patient 28 . . . hovering directly over the body of the patient,' without any three-dimensional significance." *Id.* at 27 (quoting Ex. 2002 ¶ 103) (citing Ex. 1008 ¶ 39). Patent Owner adds, "neither Figure 2 nor Figure 3 discloses a volume of the anatomy of the patient at a certain depth below the outer layer, or skin, of the patient." *Id.* at 28 (quoting Ex. 2002 ¶ 103). Finally, Patent Owner contends, "Doo does not disclose 3D 'inner layers' that can be confined (i.e., navigated) and viewed along any axis." *Id.* (quoting Ex. 1002 ¶ 103).

Petitioner responds that Patent Owner's focus on Doo's "2D X-ray" fails because the '271 patent specification explains that "3D data may include a 2D image, such as an X-ray image, because when the 2D image is projected into a 3D space the 2D image **has 3D significance.**" Reply 17 (quoting Ex. 1001, 12:1–7). Patent Owner replies that "there is no indication in Doo that image 132 in FIG. 3 is a 3D volume including '**an outer layer . . . and multiple inner layers** of the patient,' as recited in claim 1." Sur-reply 16–17. Rather, Patent Owner contends, "it is simply a single skeletal surface model." *Id.* (citing Ex. 2002 ¶ 103).

Petitioner's argument is more persuasive. We agree with Petitioner, for example, that under the plain language of limitation 1[B], Doo's headset displays (on display 30) one of the inner layers of the patient (medical image

32) from Doo’s 3D data projected onto real-time, non-image actual views of the outer layer of the patient. *See* Pet. 34–35; Ex. 1012 ¶¶ 69–73; Ex. 1008 ¶¶ 37–39. The medical images in Doo include CT and MRI images. Ex. 1008 ¶ 40. Doo’s display overlays one of these images over a patient’s anatomical feature in augmented reality. *Id.* ¶ 37. And Dr. Kazanzides persuasively testifies that Doo’s projected display of internal organs, such as bones and a heart, are “inner layers of the patient from the 3D data.” Ex. 1012 ¶ 72 (citing Ex. 1008, Figs. 2, 6).

In contrast, Patent Owner’s arguments rely on claim construction positions we have not adopted. As we explain above, “3D data” as claimed “may include a 2D image, such as an X-ray image that may be projected onto . . . the patient.” *See* Ex. 1001, 12:4–7. Thus, Patent Owner’s argument that Doo’s 2D X-ray projection onto the patient lacks 3D significance is inapposite. *See* PO Resp. 27. Likewise, Patent Owner’s contention that Doo’s inner layers cannot be confined or navigated relies on an incorrect claim construction of “confined” and, once again, argues the wrong limitation, as “confined” is recited in limitation 1[C]. *See id.*

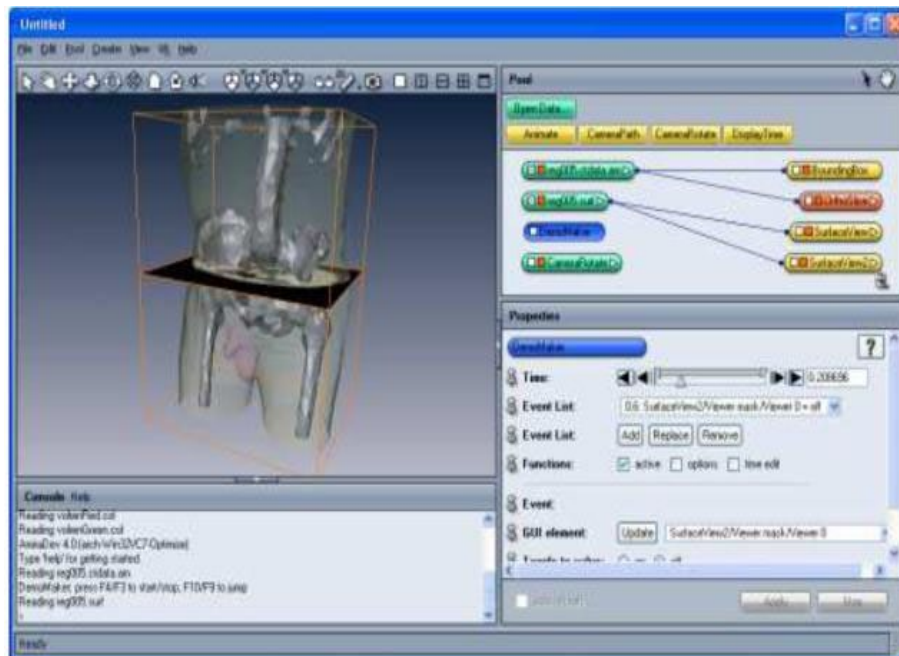
Further, Patent Owner’s argument that there is no indication that Doo’s Figure 3 image includes an outer layer and multiple inner layers re-argues limitation 1[A], for which we already found Patent Owner’s arguments unpersuasive. *See id.* The argument also overlooks that Doo’s projected inner layer may be taken from CT or MRI data. *See* Sur-reply 16–17; Ex. 1008 ¶ 40, *cited in* Pet. 33–34. As we explain above, Dr. Kazanzides persuasively testifies that a POSITA would have understood that Doo’s CT and MRI images “would include an outer layer of the patient and multiple inner layers of the patient.” Ex. 1012 ¶ 65, *cited in* Pet. 33–34. Patent Owner does not persuasively address Dr. Kazanzides’s testimony, and

focuses on distinguishing Doo based on claim construction positions we did not adopt. *See* PO Resp. 26–27.

Accordingly, we agree with Petitioner that Doo discloses limitation 1[B].

f. 1[C] the projected inner layer of the patient from the 3D data being confined within a volume of a virtual 3D shape

Petitioner relies primarily on Amira to disclose limitation 1[C]. Pet. 42–43 (citing Ex. 1012 ¶¶ 81–83). Petitioner points to Amira’s 3D “bone model within both a . . . translucent skin model and a bounding box,” as shown below in the following Amira figure:



Pet. 42–43 (citing Ex. 1005, 79–80¹¹; Ex. 1012 ¶¶ 81–83). The above image depicts a user interface, in which, Petitioner argues, Amira’s bounding box is indicated by yellow lines. *Id.* at 43. Petitioner explains that Amira’s bounding box confines a virtual 3D shape inside because:

¹¹ We follow Petitioner’s lead in citing Amira’s native page numbers, rather than the numbers Petitioner adds for this IPR.

Amira's bounding box is a virtual box including a top side, a bottom side, a left side, a right side, a front side, and a back side. Amira illustrates the 3D bone model confined within both the virtual 3D translucent skin model and the virtual bounding box. Like Amira's bounding box, Amira's skin model also forms a virtual 3D shape that the bone model is confined within.

Id. (citing Ex. 1012 ¶ 83).

Patent Owner raises two arguments for limitation 1[C], including one regarding the claimed “projected” and another regarding the claimed “confined.” PO Resp. 37–40. After considering Patent Owner's arguments, which we address below, we agree with Petitioner that the combination of Doo and Amira discloses limitation 1[C].

(1) “projected”

First, Patent Owner argues that Amira does not “**project** an inner layer of the patient from the 3D data” onto the patient. PO Resp. 37 (citing Ex. 2004 ¶ 134). Even if Amira offered a “virtual reality option,” Patent Owner contends, “[t]his is significantly different from an augmented reality environment where virtual objects are projected onto a real-life object.” *Id.* (citing Ex. 2004 ¶¶ 117–18).

This argument is inapposite because it does not address Petitioner's proposed combination. Note that the disputed limitation recites a “projected inner layer” but does not recite the verb “project,” as Patent Owner implies. *See id.* Rather, the act of projection is encompassed by the prior limitation 1[B], “*displaying*, in an augmented reality (AR) headset, one of the inner layers of the patient from the 3D data *projected onto* real-time, non-image actual views of the outer layer of the patient.” (Emphasis added.)

As we explain above, Petitioner relies on Doo, not Amira, for limitation 1[B]. Pet. 34, 41; Reply 21 (“Doo, however, discloses displaying

one of the inner layers of the patient . . . in an augmented reality (AR) headset.”). As Petitioner explains, a POSITA “would have been motivated to combine Amira with Doo to enable the intra-operative medical image viewing system and method disclosed in Doo to take advantage of the visualization technology disclosed in Amira.” Pet. 41 (citing Ex. 1012 ¶ 103). Thus, Patent Owner’s argument that Amira does not “**project** an inner layer of the patient from the 3D data” onto the patient improperly argues Amira in isolation. See PO Resp. 37; *Nat’l Steel Car, Ltd. v. Canadian Pac. Ry., Ltd.*, 357 F.3d 1319, 1336–37 (Fed. Cir. 2004) (rejecting argument directed at the wrong reference); *In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) (“Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references.”).

(2) “*confined*”

Second, Patent Owner contends “Amira also does not disclose ‘the 3D data being **confined** within a volume of a **virtual** 3D shape.’” PO Resp. 38. Patent Owner raises several supporting arguments, none of which undermines Petitioner’s persuasive showing.

Patent Owner initially argues that Amira does not disclose a “virtual 3D shape” used “in an augmented reality environment.” *Id.* at 38–39. This argument is inapposite because, as we explain above, Petitioner relies on Doo for the “virtual 3D shape” and “augmented reality” recitations. Pet. 34, 41; Reply 21; *Nat’l Steel Car*, 357 F.3d at 1336–37.

Patent Owner next contends that “Amira does not disclose that its bounding box can be used to ‘assist the user when navigating the projected 3D data.’” PO Resp. 39 (quoting Ex. 2004 ¶ 139). This argument is inapposite because it relies on unclaimed language, as the claim does not

recite “assist the user when navigating the projected 3D data.” Patent Owner relies on its proposed construction for “confined within” as requiring a “navigational or orientation function” (PO Resp. 18), which we have not adopted for reasons we explain above.

Further, Patent Owner argues that “Amira does not show direct volumerendered 3D data confined within a virtual 3D shape.” PO Resp. 39. This argument also relies on a proposed claim construction position that we have not adopted. *See id.* at 11.

Finally, Patent Owner contends that Amira does not disclose claim 1’s “volume rendering of the anatomy of the patient ‘without segmentation and without constructing intermediate polygonal models.’” *Id.* at 39–40 (quoting Ex. 2002 ¶ 126). But claim 1 does not recite “without segmentation and without constructing intermediate polygonal models,” so this argument fails because it is not commensurate in scope with limitation 1[C].

Thus, we agree with Petitioner that the combination of Doo and Amira discloses limitation 1[C], “the projected inner layer of the patient from the 3D data being confined within a volume of a virtual 3D shape.”

g. Conclusion as to Claim 1

For the above reasons, we determine that Petitioner has shown by a preponderance of the evidence that claim 1 would have been obvious over the combination of Doo and Amira.

2. Dependent Claims 2–6

Patent Owner raises specific arguments for dependent claim 3, but does not address Petitioner’s arguments for dependent claims 2 and 4–6 over

the combination of Doo and Amira. PO Resp. 40–43.¹² We have reviewed Petitioner’s arguments for dependent claims 2 and 4–6 and determine that Petitioner has established, by a preponderance of the evidence, that claims 2 and 4–6 would have been obvious over the combination of Doo and Amira. *See* Pet. 43–47.

Claim 3 recites the following limitations, numbered by Petitioner:

The method of claim 1,

[3a] wherein: the virtual 3D shape is configured to be controlled to toggle between displaying and hiding lines of the virtual 3D shape; and

[3b] the virtual 3D shape is configured to be controlled to reposition two-dimensional (2D) slices and/or 3D slices of the projected inner layer of the patient from the 3D data.”

Pet. 44 (paragraphs added for clarity).

For this claim, Petitioner relies, for example, on Amira’s disclosure that “the virtual 3D shape is configured to be controlled to toggle between displaying and hiding lines of the virtual 3D shape; and the virtual 3D shape is configured to be controlled to reposition two-dimensional (2D) slices and/or 3D slices of the projected inner layer of the patient from the 3D data.” Pet. 44 (quoting Ex. 1012 ¶¶ 85–86). After considering Patent Owner’s position below, we agree with Petitioner.

Patent Owner disputes that Amira discloses limitation [3b]. PO Resp. 41–42. Patent Owner contends that the claimed “virtual 3D shape” is

¹² Patent Owner’s challenge to claim 5 over Doo alone is not pertinent here because Petitioner raises arguments against claim 5 over Amira, which Patent Owner does not address apart from repeating its claim 1 argument, which, as we explain above, is not persuasive. *See* PO Resp. 32–35 (“As discussed above, Amira does not disclose the ‘virtual 3D shape’ of claim 1. . . . For the same reasons, Amira does not disclose the elements of claim 5.”), 42; Pet. 46.

a “virtual control.” *Id.* at 41. According to Patent Owner, “Amira discloses using a conventional mouse and a user interface displayed on a conventional computer monitor to rotate an object displayed on the computer monitor.” *Id.* (citing Ex. 2004 ¶¶ 143–44). This “is vastly different from a virtual control,” Patent Owner contends. *Id.* (quoting Ex. 2004 ¶ 143).

But Patent Owner’s argument relies on a construction for “virtual 3D shape” we have not adopted. As we explain above, we agree with Petitioner that a “virtual 3D shape” is better understood in the context of the specification as a “virtual 3D shape (i.e., form) as simple as a box and as complex as the outer layer of the patient,” not a user interface control. *See* Pet. 13. Patent Owner does not dispute, under the correct construction, that Amira discloses the claimed virtual 3D shape.¹³ *See* PO Resp. 40–42. We agree with Petitioner that Amira discloses this under the correct construction.

We, therefore, determine that Petitioner has also shown by a preponderance of the evidence that claim 3 would have been obvious over the combination of Doo and Amira.

3. *Independent Claim 11*

Unlike claim 1, Petitioner challenges claim 11 only over Doo and Amira, and not over Doo alone. Pet. 31.

¹³ Petitioner also presents arguments under Patent Owner’s proposed “virtual 3D shape” construction, but we do not reach these arguments because we do not adopt Patent Owner’s proposed construction. Reply 22–23.

a. A method for augmenting real-time, non-image actual views of a patient with three-dimensional (3D) data, the method comprising

The preamble of claim 11 is identical to the preamble of claim 1, and the parties raise similar arguments. Pet. 47; PO Resp. 43. For similar reasons as those we discuss above, we find that Doo discloses the preamble of claim 11, whether or not it is limiting.

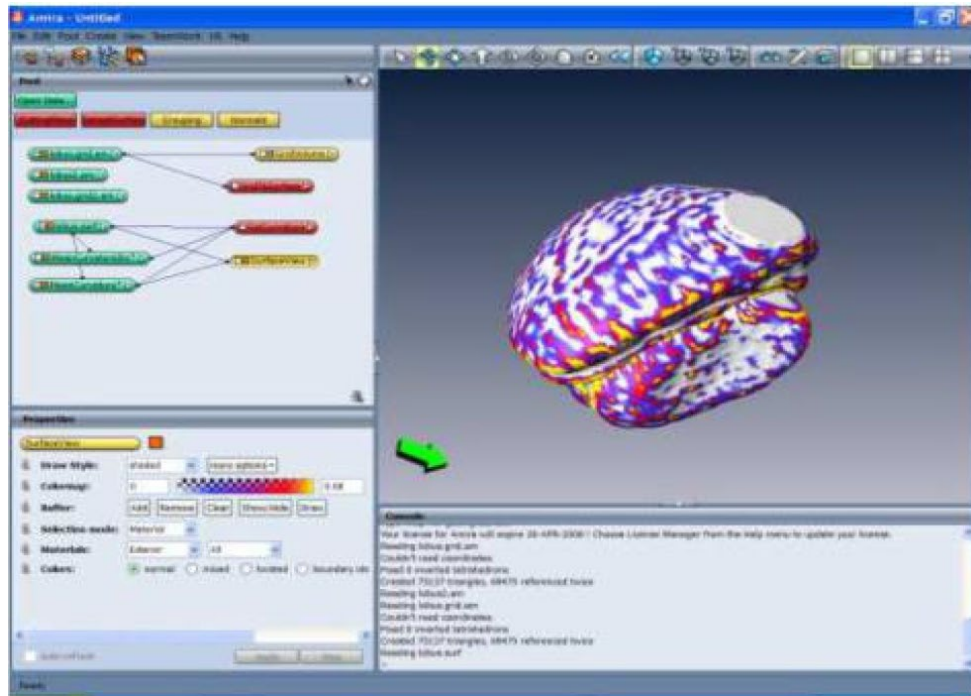
b. 11[A] identifying 3D data for the patient, the 3D data including an outer layer of the patient and multiple inner layers of the patient, the multiple inner layers of the patient having an original color gradient

Limitation 11[A] is similar to limitation 1[A], and the parties raise similar arguments. Pet. 47; PO Resp. 43. Petitioner also relies on Amira for the color gradient aspects of this limitation, which Patent Owner does not challenge. See Pet. 47–51 (e.g., “Amira discloses coloring based on a detected property in a 3D data set[.]” (citing Ex. 1005, 5, FIG. 1.1)); PO Resp. 43. Based on Petitioner’s arguments and evidence, we find that the combination of Doo and Amira discloses limitation 11[A].

c. 11[B] altering the original color gradient of the multiple inner layers to be lighter than the original color gradient in order to be better visible when projected onto real-time, non-image actual views of the outer layer of the patient

For this limitation, Petitioner relies in part on Doo’s disclosure of “adjusting the transparency of the overlaid image,” including “in the sense that the surgeon 26 controls the image opacity throughout the range of fully transparent, e.g., when the image is not in use, to fully opaque, e.g. when high-contrast is desired.” Pet. 47–48 (first quoting Ex. 1008, claim 5, then quoting Ex. 1008 ¶ 30). But principally, Petitioner relies on Amira’s

disclosure of “coloring based on a detected property in a 3D data set.” *Id.* at 48. Petitioner points us to Figure 1.1 of Amira, reproduced below:



Id. at 49 (citing Ex. 1005, 5). Petitioner quotes Amira’s explanation of this figure: “Figure 1.1: Data objects and modules are represented as little icons in the Pool (top left). In the 3D graphic window a surface colored according to its curvature is shown.” *Id.* (quoting Ex. 1005, 5).

Petitioner further argues that Figure 2.17 of Amira, reproduced below, assigns different colors to different portions of the 3D data:

After considering Patent Owner’s arguments for this limitation, which we discuss below, we agree with Petitioner that Amira discloses limitation 11[B].

Patent Owner raises several arguments that do not persuasively respond to Petitioner’s asserted combination of teachings. First, Patent Owner contends that Doo’s adjusting transparency or opacity of the overlaid image is not the same as “altering the original color gradient of the multiple inner layers.” PO Resp. 43–44 (citing Ex. 2002 ¶ 138). Even if true, this does not undermine Petitioner’s persuasive showing because Petitioner relies on Amira’s teachings for this limitation, not on Doo alone. *See* Pet. 47–48; PO Resp. 44 (acknowledging Petitioner’s reliance on Amira). Second, Patent Owner contends, “Amira does not ‘augment[] real-time, non-image actual views of a patient,’” and “Amira also does not project ‘3D data . . . onto real-time, non-image actual views of the outer layer of the patient.’” *Id.* (citing Ex. 2004 ¶ 149). These arguments are unpersuasive because Petitioner relies on Doo, not Amira, for such limitations. Pet. 47 (referring to previous discussion of Doo and Amira for claim 1); Reply 21; *see Nat’l Steel Car*, 357 F.3d at 1336–37 (rejecting argument directed at the wrong reference).

Patent Owner also contends that Amira does not “alter the original color gradient [of the 3D data] to be better visible when projected onto real-time, non-image actual views of the outer layer of the patient.” PO Resp. 44 (citing Ex. 2004 ¶ 155). This is because, Patent Owner argues, a POSITA “would not appreciate the challenges associated with ‘altering the color gradient of *direct volume rendered* 3D imaging to be better visible when projected on to non-image actual views of a patient in an operating room.’” *Id.* (emphasis added); *see also id.* at 45 (arguing that Amira’s color

adjustment on a computer monitor “is much different from altering the color gradient of a direct volume 3D rendering projected on to non-image actual views of a patient in AR,” and “unlike Amira, the projected 3D data of the ’271 patent does not require an intermediate segmentation step and is not a surface model.”). This argument is unpersuasive because it relies on Patent Owner’s proposed construction of “3D data” as requiring DVR.

Lastly, Patent Owner criticizes Petitioner’s reliance on Amira’s use of “an editable color map to control visualization of an overlay image” and “image fusion,” which “consists of combining relevant information from two or more images into a single image using different color mappings.” *Id.* at 45 (quoting Ex. 1012 ¶ 96). Patent Owner contends that Petitioner “mistakenly equates ‘altering the original color gradient of the multiple inner layers’ with Amira’s use of ‘overlay image[s]’ and ‘image fusion’ on a computer monitor.” *Id.* at 45–46 (citing Ex. 2002 ¶ 139). “This is different from ‘altering the original color gradient of the multiple inner layers,’” Patent Owner argues. *Id.* at 46 (citing Ex. 2004 ¶¶ 150–55).

In response, Petitioner asserts that Dr. Mulumudi “admitted that it was known in the art how to change the brightness of an image” by changing its contrast. Reply 23 (citing Ex. 1022, 150:22–151:3). Petitioner adds that “Doo discloses altering a medical image’s contrast.” *Id.* at 24 (citing Pet. 47–48; Ex. 1008 ¶¶ 30, 51). Petitioner also reasserts that “Amira discloses the use of editable color maps to alter color gradients in a 3D data set.” *Id.* Patent Owner’s Sur-reply does not address these arguments.

Ultimately, we find Petitioner’s argument persuasive. In the combination, we agree with Petitioner that Amira’s disclosure of “[c]hang[ing] the minimum and maximum values of the Overlay color map” and “chang[ing] the contrast . . . or . . . brightness” would have “improv[ed]

visibility of a virtual image overlaid on an actual patient view.” Pet. 51 (quoting Ex. 1005, 101–103; Ex. 1012 ¶¶ 91–96). This disclosure, coupled with Doo’s disclosure of a surgeon “control[ing] the image opacity . . . when high-contrast is desired,” fairly suggests limitation 11[B], “altering the original color gradient of the multiple inner layers to be lighter than the original color gradient in order to be better visible when projected onto real-time, non-image actual views of the outer layer of the patient.” *See id.* at 48 (quoting Ex. 1008 ¶ 30).

d. 11[C] displaying, in an augmented reality (AR) headset, one of the inner layers of the patient from the 3D data projected onto real-time, non-image actual views of the outer layer of the patient, the projected inner layer of the patient from the 3D data being having the altered color gradient

Petitioner raises additional arguments based on the combination of Doo and Amira for limitation 1[C]. Pet. 51–52 (citing, e.g., Ex. 1012 ¶ 97; Ex. 1005, 100). Patent Owner relies on its earlier arguments for limitation 1[B]. PO Resp. 46. Based on our review of Petitioner’s arguments and evidence, including the testimony of Dr. Kazanzides, we find that the combination of Doo and Amira discloses limitation 11[C].

e. Conclusion as to claim 11

For the above reasons, we determine that Petitioner has shown by a preponderance of the evidence that claim 11 would have been obvious over the combination of Doo and Amira.

4. Dependent Claims 12–20

Turning to claims 12–19, Petitioner summarizes these dependent claims, which recite parallel language, as follows:

Claim [12–19]: “The method as recited in claim 11, wherein the altered color gradient represents a tissue

[hardness/relaxivity/echogenicity/enhancement
amount/enhancement speed/radioactivity/water content] tissue
property of the multiple inner layers of the patient.

Pet. 52 (alteration modified). Dr. Kazanzides testifies that a POSITA would have understood that a color gradient could be applied to represent any parameter that a user could identify or define based on the available 3D data. *Id.* (citing Ex. 1012 ¶¶ 98–101).

Petitioner notes that Dr. Kazanzides relies, for example, on Amira’s disclosure of “intensity and geometrical measurements on image or label data,” “color schemes [for] visualizations of polygonal models,” and coloring surfaces to “visualize a second independent data set.” *Id.* at 52–53 (first quoting Ex. 1005, 11, then quoting Ex. 1005, 9). Petitioner also points to Amira’s disclosure of “a color gradient representing curvature,” “a color gradient representing blood flow inside the carotid artery,” and “color gradients representing features of a bone model and features of a skin model.” *Id.* at 53 (citing Ex. 1005, 5, 69–70, 79–80).

Patent Owner argues, in part, that Dr. Kazanzides’s testimony lacks support and “fails to identify any of the tissue properties recited in claims 12-19.” PO Resp. 46 (citing Ex. 1012 ¶ 101; Ex. 2004 ¶ 159). Patent Owner also asserts that “Amira does not disclose altering a color gradient to identify any of the characteristics specifically identified in claims 12-19, e.g., tissue [hardness/relaxivity/echogenicity/ enhancement amount/enhancement speed/density/radioactivity/water content].” *Id.* at 47 (citing Ex. 2002 ¶ 143). In Reply, Petitioner asserts that, because “Amira recommends ‘experiment[ing] with changing the color maps’” that “the different color mappings inherently represent different tissue properties

revealed by the relevant 3D data sources.” Reply 25 (citing Ex. 1005, 103, 115).¹⁴

Petitioner bears the burden to prove unpatentability, but Petitioner has not met that burden here for dependent claims 12–19. *See Dynamic Drinkware, LLC v. National Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (“In an inter partes review, the burden of persuasion is on the petitioner to prove ‘unpatentability by a preponderance of the evidence,’ 35 U.S.C. § 316(e), and that burden never shifts to the patentee.”). We agree with Patent Owner that Dr. Kazanzides’s testimony lacks underlying factual support and fails to identify, in the references, “any of the tissue properties recited in claims 12–19.” PO Resp. 46 (citing Ex. 1012 ¶ 101; Ex. 2004 ¶ 159). We also agree with Patent Owner that “Amira does not disclose altering a color gradient to identify any of the characteristics specifically identified in claims 12–19, e.g., tissue [hardness/relaxivity/echogenicity/enhancement amount/enhancement speed/density/radioactivity/water content].” *Id.* at 47 (citing Ex. 2002 ¶ 143).

Petitioner’s Reply argument that “the different color mappings *inherently* represent different tissue properties” is unsupported. Reply 25 (emphasis added). Petitioner provides no persuasive reasoning as to why the tissue properties of hardness, relaxivity, echogenicity, enhancement amount, enhancement speed, density, radioactivity, or water content in claims 12–19 are inherent in Amira’s disclosure. To establish inherency, it must be “clear that the missing descriptive matter is necessarily present in the thing described in the reference Inherency, however, may not be established

¹⁴ Patent Owner also raises arguments based on its proposed DVR construction, which we do not reach. PO Resp. 47–48.

by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.” *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999) (citations and internal quotations omitted). Petitioner does not persuade us that the high bar of “necessarily present” has been met here. For example, it does not follow that Amira using a color gradient to represent “blood flow inside the carotid artery” means that Amira necessarily would have used a color gradient to represent the many tissue properties required by claims 12–19. *See* Pet. 53.

Accordingly, we determine that Petitioner has not shown by a preponderance of the evidence that claims 12–19 would have been obvious over the combination of Doo and Amira.

Turning to dependent claim 20, Patent Owner does not address Petitioner’s arguments for this dependent claim over the combination of Doo and Amira. PO Resp. 46–48. We have reviewed Petitioner’s arguments for dependent claim 20 and determine that Petitioner has established, by a preponderance of the evidence, that claim 20 would have been obvious over the combination of Doo and Amira. *See* Pet. 53–54.

IV. CONCLUSION

In summary:

Remanded Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Remanded Claim(s) Shown Unpatentable	Remanded Claim(s) Not Shown Unpatentable
1–6, 11–20	103	Doo, Amira	1–6, 11, 20	12–19

V. ORDER

It is, therefore:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–6, 11, and 20 of the '271 patent are unpatentable;

ORDERED that Petitioner has not shown by a preponderance of the evidence that claims 12–19 of the '271 patent are unpatentable; and

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.

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