Filed on Behalf of Patent Owner Dental Monitoring SAS

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ALIGN TECHNOLOGY, INC.,
Petitioner,

v.

DENTAL MONITORING SAS,
Patent Owner.

IPR2023-01369
U.S. Patent No. 10,755,409 B2

PATENT OWNER'S NOTICE OF APPEAL

Notice is hereby given pursuant to 35 U.S.C. §§ 141(c), 142, 319; 37 C.F.R. §§90.2(a), 90.3(a); and Federal Rules of Appellate Procedure/Federal Circuit Rule 4(3)(a), that Patent Owner Dental Monitoring SAS, Inc. ("Patent Owner") hereby appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered on March 3, 2025 (Paper 42) (the "Final Written Decision"), and from all underlying orders, decisions, rulings and opinions regarding U.S. Patent No. 10,755,409 ("the '409 Patent"). The Final Written Decision is attached to this Notice as Exhibit A.

For the limited purpose of providing the Director with the information requested in 37 C.F.R. § 90.2(a)(3)(ii), Patent Owner anticipates that the issues on appeal may include the following, as well as any underlying findings, determinations (including claim constructions), rulings, decisions, opinions, or other related issues:

- Whether the Board erred determining not to construe certain claim terms in the '409 patent, including "deep learning device," "real time," and "tooth shape parameter."
- Whether the Board erred in determining that Carrier and Maninis each qualify as prior art to the challenged claims of the '409 Patent.

- Whether the Board erred in finding that claims 1-15 of the ’409 Patent are unpatentable under 35 U.S.C. § 103 over the combination of Salah, Carrier, and Maninis.
- Whether the Board erred in finding that a person of ordinary skill in the art would have been motivated to combine the Salah, Carrier, and Maninis references.
- Whether the Board erred in denying Patent Owner’s motion to exclude certain exhibits, including Exhibits 1022 (Arxiv.org Submission Help Page), 1023 (Arxiv.org Article Replacement Help Page (2017)), 1025 (Arxiv.org Author Search Page for Luc Van Gool), 1026 (Arxiv.org Article Replacement Help Page (2016)), 1031 (Declaration of Nathaniel E. Frank-Wright), and paragraphs 62-67 of Exhibit 1002 (Declaration by of Dr. Hassan Foroosh).

Copies of this Notice of Appeal are being filed simultaneously with the Director, the Patent Trial and Appeal Board, and the Clerk of the United States Court of Appeals for the Federal Circuit, along with the required docketing fee.

Dated: May 5, 2025

Respectfully submitted,

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CERTIFICATE OF FILING

The undersigned hereby certifies that, in addition to being electronically filed through the PTAB's P-TACTS System, a true and correct copy of the above-captioned PATENT OWNER'S NOTICE OF APPEAL is being sent via priority mail on May 2, 2025 to the Director of the United States Patent and Trademark Office, at the following address:

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
Madison Building East, 10B20
600 Dulany Street
Alexandria, VA 22314-5793

The undersigned also hereby certifies that a true and correct copy of the above-captioned PATENT OWNER'S NOTICE OF APPEAL and the filing fee is being filed via CM/ECF with the Clerk's Office of the United States Court of Appeals for the Federal Circuit on May 2, 2025.

Dated: May 5, 2025

Respectfully submitted,

/s/ Rocco J. Recce
Rocco J. Recce
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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), the undersigned certifies service of PATENT OWNER'S NOTICE OF APPEAL on the counsel of record for the Petitioner by filing this document electronically through the PTAB's P-TACTS System as well as delivering a copy via electronic mail to the following address:

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Dated: May 5, 2025

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EXHIBIT A

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Paper 42
Entered: March 3, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ALIGN TECHNOLOGY, INC.,
Petitioner,

v.

DENTAL MONITORING SAS,
Patent Owner.

IPR2023-01369
Patent 10,755,409 B2

Before JEAN R. HOMERE, MICHAEL R. ZECHER, and KARA L. SZPONDOWSKI, *Administrative Patent Judges*.

HOMERE, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)
Denying Patent Owner's Motion to Exclude
37 C.F.R. § 42.64(c)

I. INTRODUCTION

A. Background

Align Technology, Inc. ("Petitioner") filed a Petition for *inter partes* review of claims 1–15 of U.S. Patent No. 10,755,409 (Ex. 1001, "the '409 patent"). Paper 2 ("Pet."), 1. Dental Monitoring SAS ("Patent Owner") filed a Preliminary Response. Paper 8 ("Prelim. Resp."). Upon consideration of the parties' contentions and supporting evidence, we instituted an *inter partes* review pursuant to 35 U.S.C. § 314, as to all the challenged claims of the '409 patent with respect to the sole ground set forth in the Petition. Paper 10 ("Inst. Dec.").

After institution of trial, Patent Owner filed a Response (Paper 19, "PO Resp."); Petitioner filed a Reply to Patent Owner's Response (Paper 23, "Pet. Reply"); and Patent Owner filed a Sur-Reply to Petitioner's Reply (Paper 29, "PO Sur-Reply"). In addition, Patent Owner filed a Motion to Exclude certain evidence (Paper 34, "PO Mot. Excl."); Petitioner filed an Opposition to Patent Owner's Motion to Exclude (Paper 35, "Pet. Opp. Mot. Excl."); and Patent Owner filed a Reply to Petitioner's Opposition (Paper 38, "PO Reply Opp. Mot. Excl."). At the request of both parties, we held an oral hearing on December 3, 2004. A transcript of the hearing has been entered into the record. Paper 41 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6. This is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of all the challenged claims of the '409 patent. For the reasons discussed below, we determine that Petitioner has demonstrated by a preponderance of the evidence that challenged claims 1–15 of the '409 patent are unpatentable. We also *deny* Patent Owner's Motion to Exclude.

B. Real Parties in Interest

Petitioner identifies itself as the sole real party in interest. Pet. 73.

Patent Owner identifies itself as the sole real party in interest. Paper 4, 2.

C. Related Matters

The parties indicate that the '409 patent is the subject of the following district court proceeding: *Dental Monitoring SAS v. Align Technology, Inc.*, Case No. 3:22-cv-07335-WHA (N.D. Cal.). Pet. 73; Paper 4, 2. Patent Owner indicates that the '409 patent is also subject of the following district court proceeding: *Dental Monitoring v. Get-Grin Inc.*, Case No. 1:22-cv-00647-WCB (D. Del.). Paper 4, 2.

D. The Challenged '409 Patent

The '409 patent relates to a method for acquiring and analyzing an image of a dental arch of a patient for orthodontic treatment of the patient. Ex. 1001, codes (54), (57). Conventional orthodontic treatments require the patient to make an appointment and transmit captured dental images to the orthodontist, who subsequently uses the images to assess the patient's conditions to devise a treatment plan accordingly. *Id.* at 1:11–15. The '409 patent purports to provide an improved method employing a deep learning device specifically trained to assess a simple image of the patient's dental arch to reconstruct, with a good reliability, a dental arch in the form of an assembled model. *Id.* at 3:13–17, 18:56–59, 23:7–10.

In particular, upon being activated to acquire an image of the patient's arch ("analysis image"), an acquisition apparatus (e.g., cell phone) acquires

the analysis image, which it submits to a deep learning device (preferably, a neural network) trained by a learning base to determine at least one probability relating to an attribute value of at least one tooth represented on a zone in the analysis image "analysis tooth zone," and/or at least one probability relating to an image attribute value of the tooth. *Id.* at 1:23–50, 8:62–63. According the '409 patent,

> [T]his image attribute may define whether, in light of the image as a whole or of a part of the image, the dental situation "is pathological" or "is not pathological", without each tooth being examined. The image attribute also makes it possible to detect, for example, whether the mouth is open or closed, or, more generally, whether the image is suitable for a subsequent treatment, for example whether it makes it possible to monitor the occlusion.

Id. at 3:29–37.

The deep learning device subsequently assesses the probability relating to the location and/or the type of tooth represented in the analysis of the tooth zone. *Id.* at 1:51–58. More particularly, the '409 patent states the following:

> In a preferred embodiment, the shape of a particular tooth model is analyzed so as to define its tooth attribute value, for example its number. This shape recognition is preferably performed by means of a deep learning device, preferably a neural network. Preferably, a library of historical tooth models is created, each historical tooth model having a value for the tooth attribute, as described hereinbelow (step a)), the deep learning device is trained with views of the historical tooth models of this library, then one or more views of the particular tooth model are analyzed with the trained deep learning device, so as to determine the tooth attribute value of said particular tooth model.

Id. at 8:39–50. The '409 patent describes a neural network as follows:

> A "neural network" or "artificial neural network" is a set of algorithms well known to a person skilled in the art. The neural network may in particular be chosen from:
> the networks specializing in the classification of images, called "CNN" ("convolutional neural network"), for example
> AlexNet (2012)
> ZF Net (2013)
> VGG Net (2014)
> GoogleNet (2015)
> Microsoft ResNet (2015)
> Caffe: BAIR Reference CaffeNet, BAIR AlexNet
> Torch: VGG_CNN_S, VGG_CNN_M, VGG_CNN_M_2048, VGG_CNN_M_1024, VGG_CNN_M_128, VGG_CNN_F, VGG_ILSVRC-2014 16-layer, VGG ILSVRC-2014 19-layer, Network-in-Network (Imagenet & CIFAR-10)
> Google: Inception (V3, V4).
> The networks specializing in the location and detection of objects in an image, the object detection network, for example:
> R-CNN (2013)
> SSD (Single Shot MultiBox Detector: Object Detection network), Faster R-CNN (Faster Region-based Convolutional Network method: Object Detection network)
> Faster R-CNN (2015)
> SSD (2015).
> The above list is not limiting.

Id. at 16:15–43.

Further, the '409 patent also discusses an "embedded monitoring" wherein the image analysis is useful for guiding the image acquisition of a dental arch for remote diagnosis. *Id.* at 23:46–49. Figures 12A–12D, reproduced below, further illustrate the subject matter of the '409 patent:

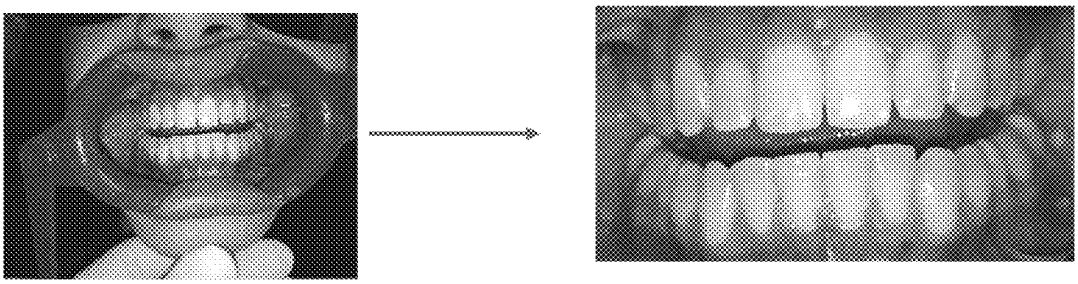

Fig. 12A Fig. 12B

FIG. 12A and FIG. 12B above illustrate how a dental retractor is used to facilitate the acquisition of an image, which is cropped, processed, and updated as in FIG. 12B making it possible to determine the contour of the patient's teeth. Ex. 1001, 7:16–20.

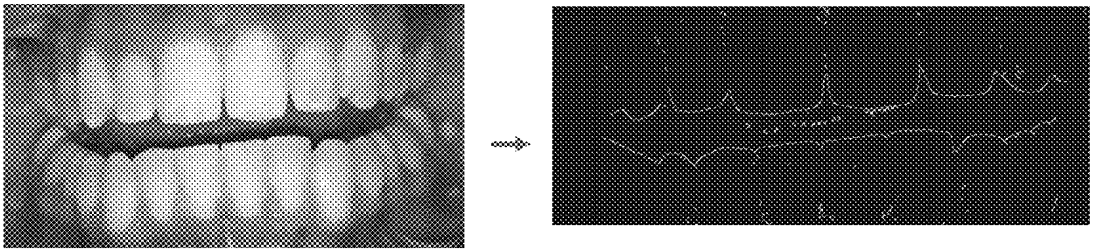

Fig. 12C Fig. 12D

FIG. 12C above depicts an updated image, and FIG. 12D represents an updated map relating to the contour of the teeth obtained from the updated image of FIG. 12C. Ex. 1001, 7:22–25.

Additionally, the '409 patent discloses determining whether the quality or another characteristic of an acquired image (e.g., "mouth open" "mouth closed" or "orthodontic appliance") meets a particular "setpoint" for such an image, requiring adjustments if that "setpoint" is not met, and "guid[ing]" a patient to make the correct adjustments to acquire the correct image. *Id.* at 26:16–26, 28:27–43.

E. The Challenged Claims

Petitioner challenges claims 1–15 of the '409 patent. Pet. 1. Claim 1 is independent. Claim 1 is illustrative of the challenged claims and is reproduced below.

> 1. A method for acquiring an image of a dental arch of a patient, said method comprising the following steps:
>
> a') activation of an image acquisition apparatus so as to acquire an image, called "analysis image", of said arch;
>
> b') analysis of the analysis image by means of a deep learning device trained by means of a learning base;
>
> c') determination, for the analysis image, as a function of the results of the analysis in the preceding step, of a value for an image attribute;
>
> d') comparison of said image attribute value with a setpoint;
>
> e') sending of an information message as a function of said comparison, the information message being related to the quality of the image acquired or to the position of the acquisition apparatus in relation to said arch or to the setting of the acquisition apparatus or to the opening of the mouth or to the wearing of a dental appliance, or to a combination thereof, to check whether the analysis image respects the setpoint and, if it does not respect the setpoint, to guide the operator in order for him or her to acquire a new analysis image.

Ex. 1001, 32:13–33.

F. Prior Art and Asserted Grounds of Unpatentability

The Petition relies on the following prior art references:

Name	Reference	Exhibit
Salah	WO 2016/066651 A1, published May 6, 2016	1008
Carrier	US 2021/0068923 A1, published March 11, 2021	1005

Name	Reference	Exhibit
Maninis	*Convolutional Oriented Boundaries: From Image Segmentation to High-Level Tasks*, published April 28, 2017	1007

Petitioner asserts that claims 1–15 are unpatentable based on the following ground:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–15	103[1]	Salah, Carrier, Maninis

Pet. 15.

In support of its contentions, Petitioner submits Declarations by Dr.Hassan Foroosh (Exs. 1002 1048), Nathaniel E. Frank-Wright (Exs. 1030, 1031), and Dr. Maureen Valley (Ex. 1035). Likewise, Petitioner submits Deposition Transcripts by Dr. John Mongan (Ex. 1037), Dr. Budi Kusnoto (Ex. 1038); and Dr. Hassan Foroosh (Ex. 1049).

In response, Patent Owner submits Declarations by Dr. John Mongan (Ex. 2028) and Dr. Budi Kusnoto (Ex. 2030). Further, Patent Owner submits Deposition Transcripts of Dr. Hassan Foroosh (Exs. 2048, 2054), and Dr. Maureen Valley (Ex. 2053).

[1] The application resulting in the '409 patent does not claim priority to a date prior to the date when the Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, 125 Stat. 284 (2011), took effect. Thus, we refer to the AIA version of § 103.

II. PATENTABILITY ANALYSIS

A. Principles of Law

1. Inter Partes Review

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). Petitioner bears the burden of persuasion to prove unpatentability of each challenged claim by a preponderance of the evidence. 35 U.S.C. § 316(e). This burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

2. Obviousness

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed invention and the prior art are such that the claimed invention, as a whole, would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of skill in the art, and (4) when in

evidence, any objective evidence of nonobviousness.[2] *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

The level of ordinary skill in the art is "a prism or lens" through which we view the prior art and the claimed invention. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). The person of ordinary skill in the art ("POSITA") is a hypothetical person presumed to have known the relevant art at the time of the invention. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). In determining the level of ordinary skill in the art, we may consider certain factors, including: "(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field." *Best Med. Int'l, Inc. v. Elekta Inc.*, 46 F.4th 1346, 1353 (Fed. Cir. 2022). "The patent's purpose can also be informative." *Id.*

Petitioner contends that a POSITA at the time of the invention "would typically have an advanced degree, such as a Masters' Degree or Ph.D. in computer science, computer engineering, electrical engineering, or a related field, with at least two years of work in computer vision, image analysis, medical imaging, or related areas." Pet. 14. Petitioner asserts that such an artisan "could have less education but significant professional experience in one or more of these fields," or "could be a member of an interdisciplinary team including persons with backgrounds such as electrical engineering,

[2] During trial, the parties have not directed us to any such objective evidence.

computer science, optical imaging, and dentistry or orthodontics, and could call upon the knowledge of other team members as appropriate." *Id.* at 14–15 (citing Ex. 1002 ¶¶ 69–70).

Patent Owner offers a slightly different definition of the level of ordinary skill in the art. PO Resp. 4–5. Patent Owner contends that:

> [A] person of ordinary skill in the relevant field as of July 21, 2017 would have had a bachelor's degree or higher in computer science, bioinformatics, or a related engineering discipline, and several years of work experience relating to the development of machine learning or artificial intelligence models or algorithms. A [POSITA] ***would*** have also worked as part of a multi-disciplinary team, which ***would have included individuals familiar with medical imaging, dental imaging, dentistry, and/or orthodontics***.

Id. (quoting Ex. 2002 ¶ 47; citing Ex. 2028 ¶¶ 48–51, Ex. 2030 ¶¶ 27–30) (emphasis and alteration in original).

In light of its proposed definition of the POSITA, Patent Owner asserts that Dr. Foroosh has no professional training or experience with dentistry or orthodontics, and did not consult with such a person to form his opinions. *Id.* at 6 (citing Ex. 2048, 11:9–12; 12:19–22; 13:12–23). According to Patent Owner, although Dr. Foroosh once had an industrial engagement to analyze dental images (not with neural networks), he had no contact with the dental experts engaged by the company leading the project. *Id.* (citing Ex. 2048, 19:20–20:11). Consequently, Patent Owner asserts that Dr. Foroosh's lack of relevant experience or understanding of the "orthodontics standards" for acquiring dental photographs led him to misinterpret Carrier and Salah (e.g., reading into Carrier a "tooth counting" technique that is not disclosed). *Id.*

It is undisputed that the definitions between the parties' descriptions of a POSITA are "not materially different." PO Resp. 5, Pet. Reply 1; Ex. 1048 ¶ 9; Ex. 2028 ¶ 50. As correctly noted by Patent Owner, "the parties agree that a [POSITA] is a member of an interdisciplinary team including dental expertise where 'appropriate'" "to rely on dental expertise when addressing them." PO Sur-Reply 3 (citing Ex. 1048 ¶ 3). We therefore find Petitioner's description of POSITA to be consistent with the problems and solutions disclosed in the '409 patent and prior art of record, and adopt it as our own for purposes of this Decision, albeit without the one instance of "at least," which introduces ambiguity as to the appropriate level of work experience. *See, e.g.*, *In re GPAC Inc.*, 57 F.3d at 1579 (approving the determination of the level of ordinary skill in the art by appeal to the references of record). The qualifier "at least" expands the range of work experience without an upper bound, and does not meaningfully indicate the level of skill in the art.

The record before us indicates that Dr. Foroosh has the requisite educational background coupled with the appropriate level of work experience as part of a dental expert team to analyze dental images, and he called upon the Declaration testimony of Dr. Maureen Valley, a dental professional, to inform his analysis. Ex. 1002 ¶¶ 1–13; Ex. 1003; Pet Reply 2 (citing Ex. 1048 ¶¶ 1–9; Ex. 1035 ¶¶ 1–10; Ex. 1036). As one example of relevant work experience, Dr. Foroosh testifies that he "conducted extensive research in the field of 3D computer vision and computer modeling" throughout 2006 and 2007, where he "developed algorithms for 3D registration, modeling and visualization of maxilla and mandible of patients for dental surgery using Computer Aided Tomography (CAT) scanning."

Ex. 1002 ¶ 6; Ex. 1003, 12–13; *see also* Ex. 1002 ¶ 7 (describing a project that "was directed to the registration/alignment of dental CT scans of patients over a period of time during the treatment of a patient, with the purpose of improving the quality of 3D models, e.g., corrections and noise removal in 3D CT scans"). Therefore, we find on this record that Dr. Foroosh qualifies to testify from or about the perspective of a POSITA, and further meets the requisite qualifications to opine on the prior art relied upon in the challenge of the '409 patent. Accordingly, we disagree with Patent Owner's assertion that Dr. Valley's testimony regarding the dental nature of the references in the Petitioner's challenge includes disclosures that Dr. Foroosh did not understand when forming his opinions. PO Sur-Reply 3–4 (citing Ex. 1035 ¶¶ 34, 41–44; Ex. 2053, 38:18–39:6, 64:5–67:19; Ex. 2048, 130:8–11, 143:22–145:10, 149:19–22).

C. Claim Construction

In an *inter partes* review, claims are construed using the same claim construction standard that would be used to construe the claims in a civil action under 35 U.S.C. § 282(b), including construing the claims in accordance with the ordinary and customary meaning of such claims as would have been understood by one of ordinary skill in the art in view of the specification and the prosecution history pertaining to the patent. *See* 37 C.F.R. § 42.100(b). "[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention" and "after reading the entire patent." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313, 1321 (Fed. Cir. 2005) (en banc). In addition to the specification and prosecution history, we also

consider use of the terms in other claims and extrinsic evidence, including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Id.* at 1312–17. Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term. *Id.* at 1315.

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

In the Petition, Petitioner contends that three claim terms require construction. *See* Pet. 15–18. First, Petitioner contends that the claim term "image attribute" should be construed to "include[] an attribute having a value (which may be a set of values for multiple teeth) relating to an image as a whole, including an attribute related to" position and/or orientation and/or calibration of the apparatus used to acquire the analysis image, a quality relating to brightness, contrast, or sharpness of the analysis image, or the content of the analysis image. *Id.* at 15–16 (citing Ex. 1001, 3:38–49, 26:16–26).

Second, Petitioner contends that the claim term "tooth attribute" should be construed to "include[] any attribute related to a tooth," including tooth type, tooth number, and tooth shape parameter. *Id.* at 16–17 (citing Ex. 1001, 1:22–28, 3:23–37, 3:59–62, 28:58–65).

Third, Petitioner contends that the claimed "analysis of the analysis image by means of a deep learning device trained by means of a learning base" should be construed to include "analyzing an image and the structure

to encompass a device comprising a deep learning neural network trained with a learning base." *Id.* at 17–18 (citing Ex. 1001, 1:24–25, 1:39–40, 1:51–2:3, 3:14–18, 4:5–6, 8:41–50, 13:64–65, 16:13–50, 24:14–15, 24:46–47, 24:66–25:4, 28:27–29, 29:24–25, 29:54–55).

In the Patent Owner Response, Patent Owner contends that three different claim terms require construction. *See* PO Resp. 13–17. Patent Owner contends that the claim term "deep learning device" refers to "a device that, through training, is capable of analyzing an image and recognizing patterns therein." *Id.* at 13–15 (citing Ex. 1001, 16:53–56; 17:37–39, 24:38–59; Ex. 2028 ¶¶ 150–153; Ex. 2048, 209:24–210:5). According to Patent Owner, the deep learning device is preferably a neural network, which is described as an algorithm or a set of algorithms (i.e., a program written in computer code) with values that are updated through the training process such that the layers in its architecture are not hardware on which the algorithm runs. *Id.* Petitioner does not dispute Patent Owner's assertion, but notes nonetheless that image analysis software (e.g., neural network architecture) runs on a physical device. Pet. Reply 2. Petitioner therefore concludes that, because the claims do not require the deep learning device to run on the image acquisition device, but instead encompass a separate device performing the image analysis steps, such distinctions are immaterial. *Id.* at 2–3 (citing Ex. 1048 ¶¶ 13–16).

Further, Patent Owner contends that the claim term "real time" means "immediately" or while the image acquisition process is still underway. PO Resp. 15 (citing Ex. 1001, 25:50–62; Ex. 2028 ¶¶ 154–155; Ex. 2048, 71:6–73:19). Petitioner does not dispute Patent Owner's assertion that "real time" denotes "immediately." Pet. Reply 3 (citing Ex. 1037, 62:10–63:11; Ex.

1048 ¶ 17). Petitioner notes, however, that "immediately" does not establish a specific time duration; it merely requires that the feedback be provided "soon enough to be part of the acquisition process." *Id.*

Furthermore, Patent Owner asserts that, because a POSITA would have understood the claim term "tooth shape parameter" as relating to one type of "tooth attribute" (e.g., tooth width, thickness, crown height, level of abrasion) associated with a distinct tooth zone, it should be therefore construed as an attribute of a tooth depicted within the boundary of a tooth zone. PO Resp. 16 (citing Ex. 1001, 8:9–21; Ex. 2028 ¶¶ 156–158). Petitioner does not dispute Patent Owner's assertion, but notes that "tooth shape parameter" is one alternative in the list of tooth attributes (e.g., tooth number/type). Pet Reply 3.

Because Petitioner's application of the asserted references to the challenged claims does not turn on an express construction of any one of the claim terms identified above, we determine that we do not need to expressly construe any term for purposes of this Decision. *See Realtime Data*, 912 F.3d at 1375.

D. Overview of the Asserted Prior Art

1. Salah (Ex. 1008)

Salah relates to "a method for monitoring the positioning and/or shape and/or appearance of a patient's teeth and a computer program for implementing this method." Ex. 1008, 1:4–6. Salah recognizes that a patient may wish to monitor any possible movement/change in the shape and/or appearance of their teeth because dental checks carried out by an orthodontist or a dentist can be quite expensive. *Id.* at 1:15–18. Salah

therefore provides a method that allows a patient to self-monitor his/her dental condition. *Id.* at 1:25–26. In particular, Salah discloses creating a three-dimensional (3D) digital reference model of the patient's arch ("tooth model"), and acquiring a two-dimensional (2D) image of the patient's arch ("updated image") such that the 2D image can be compared with the 3D reference image to assess any deformation/displacement since the initial tooth model was produced. *Id.* at 1:26–2:26.

Figures 4a and 4b, reproduced below, illustrate Salah's dental arch monitoring method:

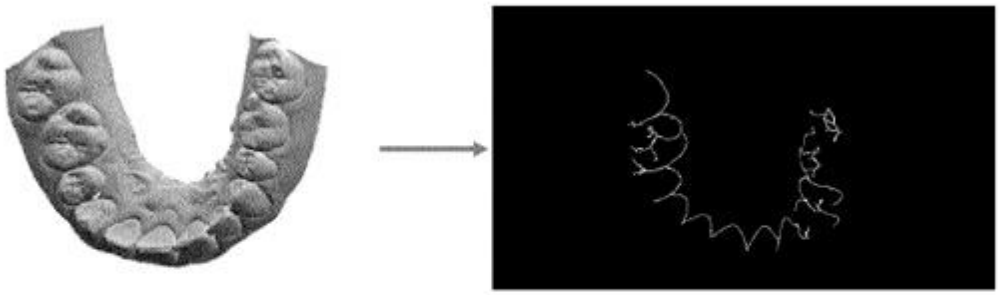

Fig. 4a Fig. 4b

Figure 4a shows a view of the initial reference model processed to reveal changes in the direction of the normal to the modeled surface. Figure 4b shows the inner gingival margin that can be extracted by analyzing the image in figure 4a. Ex. 1008, 22:18–20. "The initial reference model [IRM] may correspond to the position of the patient's teeth prior to treatment, or to the positioning of the patient's teeth that the treatment is designed to achieve." *Id.* at 20:2–3. The IRM can be prepared by an orthodontic professional using a 3D scanner "from measurements taken on the teeth or on a physical model of the patient's teeth, such as a plaster model." *Id.* at 20:13–17. The IRM is then stored in a centralized database. *Id.* at 23:9.

Figures 5a through 5d, reproduced below, further illustrate Salah's dental arch monitoring method:

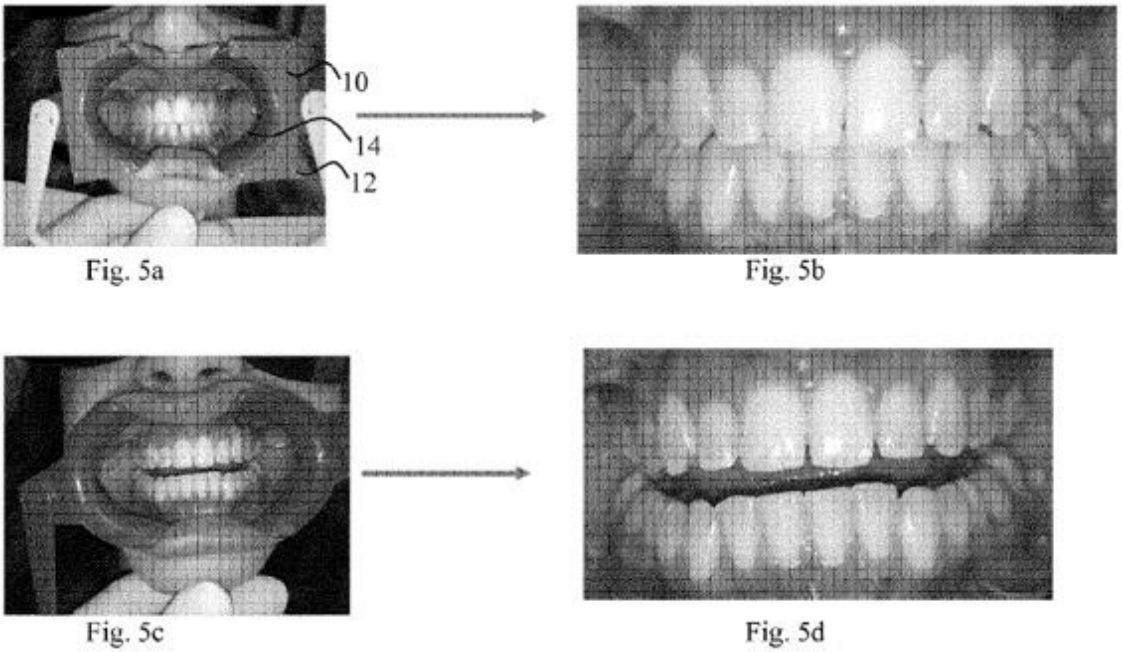

Figure 5 (5a–5d) illustrates the acquisition of updated images by the patient or an assistant using a cell phone with the aid of retractor 10 to improve teeth visibility. Ex. 1008, 23:24–26, 26:19–22. Retractor 10 may include registration marks 12 to help "guide the positioning of the image acquisition apparatus at the time of image acquisition, by means of corresponding references appearing on the acquisition apparatus display." *Id.* at 32:26–29. Registration marks 12 also "allow the approximate virtual acquisition conditions approaching the actual acquisition conditions to be determined, which allows data processing to be accelerated." *Id.* at 33:3–5.

The image-acquisition apparatus is equipped with a verification means including references or marks on a viewfinder to guide alignment by way of audio-visual prompts to facilitate its approximate positioning relative to the patient prior to acquiring the image. *Id.* at 27:19–28:10. In particular,

> The references [that appear on the viewfinder] may, for example, comprise a line intended to be aligned with the general direction of the juncture between the upper and lower teeth when the teeth are clenched by the patient, and/or a vertical line intended to be aligned with the joint between the two upper incisors. The references can also refer to other parts of the patient. For example, they may take the form of marks corresponding to the position of the eyes, or take the form of a shape in which the patient's mouth or face is to be positioned.

Id. at 28:5–10. The apparatus may also provide feedback informing the user regarding whether the quality of the image is acceptable or not, and whether to take another photo from a different position or angle. *Id.* at 27:19–26.

The first updated image is created preferably around the same time as the initial reference image or shortly thereafter. *Id.* at 25:1–2. It is stored on a universal serial bus drive, and subsequently downloaded. *Id.* at 27:5–7. The updated image can then be subsequently cropped, processed and filtered accordingly to reveal discriminant information (e.g., contour detection, convexity points) upon which deep learning can be applied. *Id.* at 33:13–36:14. "Comparison of Figures 5a and 5b, or 5c and 5d, shows the effect of cropping on an updated image." *Id.* at 34:1–2. "By identifying the registration marks on the updated image, it is possible to identify the area of the updated image containing the elements that were the subject of the initial reference model, i.e., the teeth and gums." *Id.* at 33:27–34:2. According to Salah, a POSITA knows how to use well-known processes (e.g., by applying various masks/filters, contour detection of a binary image, searching contour convexity points, checking points in a contour, and/or performing deep learning) in image processing software to detect discriminant information

(e.g., high contrast regions, contours) in an updated image. *Id.* at 34:6–36:14.

2. Carrier (Ex. 1005)

Carrier relates to a method and apparatus for capturing various images of a patient's teeth at predetermined viewing angles for remotely pre-screening the patient for possible orthodontic treatment. Ex. 1005, code (57), ¶ 6. In particular, Carrier discloses a telecommunications device (e.g., a cell phone) having a camera equipped with a processor that guides a user to take a series of images of the patient's teeth in each of a plurality of predetermined views by sequentially displaying, on a screen of the cell phone, each captured image from the camera along with an overlay including an outline of teeth (displayed atop the camera's view) such that the overlay's outline approximately matches the patient's teeth during the acquisition of the dental image. *Id.* ¶¶ 7, 63. Subsequently, the cell phone transmits the captured images to a remote location such that the orthodontist can determine whether the patient is a suitable candidate for the orthodontic treatment. *Id.* ¶ 63.

Figures 5A and 5B, reproduced below, illustrate Carrier's method of acquiring a patient's dental images:

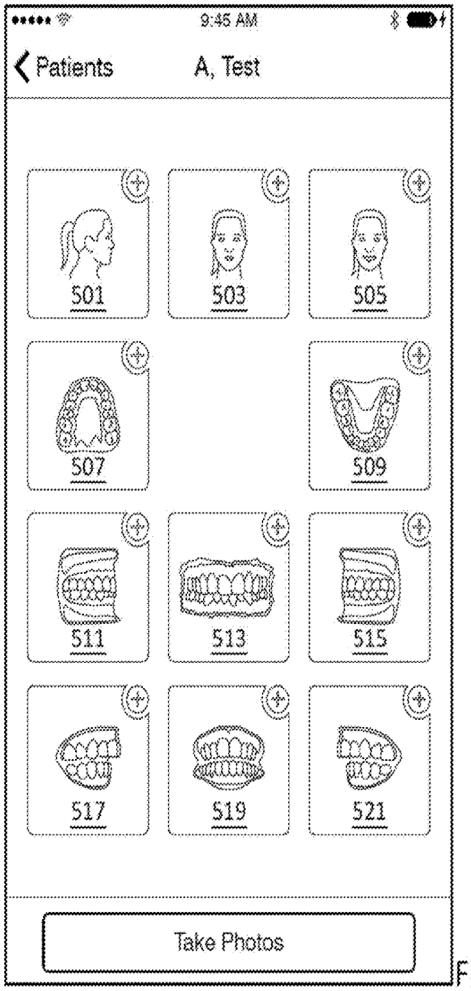

FIG. 5A

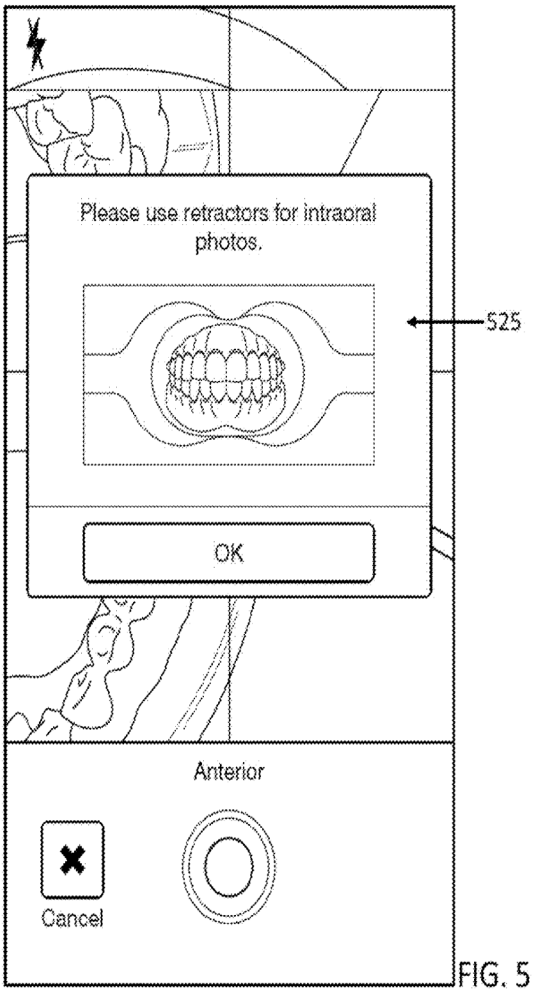

FIG. 5B

Figure 5A above illustrates an example of a user interface in a cell phone camera that enables a user viewing on the camera screen the image of a patient's teeth (with or without a retractor) to select one of a plurality of overlays for capturing the patient's dental images in a plurality of predetermined views when the teeth are aligned with the overlay outline. Ex. 1005 ¶¶ 63, 72. Figure 5B above illustrates an on-screen message to guide the user to take dental images. *Id.* ¶ 73.

Figures 6B, reproduced below, further illustrates Carrier's method of acquiring a patient's dental images:

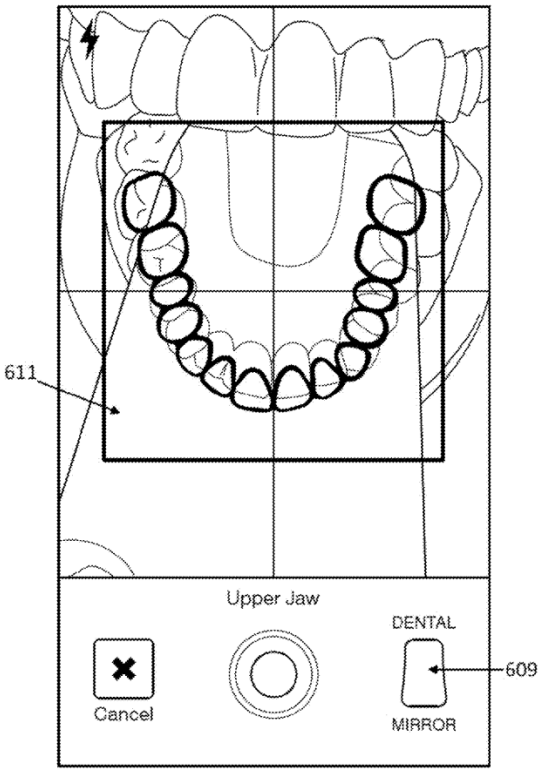

Figure 6B above depicts an example of a poor quality image of the teeth. *Id.* ¶ 77.

The disclosed camera may also include an indicator, which is triggered when the overlay approximately matches with the patient's teeth. The trigger may be visual (including changing the color of the overlay, displaying or flashing an image/icon/color/symbol on the screen, etc.) and/or audible (emitting a ping, tone, etc.), and/or tactile (e.g., vibrating), etc. Ex. 1005 ¶¶ 68–70, 73. The telecommunications device may also include a machine learning feature recognition to assess the quality of the picture by estimating the quality of contour matching between the outline of the overlay and the teeth of the patient. *Id.* ¶¶ 111, 113. Carrier states that the disclosed method is for "increasing the accuracy of the alignment of the

camera lenses with teeth of the patient" to produce "[h]igh quality dental images." *Id.* ¶ 102. More particularly, Carrier indicates that machine learning techniques may be used to detect the presence of teeth when photos are taken so as to automatically detect variations in the patient's teeth, which may improve the photo quality. *Id.* ¶ 154. The user may be alerted to take corrective measures (correct angle, move closer or away) when the patient's teeth are not fully visible. *Id.*

Upon uploading the images from the mobile telecommunications device to a remote location (e.g., a server), the images may be processed manually, automatically or semi-automatically to determine if the patient is a candidate for the orthodontic procedure. *Id.* ¶ 156.

3. Maninis (Ex. 1007)

Maninis is titled "Convolutional Oriented Boundaries [COB]: From Image Segmentation to High Level Tasks." Ex. 1007, Title. Maninis relates to using "Convolutional Neural Networks (CNNs)" to "produce[] multiscale oriented contours and region hierarchies starting from generic image classification." *Id.*, Abstr. Maninis indicates that the "latest wave of contour detectors takes advantage of deep learning to obtain state-of-the-art results," thereby providing "an end-to-end deep framework to boost the efficiency and accuracy of contour detection, using convolutional feature maps and a novel loss function." Ex. 1007, 2. Figure 2 of Maninis, reproduced below, further illustrates using a deep learning device for performing contour and edge detection in images. *Id.* at 3.

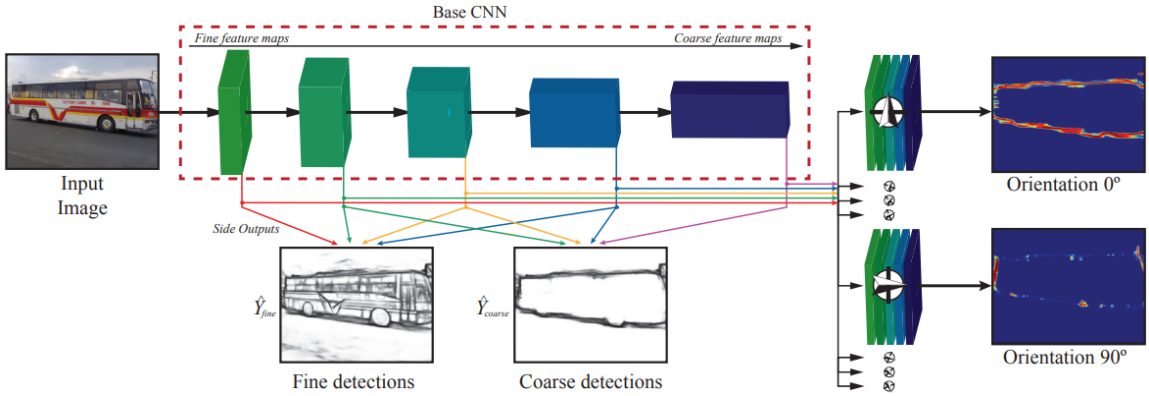

Figure 2 above illustrates a deep learning architecture depicting connections between different stages used to generate the multiscale contours using multiple feature map layers in a CNN to detect image contents at different scales (fine and coarse detections) as well as different orientations. *Id.*

Maninis uses a training dataset of 10,103 images with "localized pixel-wise semantic annotations," meaning pixel-by-pixel indications of each object's location in each image. *Id.* at 5–6. For training and optimization purposes, Maninis divides these images into "train, validation, and test sets" to train and validate the deep learning device. *Id.*

E. Whether Carrier and Maninis Qualify as Prior Art

Whether a reference qualifies as a "printed publication" is a legal conclusion based on underlying factual findings. *Jazz Pharm., Inc. v. Amneal Pharm., LLC*, 895 F.3d 1347, 1356 (Fed. Cir. 2018). The underlying factual findings include whether a reference was publicly accessible. *Id.* (citing *In re NTP, Inc.*, 654 F.3d 1279, 1296 (Fed. Cir. 2011)). We look to the underlying facts to make a legal determination as to whether a reference is a printed publication. *Suffolk Techs., LLC v. AOL Inc.*, 752 F.3d 1358, 1364 (Fed. Cir. 2014). In an *inter partes* review, the

petitioner bears the burden of establishing that a particular document is a prior art printed publication. *Jazz Pharm.*, 895 F.3d at 1356 (citing *Medtronic, Inc. v. Barry*, 891 F.3d 1368, 1380 (Fed. Cir. 2018)). The determination of whether a given reference qualifies as a prior art "printed publication" involves "a case-by-case inquiry into the facts and circumstances surrounding the reference's disclosure to members of the public." *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004) (citation omitted).

Public accessibility is a key question in determining whether a document is a prior art printed publication and is determined on a case-by-case basis. *Suffolk Techs.,* 752 F.3d at 1364 ; *see also In re Lister*, 583 F.3d 1307, 1311 (Fed. Cir. 2009) (To qualify as a printed publication, a document "must have been sufficiently accessible to the public interested in the art."). "A reference will be considered publicly accessible if it was disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence can locate it." *Medtronic*, 891 F.3d at 1380 (internal quotation marks and omissions). The key inquiry is whether the reference was made "sufficiently accessible to the public interested in the art" before the critical date. *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989); *see In re Wyer*, 655 F.2d 221, 226 (CCPA 1981). "A given reference is 'publicly accessible' upon a satisfactory showing that such document has been disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it." *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006).

1. Carrier

Patent Owner argues that, because Carrier[3] is not entitled to the priority date of the Carrier Provisional,[4] it does not qualify as prior art under *Dynamic Drinkware*[5] to support Petitioner's proposed challenge of the '409 patent.[6] PO Resp. 24. According to Patent Owner, "Petitioner is only entitled to the priority date of the Carrier Provisional if Petitioner can demonstrate that the Carrier Provisional provides written description support for at least one claim of Carrier." *Id.* (citing Pet. 9–10; Ex. 1002 ¶¶ 51–61); *see also id.* at 20 (citing Ex. 1002 ¶¶ 50, 51, Ex. 2048, 127:16–23, *Penumbra, Inc. v. RapidPulse, Inc.*, IPR2021-01466, Paper 34 (PTAB Mar. 10, 2023) (Final Written Decision) (precedential as to § II.E.3) ("Penumbra"), Ex. 2004 (redline of Carrier Provisional)). Patent Owner therefore submits that, because none of Petitioner's citations to the Carrier Provisional describes a method using "a mobile application on a mobile device associated ***with a patient***" or the "guiding ***the patient***" limitations of Carrier's claim 1, Carrier does not benefit from the priority date of the

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[3] Ex. 1005, codes (21), (22), (63) (indicating that Carrier was filed on November 18, 2020, as a continuation of application No. 16/827,594, filed on March 23, 2020, which is a continuation of application No. 15/803,718, filed on November 3, 2017, now U.S. Patent No. 10,595,966).

[4] Ex. 1005, code (60) (indicating that the provisional application was filed on November 4, 2016).

[5] *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1380 (Fed. Cir. 2015).

[6] Ex. 1001, code (22) (indicating that the application that issued as the '609 patent was filed on July 10, 2018); *id.* at code (65) (indicating a claim of priority on US 2019/0026889 A1, filed on January 24, 2019); *id.* at code (30) (indicating a claim of priority on foreign application FR 17 56947 filed on July 21, 2017).

Carrier Provisional. *Id.* at 25 (citing Ex. 2028 ¶¶ 104–109; Ex. 2030 ¶¶ 24, 72–75) (emphasis altered). Patent Owner contends that a POSITA "would have understood that the Carrier Provisional is directed to method for dental professionals to capture dental images using a mobile device, whereas Carrier itself is directed to a method wherein the patient uses the mobile device to capture dental images. *Id.* (citing Ex. 1006 ¶¶ 4, 51, 56, 57, 81, 95; Ex. 1005 ¶¶ 4, 96, 101, 102, 128, 172; Ex. 2028 ¶ 106; Ex. 2030 ¶¶ 72–75); PO Sur-Reply 5–6 (arguing the same).

Petitioner counters that Patent Owner's argument fails as a matter of law because under the holding in "*Penumbra, Inc. v. RapidPulse, Inc.*, a patent document is prior art under AIA §102 as of its provisional application's filing date so long as it meets 'the "ministerial requirements" of §§ 119 and 120' and the provisional application "'describe[s] the subject matter' relied upon in the reference patent document." Pet Reply 4 (citing *Penumbra*, precedential as to §II.E.3) (alteration in original).

We agree with Petitioner. At the outset, we note that *Penumbra* is a precedential decision that is binding on us. *Penumbra* states, in relevant-part, the following:

> [F]or prior-art determinations under AIA § 102, "there is no need to evaluate whether any claim of [a reference] patent document is *actually entitled to priority* or benefit under 35 U.S.C. 119, 120." MPEP § 2154.01(b) (emphasis added). Rather, under the AIA, a reference patent document need only meet the "ministerial requirements" of §§ 119 and 120, and the provisional or other earlier application(s) to which the reference patent document claims a right of priority must "describe[] the subject matter" relied upon in the reference patent document as prior art. 35 U.S.C. § 102(d)(2).

Penumbra, Paper 34 at 32 (second and third alterations in original).

In other words, when determining whether a reference qualifies as prior art under AIA § 102, we only need to determine whether the provisional application describes the subject matter in the non-provisional application relied upon by Petitioner. Stated differently, the holding in *Dynamic Drinkware* as to whether a claim in the non-provisional has sufficient written description support in the provisional application does not apply to an AIA § 102 reference, such as Carrier. *Id.* at 31–33. Accordingly, we do not agree with Patent Owner that "the reasoning and statutory interpretation in *Dynamic Drinkware* still controls." PO Sur-Reply 4. Because Petitioner provides in the Petition citations to where the Carrier Provisional describes the subject matter relied upon in Carrier (Pet. 10), and Patent Owner does not persuasively argue in the Response or the Sur-Reply that Petitioner's proffered support is deficient, we agree on this record that the subject matter of Carrier that Petitioner relies upon for its challenge, which also appears in the Carrier Provisional, is prior art to the claims of the '409 patent. Consequently, we disagree with Patent Owner's argument regarding the alleged lack of written description support in the Carrier provisional for a user (as opposed to a dental professional) using a mobile device to capture dental images (PO Resp. 24; Sur-Reply 5–6) because Petitioner does not rely on Carrier for such a feature, which is not even recited in the challenged claims. Accordingly, on the record before us, we determine that the subject matter from Carrier upon which Petitioner's challenge is based qualifies as prior art to challenged claims of the '409 patent.

2. Maninis

Patent Owner argues that Maninis does not qualify as prior art to support Petitioner's proposed challenge of the '409 patent. PO Resp. 35. In particular, Patent Owner argues that, although Petitioner downloaded a copy of Maninis from the website arXiv.org that purportedly was submitted on April 28, 2017, Petitioner has not sufficiently shown that it was publicly available to a POSITA at that date. *Id.* at 35–37 (citing Ex. 1007, 1; Ex. 1002 ¶ 64; Ex. 2048, 236:17–24). Patent Owner contends that Petitioner has not identified the date on which Maninis was published, but offers two pieces of circumstantial evidence to suggest that it was published sometime between April 28, 2017, and the July 21, 2017, priority date of the '409 patent. *Id.* at 35. Further, Patent Owner contends that Petitioner produces archived copies of the arXiv.org website from 2016 and 2017 reflecting the "policy" of arXiv.org to endeavor to publish articles shortly after they are submitted. *Id.* at 35–36 (citing Ex. 1022; Ex. 1023; Ex. 1026; Ex. 1002 ¶¶ 63–66). Patent Owner argues, however, that those submissions by Petitioner are unauthenticated hearsay without testimony from an individual with personal knowledge of those policies or how the Maninis paper was handled. *Id.* at 36 (citing Ex. 2048, 231:2–234:24).

According to Patent Owner, aside from Petitioner's declarant, Mr. Foroosh's, anecdotal suggestion that his own papers were published quickly, Petitioner does not account for the submission review time of the Maninis paper. *Id.* (citing Ex. 1002 ¶ 63; Ex. 2048, 232:1–15). Further, Patent Owner argues that Petitioner solely relies upon the later date (i.e., July 21, 2017) when a different version of the Maninis paper was submitted for publication, whereas both the earlier and later versions of Maninis share the

same uniform resource locator ("URL"), and Petitioner fails to provide any evidence to substantiate the actual publication date of the version of Maninis relied upon in the challenge. *Id.* (citing Ex. 1002 ¶¶ 62, 67; Ex. 1024; Ex. 2048, 235:5–236:8).

Petitioner counters that, contrary to Patent Owner's assertions, the production of a Wayback Machine archive of an arXiv.org search page is evidence to confirm Dr. Foroosh's personal knowledge of arXiv.org's routine business practice at the time and an express intent to publish Maninis. Pet. Reply 6 (citing Ex. 1002 ¶¶ 62–67; Ex. 1022; Ex. 1023; Ex. 1026; Ex. 1030; Ex. 1031). Petitioner asserts that Patent Owner does not address the Wayback Machine archive of an arXiv.org search page providing a direct download link for the Maninis PDF prior to July 21, 2017, or Dr. Foroosh's testimony that metadata indicates a creation date consistent with publication according to arXiv's policies. *Id.* (citing Ex. 1002 ¶ 66; Ex. 1025; Ex. 1031).

Based on the fully developed record, Petitioner presents sufficient evidence establishing that Maninis is prior art to the '409 patent. Based on the indicia on the face of Maninis itself, it is undisputed that it was submitted for publication on arXiv.org on April 28, 2017. Ex. 1007 (the first page bears the indicia "arXiv:1701.04658v2 [cs.CV] 28 Apr. 2017"). Petitioner produces a Declaration by Dr. Foroosh testifying subject to penalty for perjury about his personal knowledge of arXiv.org's routine business practice in the 2017 timeframe and arXiv.org's express intent to publish submitted documents. Ex. 1002 ¶¶ 62–67, 234, 235. According to Dr. Foroosh's Declaration,

> [I]t was the established policy of arXiv.org in 2017 to publish submitted papers within about one business day of the date of submission . . . . As the arXiv.org website explains, a submitted paper will be announced about one day after being submitted, and it will then be mailed to all arXiv.org subscribers (who would typically be persons interested in the paper's relevant field) shortly thereafter . . . . Regarding Maninis, with a submission date of April 28, 2017, it would have been announced on Sunday April 30, 2017, or Monday May 1, 2017, and would have been transmitted to subscribers no later than Tuesday May 2, 2017.
>
> Once a paper is announced, it was arXiv.org's stated policy that the paper may not be modified without creating a new version. EX1023 (archived July 18, 2017); EX1026 (archived September 8, 2016). Maninis itself reflects this practice, as the document indicates that it is the second version (with v2 as part of the stamp on the left side of the document), meaning that it was a revision made on April 28, 2017, to an earlier version (that had been submitted on January 17, 2017, see EX1021). Thus, under arXiv.org's standard practice, the version of Maninis submitted on April 28, 2017, would not have been changed after its announcement (on or about April 30, 2017). I have reviewed metadata contained in a copy of Maninis downloaded from the download link (https://arxiv.org/pdf/1701.04658), and this metadata indicates that the document was created and last modified on April 30, 2017. This is consistent with Maninis being placed in final form by arXiv.org as of an announcement date of April 30, 2017, with the version of Maninis that was published at that time being the same as the document provided as EX1007. This is also consistent with my experience with arXiv.org regular practice from early 2017 until today.
>
> The public availability of Maninis to interested persons prior to July 21, 2017, is also corroborated by archived webpages of both arXiv.org and the authors of Maninis. As of May 3, 2017, the university website featuring the author's Convolutional Oriented Boundaries software included a link (to https://arxiv.org/abs/1701.04658) for downloading a PDF copy of Maninis from arXiv.org. EX1024 (archived May 3, 2017). Additionally, as of July 8, 2017, the arXiv.org author search webpage for Prof. Luc Van Gool, the last author listed on Maninis, listed Maninis as one of his recent papers that was available on arXiv.org,

> providing links to both the abstract page (https://arxiv.org/abs/1701.04658) and a link to directly download Maninis (https://arxiv.org/pdf/1701.04658). EX1025 (archived July 8, 2017). Thus, Maninis was disseminated to interested persons in the scientific community prior to July 21, 2017. Accordingly, I understand that Maninis may be considered in evaluating the patentability of the claims of the '409 patent.

Id. ¶¶ 65–67.

Petitioner also produces an additional declaration by Dr. Foroosh attesting that he had "reviewed metadata contained in a copy of Maninis downloaded from the download link (https://arxiv.org/pdf/1701.04658)" that "indicates that the document was created and last modified on April 30, 2017." Ex. 1029 ¶ 3, Ex. 1002 ¶ 66. Further, Dr. Foroosh indicates that he had downloaded a copy of the Maninis PDF file (Ex. 1007) from the link reproduced above. *Id.*

Furthermore, Petitioner produces archived copies of the arXiv.org website from 2016 and 2017 reflecting the "policy" of arXiv.org to endeavor to publish articles shortly after submission. Ex. 1022; Ex. 1023; Ex. 1026.[7] Additionally, Petitioner produced a Declaration from Mr. Frank-White, the Records Request Processor at the Internet Archive, explaining the functioning of the Internet Archive's Wayback Machine and further explaining how each archived web page's URL reflects its archiving date. Ex. 1031.[8]

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[7] We determine in the "Motion to Exclude" analysis section *infra* that these Exhibits were timely submitted, that they are authenticated, and that they are not inadmissible hearsay.

[8] We likewise determine in the "Motion to Exclude" analysis section *infra* that Exhibit 1031 was timely submitted as reply evidence, that Petitioner has

On this record, we do not agree with Patent Owner that Petitioner has provided no evidence that the arXiv.org's policies were applied to Maninis or that the arXiv.org website was operating properly. PO Sur-Reply 6–7. As noted above, "[a] reference will be considered publicly accessible if it was disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence can locate it." *Medtronic*, 891 F.3d at 1380 (internal quotation marks and omissions omitted). In light of the foregoing Declarations and supporting Exhibits filed by Petitioner, we find that, given the ordinary course of business of arXiv.org, a person who exercises reasonable diligence would have been apprised of the availability of the Maninis reference at least before July 17, 2017, which is the earliest effective filing date of the '409 patent.

Accordingly, based on the weight of the evidence on the record before us, we determine that Maninis qualifies as prior art to support Petitioner's proposed challenge of the '409 patent.

F. Asserted Obviousness Based on Salah, Carrier, and Maninis

Petitioner argues that claims 1–15 are rendered obvious based on the combined teachings of Salah, Carrier, and Maninis. Pet. 18–70. Patent Owner opposes. PO Resp. 37−67. Upon consideration of Petitioner's explanations and supporting evidence on the record before us, we are persuaded that Petitioner has demonstrated by a preponderance of the

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established proper foundation for paragraphs 62 through 67 of Exhibit 1002, and that they constitute proper opinion testimony by Dr. Foroosh.

evidence that the challenged claims would have been obvious over the combination of Salah, Carrier, and Maninis. Our analysis below focuses on the disputed claim elements.

1. The Preamble

Independent claim 1 recites "[a] method for acquiring an image of a dental arch of a patient, said method comprising the following steps." Ex. 1001, 32:13–14.

Petitioner argues that, to the extent the preamble is limiting, Salah teaches these limitations. Pet. 24–25 (citing Ex. 1008, code (57), 12:20–24) (asserting "Salah teaches acquiring images of patients' dental arches"). Further, Petitioner argues that Carrier likewise teaches these limitations. *Id.* (citing Ex. 1005 ¶ 9; Ex. 1006 ¶ 7) (asserting that Carrier "teaches methods of obtaining images of patients' teeth 'for therapeutic use.'"). According to Petitioner, "both references teach using a mobile device that guides users to acquire dental images." *Id.* (citing Ex. 1008, 27:21–28:2, Figs. 5A–D; Ex. 1006 ¶¶ 59, 96, Figs. 2A–3B, 5C–7C; Ex. 1005 ¶¶ 104, 173, Figs. 2A–3B, 5C–7C; Ex. 1002 ¶¶ 89–93).

Patent Owner does not specifically respond to these arguments. *See generally* PO Resp. Nonetheless, the burden of persuasion remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware, LLC*, 800 F.3d at 1378.

Without determining whether the preamble is limiting, we have reviewed Petitioner's unrebutted arguments and the underlying evidence, and we find that Petitioner has shown by a preponderance of the evidence

that combination of Salah and Carrier (and, thus, the combination of Salah with Carrier and Maninis) teaches the subject matter of the preamble.

2. Step 1a') activation of an image acquisition apparatus

Independent claim 1 further recites "activation of an image acquisition apparatus so as to acquire an image, called 'analysis image', of said arch." Ex. 1001, 32:15–16.

Petitioner argues that Salah teaches these limitations. Pet. 25 (citing Ex. 1008, 27:11–13, 31:4–7; Ex. 1002 ¶ 94) (asserting "Salah teaches that a user . . . may acquire dentition images using . . . a cellphone . . . that includes a viewfinder or screen to aid in alignment" "to acquire images displayed on a viewfinder or screen when aligning the apparatus constitutes the recited 'activation' to acquire an 'analysis image'"). Further, Petitioner argues that Carrier likewise teaches these limitations. *Id.* at 25–27 (citing Ex. 1002 ¶¶ 95–97; Ex. 1005 ¶¶ 8, 104, 107, 108, 171, Figures 3A–B, Figure 7B; Ex. 1006 ¶¶ 7, 59, 62, 63, 94, Figs. 3A–B, Figure 7B) (asserting that Carrier teaches a mobile device (e.g., a smart phone) for acquiring images of a patient's teeth when they are aligned with an outline of teeth in an overlay displayed on the screen of the mobile device). According to Petitioner, both Salah and Carrier teach a mobile phone to acquire an image of a dental arch displayed on the screen during alignment. *Id.* at 27 (citing Ex. 1002 ¶ 98).

Patent Owner does not specifically respond to these arguments. *See generally* PO Resp.

We have reviewed Petitioner's unrebutted arguments and the underlying evidence, and we find that Petitioner has shown by a preponderance of the evidence that the combination of Salah and Carrier

(and, thus, the combination of Salah with Carrier and Maninis) teaches the limitations in step 1a'.

3. Step 1b') analysis of the analysis image

Independent claim 1 further recites "analysis of the analysis image by means of a deep learning device trained by means of a learning base." Ex. 1001, 32:17–18.

Petitioner argues that the combination of Salah, Carrier and Maninis teaches these limitations. Pet. 27–31. In particular, Petitioner argues that Salah's disclosure of an acquisition apparatus that includes a verification means to guide a user (1) in positioning the camera to acquire an image of a patient's dental arch, (2) in determining whether the image is acceptable, and (3) in subsequently employing deep learning to analyze the captured image to detect the contour of teeth teaches "the analysis of the image." *Id.* at 27–28 (citing Ex. 1002 ¶¶ 99–101; Ex. 1008, 27:21–28:2, 34:5–36:14, Figs 6b). Further, Petitioner argues that Carrier's disclosure of using contour/object detection to assess image alignment and to guide users to acquire an image of a patient's dental arch such that all teeth are visible to detect the positions of tooth edges relative to an overlay teaches analyzing an acquired image. *Id.* at 28 (citing Ex. 1002 ¶¶ 102, 103; Ex. 1005 ¶¶ 108, 128; Ex. 1006 ¶¶ 63, 81).

Furthermore, Petitioner argues that, "[a]lthough Carrier does not expressly disclose that its image analysis techniques employ 'a deep learning device trained by means of a learning base,' Carrier invites the use of 'any appropriate technique[s] (e.g., edge detection image processing, etc.),' and Salah expressly identifies *deep learning* as an option for detecting tooth

contours." *Id.* at 28–29 (citing Ex. 1002 ¶ 104; Ex. 1005 ¶ 108; Ex. 1006 ¶ 63; Ex. 1008, 34:5–36:14).

Additionally, Petitioner proposes to modify Salah-Carrier's system to use Maninis's deep learning techniques for detecting contours/edges to perform image analysis, a process referred as "Convolutional Oriented Boundaries (COB)." *Id.* at 29 (citing Ex. 1002 ¶ 105; Ex. 1007, Abstr., 3–5, Figures 3–5). According to Petitioner, Maninis's disclosure of using a deep learning architecture to perform image analysis would enable both "detection of tooth edges and recognition of individual teeth as taught by Carrier." *Id.* at 30 (citing Ex. 1002 ¶ 106). Petitioner then asserts, "[t]hus, Salah, Carrier, and Maninis teach 'analysis of the analysis image' (to determine values for tooth presence and edges, as taught by Carrier) 'by means of a deep learning device trained by means of a learning base' (a device comprising a deep learning neural network trained with a learning base, as taught by Salah and Maninis)." *Id.* at 31 (citing Ex. 1002 ¶ 109).

Patent Owner disagrees that the proposed combination of Salah, Carrier and Maninis teaches limitation 1b'. PO Resp. 37–59. We address Patent Owner's arguments *seriatim* as they are presented in Patent Owner's Response.

4. Carrier's Alignment Techniques Are Unsuitable for Salah's Image Acquisition Process/Device that use Registration Marks

Patent Owner argues that the proposed combination of Salah, Carrier, and Maninis is fatally flawed because Salah, as acknowledged by Petitioner, does not disclose using a deep learning device to determine image attribute values to guide the image acquisition. PO Resp. 37 (citing Ex. 1002 ¶¶ 47, 77–82; Ex. 2028 ¶¶ 161–162). Further, Patent Owner argues that

Petitioner's reliance upon Carrier's alignment techniques falls short of remedying Salah's deficiencies. *Id.* In particular, Patent Owner submits that Carrier's first technique of using an on-screen overlay that assesses alignment by checking whether identified contours of the patient's teeth are within a threshold distance of the overlay ("overlay technique") misses the mark. *Id.* Likewise, Patent Owner asserts that Carrier's second technique of using an image recognition algorithm to identify which teeth by number are present in an image ("tooth counting technique"), thereby ensuring all required teeth are visible, is similarly deficient. *Id.* at 37–38.

Furthermore, Patent Owner argues that, although Petitioner asserts that Carrier's alignment techniques would help to guide users of Salah's image acquisition device by providing them with feedback as they are acquiring the image, Petitioner has not identified any deficiency in Salah's existing technique that Carrier's techniques might provide. *Id.* at 45 (citing Ex. 1002 ¶¶ 81–82; Ex. 2028 ¶¶ 173–181). Patent Owner also argues that Carrier's techniques would be detrimental to Salah's disclosure of adding "registration marks" (with known size, orientation, and optical character) to retractors to automatically align a mobile phone in relation to a patient's teeth to meet "target acquisition conditions" to provide real time guidance to users of the mobile device during the acquisition of dental images. *Id.* at 46 (citing Ex. 2028 ¶¶ 78, 79, 95, 178; Ex. 1008, 29:18–23). According to Patent Owner, because Salah's registration marks are not amenable to teeth variability or movability, which occurs over time during treatment of a patient, Salah discourages alignment techniques such as those disclosed by Carrier. *Id.* at 47 (citing Ex. 2028 ¶¶ 179–181). Therefore, Patent Owner submits that a POSITA would have recognized that Carrier's alignment

techniques are computationally more challenging than Salah's standardized geometric mark or symbol. *Id.* (citing Ex. 2028 ¶179; Ex. 1008, 12:6–16, 28:27–29:2). Accordingly, Patent Owner asserts that, "when evaluating [Petitioner's] alleged motivation, [we] should consider the negative impacts that such a modification would have on Salah's methods of monitoring the positioning, shape, and/or appearance of a patient's teeth." *Id.* at 47 n.5 (citing *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1368 (Fed. Cir. 2016)). Additionally, Patent Owner asserts that, to the extent Petitioner proposes that Salah's and Carrier's alignment techniques would be deployed together, in parallel, such a combination would be nonsensical as it would result in two competing alignments techniques that would confuse the user, waste resources, and provide no operational advantages. *Id.* at 48 (citing Ex. 2028 ¶ 181; Ex. 2030 ¶ 95; Ex. 1008, 10:22–26, 54:12–15, 31:23–25; Ex. 1006 ¶¶ 19, 63, 88–89; Ex. 1005 ¶¶ 20, 108, 165–166).

Based on the fully developed trial record, we do not agree with Patent Owner's arguments as they are premised on a mischaracterization of Petitioner's proposed combination. As set forth above, in its contentions for the limitations in step 1b', Petitioner relies on Salah for its teaching of using an image acquisition apparatus including a verification means to guide a user in positioning, capturing an image of a patient's dental arch, and subsequently using deep learning to analyze the captured image to detect edges and contours therein. Pet. 27–28. Petitioner then proposes modifying Salah's system with Carrier's teaching of using contour/object detection to assess image alignment and to guide users to acquire an image of a patient's

dental arch such that all teeth are visible to detect the positions of tooth edges relative to an overlay. *Id.* at 28.

Although Carrier's alignment techniques provide the benefit of effectively assessing alignment based on the appearance of the patient's teeth to thereby ensure high quality dentition images, Petitioner does not propose a bodily incorporation of Carrier system into Salah's image acquisition system. "The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference . . . . Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art." *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). "The obviousness analysis cannot be confined by the formalistic conception of the words teaching, suggestion, and motivation, or by overemphasis on the importance of . . . the explicit content of issued patents." *KSR*, 550 U.S. at 402. In this case, Petitioner relies upon Salah's and Carrier's complimentary teachings of acquisition devices that guide the user in real-time to capture high quality dental images. Pet. Reply 11 (citing Ex. 1002 ¶¶ 81, 84–86). Thus, while Salah also discloses another acquisition device that uses registration marks in an overlay to align the captured picture, Petitioner does not propose using Carrier's alignment techniques in Salah's acquisition device that uses registration marks. Rather, the proposed combination seeks to incorporate Carrier's teaching of providing real-time guidance to users of Salah's image acquisition system. Accordingly, we find unavailing Patent Owner's argument regarding Salah's use of registration marks being incompatible with Carrier's alignment techniques, which mischaracterizes Petitioner's proposed combination. *See* PO Resp. 46–47; PO Sur-Reply 13–15.

5. Maninis's COB network Cannot Be Trained to Perform the Claimed Image Analysis

Patent Owner argues that Petitioner improperly relies upon an incompatible deep learning device (e.g., a COB neural network) disclosed by Maninis to remedy the admitted deficiencies of Salah and Carrier.[9] PO Resp. 38–39 (citing Ex. 1002 ¶¶ 83–87; Ex. 2028 ¶¶ 168–171). According to Patent Owner, because Maninis's COB neural network can be trained only on contours to identify an image only in contours, it is incapable of being trained on a learning base containing historical images with semantic contours of individually labelled teeth to perform the claimed image analysis, as proposed by Petitioner. *Id.* at 39–41. Further, Patent Owner argues that, to the extent that Petitioner is now proposing using other neural networks disclosed in Maninis in addition to the COB neural network to perform the claimed image analysis, such an approach is not suggested in the Petition, which does not offer any evidence regarding motivations or expectations of success for such a combination. *Id.* at 42. Simply put, Patent Owner argues that Maninis's COB neural network for detecting generic contours cannot perform any semantic determination to identify image value attributes. *Id.*

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[9] Patent Owner alleges that Petitioner's new reliance on different neural networks from Maninis to satisfy this limitation constitutes an improper new ground. PO Sur-Reply 12; *see also* Paper 27 (Patent Owner's Listing of New Arguments in Petitioner's Reply). We disagree. As set forth by Petitioner in the Reply, the Petition cited to and discussed that Maninis uses neural networks not only to detect contours, but also uses the regions identified by those contours to classify objects. Reply 8 (citing Pet. 11, 22, 23, 33–34 (citing Ex. 1007, 11–12); Ex. 1002 ¶¶ 68, 83, 85, 116–117).

Based on the fully developed trial record, we do not agree with Patent Owner's arguments for the following reasons.

a. Scope of Limitations in Step 1b'

As an initial matter, we note that the claim recites in step 1a') "an image acquisition apparatus" and in step 1b') "a deep learning device trained by . . . a learning base" for analyzing an image captured by the image acquisition apparatus ("analysis image"). Ex. 1001, 32:15–18. Although Patent Owner argues that the image acquisition apparatus is a mobile device, Patent Owner has not accounted for the nature of the "deep learning device" aside from indicating that the latter device pertains to a neural network trained by the learning base for assessing the analysis image. PO Resp. 10–13; Ex. 1001, 3:13–17, 18:56–59, 23:7–10. The record before us, however, is devoid of any evidence to substantiate any inference from Patent Owner that the claimed "deep learning device" is somehow integrated in the mobile device. *See, e.g.*, PO Resp. 33–34 (arguing that "a [person of ordinary skill in the art] would have recognized that the Maninis COB neural network was too computationally expensive and resource draining to run on even the most optimized mobile devices"). Further, while the Specification of the '409 patent indicates that the learning base comprises more than 100,000 historical images of patients' dental arches annotated with information to train the deep learning device in analyzing the analysis image, the claim is not so limiting. *See* Ex. 1001, 15:65–16:3. Because the claim does not require a particular type of neural network that is trained by a particular learning base in a particular way, Patent Owner's arguments to that effect (*see* PO Resp. 42) are not commensurate with the scope of the claim. *In re*

Hinicker, 150 F. 3d 1362, 1369 (Fed. Cr. 1998). It suffices that Petitioner need only show a deep learning device capable of being trained by a learning base to analyze a captured image to properly account for step 1b'.

b. Incompatibility/Inoperability Arguments

Regarding the proposed combination of Salah and Carrier with Maninis, we note Petitioner's clarification that the Petition does not use the phrase "Maninis COB neural network," which was introduced in Patent Owner's Response by Dr. Mongan, and excludes Maninis's disclosure of coupling COB with different neural networks or pipelines that are not COB. Pet. Reply 7 (citing Ex. 1037, 103:14–104:19, 107:2–17; Ex. 1038 ¶¶ 23–25). Petitioner emphasizes that such a mischaracterization of the Maninis reference distorts the proposed combination as it excludes key teachings relied upon in the Petition. *Id.* at 8. According to Petitioner, the proposed combination relies primarily on Maninis for its teaching of deep learning architecture trained by a learning base to detect and identify contours, which are used to classify objects (e.g., teeth captured by the Salah-Carrier's acquisition device). *Id.* at 8–9 (citing Pet. 11, 22, 23, 33, 34; Ex. 1007, 11–12; Ex. 1002 ¶¶ 68, 83, 85, 116–118; Ex. 1048 ¶¶ 25–28).

With this clarification from Petitioner in mind, we do not agree with Patent Owner's argument that, because Maninis's deep learning architecture is only trained to identify contours, which are used to classify objects, the disclosed deep learning device is incapable of being trained to perform the claimed image analysis. PO Resp. 39–42. As noted above, because the claim does not identify a particular type of deep learning device, it suffices that the deep learning architecture disclosed by Maninis is capable of

performing the claimed image analysis. The '409 patent provides a non-exhaustive list of deep learning devices trained with a learning base from which a suitable neural network may be chosen to include "networks specializing in the classification of images, called 'CNN.'" Ex. 1001, 16:13–19. Indeed, this is the same deep learning architecture taught by Maninis and relied on by Petitioner in its claim mapping for the limitations in step 1b'. *See* Pet. 30 (arguing that "Maninis's use of a computing device comprising a trained deep-learning [CNN] to analyze images matches the '409 patent's preferred embodiment").

More specifically, Petitioner avers, and we agree, that Salah discloses that the deep learning device can be used to perform image analysis and that employing deep learning to analyze the captured image to detect the contour of teeth teaches "the analysis of the image." Pet. 27–28. Petitioner further argues, and we agree, that Carrier invites the use of 'any appropriate technique[s] (e.g., edge detection image processing, etc.),' and Salah expressly identifies *deep learning* as an option for detecting tooth contours." *Id.* at 28–29 (emphasis added). Additionally, Petitioner argues, and we agree, that Maninis discloses a deep learning architecture of the type cited in the '409 patent for performing image analysis. *Id.* at 29–30.

To the extent Patent Owner argues that Petitioner exclusively relies on Maninis's COB neural network to teach the claimed "a deep learning device trained by means of a learning base," we disagree. *See* PO Resp. 39–42; PO Sur-Reply 8–11. In its claim mapping of step 1b', Petitioner relies on Mannis's COB together with different CNNs, which are not themselves a COB, to perform object and contour detection. *See* Pet. 29–30; Pet. Reply 7–8; *see also* Pet. 11, 22, 23, 33–34. Stated differently, at no point does

Petitioner exclusively rely on Maninis's COB neural network to teach step 1b' and any arguments from Patent Owner premised on this assertion are not responsive to Petitioner's contentions.

After considering the entire record before us, we find that Petitioner has shown by a preponderance of the evidence that the proposed combination of Salah, Carrier and Maninis teaches the limitation in step 1b'.

6. The Proposed Combination is a Product of Impermissible Hindsight

Patent Owner argues that the proposed combination of Salah, Carrier, and Maninis is deficient because, absent impermissible hindsight, a POSITA would not have been motivated to combine Salah and/or Carrier with the specific neural network of Maninis, as per Dr. Foroosh's own testimony. PO Resp. 43–45 (citing Ex. 2048, 44:18–22, 62:3–16, 67:18–25, 109:2–19). Patent Owner asserts that Petitioner does not identify any problem or shortcoming in Salah's and Carrier's image acquisition methods that a POSITA would have been able to address by relying on Maninis's COB network. *Id.* at 49 (citing Ex. 2028 ¶¶ 182–184). Patent Owner further asserts that, even if "the Maninis COB neural network could function as proposed, . . . the combination would not be fit-for-purpose and is fraught with disadvantages that would overwhelm any conceivable benefit." *Id.* According to Patent Owner, while Salah discloses using deep learning in the context of analyzing post image acquisition to update a 3D module, Maninis's deep learning is intended to determine image contours as opposed to guiding image acquisition. *Id.* at 50. Patent Owner contends that Salah, in fact, teaches away from using tooth contours to measure teeth in the context of bringing the acquisition apparatus into the matching position. *Id.*

(Ex. 1008, 31:12–13, 31:26–27; Ex. 2028 ¶¶ 186–87). Although Petitioner proposes that a POSITA would have good reasons (besides speeding image classification) to employ Maninis COB neural network for object detection, Patent Owner argues that Petitioner has not identified any such good reasons to combine Maninis with Salah and Carrier. *Id*. at 50–51 (citing Ex. 1002 ¶ 85). Regardless of any speculative benefits (contour accuracy, accuracy of alignment) that could potentially ensue from the proposed combination, Patent Owner argues that a POSITA would have recognized that any such potential benefits would be wiped out by the loss of Salah's existing "registration mark" technique and the significant costs, delay, and incompatibility. *Id.* at 51 (citing Ex. 2028 ¶¶ 188–190).

Based on the complete trial record before us, we do not agree with Patent Owner's arguments. As discussed above, the proposed combination seeks to combine Carrier's teaching of providing real-time guidance with Salah's acquisition system to forward an image of a dental arch being captured to Maninis's deep learning system for performing the requisite image analysis. The record before us supports that Carrier's provisioning of real time guidance to users of Salah's acquisition device as the image of the dental arch is being captured would enhance the alignment of each tooth in the dental arch, thereby enhancing the quality of the dental arch image, as taught by Carrier. *See* Ex. 1005 ¶¶ 7, 63. Further, the record before us supports that, because Maninis's image analysis tool classifies images in as little as 60 ms, it would help the Salah-Carrier mobile device to contemporaneously identify each aligned tooth in the dental arch image being captured. Pet. Reply 15–17 (citing Ex. 1048 ¶¶ 40–42, 47). As correctly noted by Petitioner, "it is well-known that trained networks could

be made substantially more efficient and less processor-intensive." *Id.* at 16 (citing Ex. 2028 ¶ 43).

We therefore disagree with Patent Owner's assertion of hindsight. Accordingly, we find that Maninis's disclosure of a deep learning architecture for performing image analysis, taken in combination with Carrier's real-time guidance for a user of Salah's image acquisition device, is no more than a simple arrangement of known elements with each performing the same function it had been known to perform, yielding no more than what one would expect from such an arrangement. *See KSR*, 550 U.S. at 416. Therefore, the POSITA, being "a person of ordinary creativity, not an automaton," would have been able to fit the teachings of these cited references together like pieces of a puzzle to predictably yield a portable device that works in conjunction with a deep learning device to perform real-time image analysis of the dental arch being captured, thereby ensuring that the captured image is of high quality. *Id.* at 420–21. Because the proposed combination would not have been "uniquely challenging or difficult for one of ordinary skill in the art," we agree with Petitioner that the proposed modification would have been within the purview of the POSITA. Pet. Reply 16; *see Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007) (citing *KSR*, 550 U.S. at 418).

7. Maninis's Deep Learning Architecture is Unsuitable for Real-Time Guidance in Salah/Carrier's Mobile Devices

Patent Owner argues that, although claim 1 of the '409 patent does not require that the recited analysis be performed in *real-time* on the mobile device, Petitioner's entire case of obviousness rests on the notion that a POSITA would have been motivated to employ Maninis's neural network to

improve real time guidance during image acquisition in Salah's and Carrier's image acquisition device (e.g., mobile phone). PO Resp. 52 (citing Ex. 1002 ¶ 86; Ex. 2048, 56:10–15, 68:25–69:8). Accordingly, Patent Owner asserts that we must consider whether a POSITA would have had the motivation advanced by Petitioner to incorporate Maninis's deep learning architecture into the real time mobile devices of Salah and Carrier during image acquisition, even if the shortcomings in Petitioner's obviousness combination do not relate to the language of all challenged claims. *Id.* at 52–53. Likewise, Patent Owner asserts that, because both the mobile devices in Carrier and Salah include software that runs on processors to provide the real-time guidance during image acquisition, Petitioner's reliance on Maninis's computationally intensive COB neural network for use in a GPU is misplaced. *Id.* at 53 (citing Ex. 1002 ¶¶ 227–230; Ex. 2028 ¶¶ 131, 146, 191–194; Ex. 2030 ¶¶ 23, 45). Accordingly, Patent Owner asserts that it would take far longer to run the software on the portable device than on Maninis's graphics processing unit ("GPU") and that a POSITA

> practicing Salah and/or Carrier would have known they need only achieve approximate alignment and thus, would not have been motivated to employ Maninis's COB technique when it would have precluded real time feedback to guide the user on their mobile phone, effectively rendering those alignment techniques unusable.

Id. at 54 (citing Ex. 2028 ¶¶ 195–196; *In re ICON Health & Fitness*, 496 F.3d 1374, 1382 (Fed. Cir. 2007); *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984)).

Based on the complete trial record before us, we do not agree with Patent Owner's arguments. As noted above, the limitation in step 1b' does not require that the image acquisition device and the deep learning device be

integrated in a single portable device. As acknowledged by Patent Owner, both Salah and Carrier discuss the importance of including software that runs on processors to provide the real-time guidance during image acquisition. PO Resp. 53. It is likewise undisputed that Maninis relates to performing image analysis using neural networks trained by a learning base, as discussed above. We thus agree with Petitioner that because the POSITA is not an automaton, the POSITA would have been apprised of routine optimization techniques that can be adapted to combine Maninis's neural networks to work in real time with Salah-Carrier's acquisition device. Pet. Reply 16–17 (citing Ex. 1048 ¶¶ 43, 44). *See Leapfrog Enters., Inc.* 485 F.3d at 1162.

8. Whether the Proposed Implementation of Maninis's Deep Learning Architecture in Salah and Carrier Would be Costly

Patent Owner argues that implementing Maninis's neural network in Salah's and Carrier's mobile acquisition device would necessitate a significant amount of time and expense, which would weigh heavily against any motivation offered by Petitioner. PO Resp. 55. In particular, Patent Owner argues that, as purportedly admitted by Dr. Foroosh, implementing Maninis's neural network would require training it on more than 10,000 images of patient's teeth captured with Salah's and Carrier's mobile phone. *Id.* Patent Owner then argues that, because Dr. Foroosh has not presented any evidence that such images existed as of July 2017, Salah and Carrier would have to gather such images alone to subsequently train the Maninis neural network over time. *Id.* (citing Ex. 1002 ¶167; Ex. 2048, 103:23–106:5, 109:3–19, 222:7–12; Ex. 2028 ¶¶145–147, 197; Ex. 2030 ¶¶ 46, 47; Ex. 2032; Ex. 2039; Ex. 2041). According to Patent Owner, such an

implementation would be cumbersome as it would be exorbitantly expensive, complex, and time consuming to implement. *Id.* at 55–57.

Further, Patent Owner argues that a POSITA would not have been motivated to identify individual teeth to guide image acquisition in either Carrier or Salah. *Id.* at 57. Patent Owner asserts that, because Carrier's overlay technique includes an outline of teeth in a predetermined view that provides a high-quality dental photograph including information about all required visible teeth, there would not be a need to account for each tooth individually. *Id.* at 57–58 (citing Ex. 1006 ¶ 60; Ex. 1005 ¶ 105; Ex. 2028, ¶¶ 208–211; Ex. 2030 ¶¶ 79–82). Notably, Patent Owner argues that Dr. Foroosh's tooth counting method is flawed as various patients have different numbers of teeth due to tooth loss in previously sustained injuries, illnesses, extraction, etc. *Id.* Accordingly, Patent Owner argues that Petitioner's hindsight driven efforts to use Carrier to justify determining semantic contours associated with individual tooth should be rejected. *Id.* at 58–59.

Based on the complete trial record before us, we do not agree with Patent Owner's arguments. As noted above, because the limitation in step 1b' does not require a particular deep learning network to be trained in a particular way, Maninis's deep learning architecture describes the claimed deep learning device. Therefore, we agree with Petitioner that a POSITA would readily appreciate that the typical training for such widely used neural networks would not be as exorbitant as postulated by Patent Owner. Pet. Reply 19–20. We likewise agree with Petitioner that Patent Owner's assessment of the training costs are exaggerated, and would not deter the POSITA from the proposed implementation in the Salah-Carrier's real time acquisition device. *Id.* (citing Ex. 1048 ¶¶ 50–56, Ex. 2028 ¶ 149, Ex. 2030

¶ 49). Further, we agree with Petitioner that the POSITA would be motivated to use image recognition algorithms to ensure that all teeth are visible in the dental arch being captured as taught by Carrier. *Id.* at 20–22 (citing Ex. 1006 ¶¶ 80, 81; Ex. 1005 ¶¶ 126–128; Ex. 2030 ¶¶ 64, 78; Ex. 1035 ¶¶ 36–38; Ex. 1038, 58:8–61:2; Ex. 1048 ¶¶ 57–64). As correctly noted by Petitioner, because the overlay described by Carrier is patient specific and derived from the patient's teeth, it would be able to account for the current condition of the patient's teeth (e.g., movement or missing teeth). *Id.* at 22 (citing Ex. 1006 ¶¶ 60, 66; Ex. 1005 ¶¶ 105, 107; Ex. 1048 ¶ 65; Ex. 1035 ¶ 40).

9. Rationale to Combine with Reasonable Expectation of Success

Based on the fully developed record, we are persuaded that Petitioner has presented a sufficient rationale to combine the teachings of Salah, Carrier, and Maninis with a reasonable expectation of success. *See* Pet. 18–24. Petitioner contends that Salah and Carrier are in the same field of endeavor of the '409 patent, in that they disclose similar techniques of using deep learning for dental imaging (e.g., assessing alignment, using the assessment to guide users, obtaining dentition images with the user's mobile phones), with Carrier providing specific details to effectively assess alignment based on the appearance of the patient's teeth to capture high-quality dentition images. *Id.* at 21. Further, Petitioner submits the following:

> The resulting combination would use each reference's teachings to perform substantially the same function as they provide alone, with Carrier's techniques for assessing alignment used to determine the feedback to users when guiding them to acquire dental images as taught by Salah. [POSITAs] would thus have had a reasonable expectation of

> success, as the combination would be one of complementary techniques, applied in understood ways, to produce a predictable outcome.

Id. (citing Ex. 1002 ¶ 82).

Furthermore, Petitioner contends that, although Maninis is not restricted to dental imaging it describes broadly applicable techniques (e.g., deep learning) for image classification and contour detection, which would have complemented the contour/edge detection discussed in Salah and Carrier. *Id.* at 22 (citing Ex. 1002 ¶ 84). Thus, Salah, Carrier, and Maninis are at least reasonably pertinent to the particular problem with which the invention is involved (e.g., the contour/edge detection problem in object imaging). *Id.* (citing Ex. 1005 ¶¶ 108, 128; Ex. 1006 ¶¶ 63, 81; Ex. 1008, 34:5–36:14). More particularly, Petitioner asserts:

> Maninis motivates employing deep learning techniques for object and contour detection. Maninis teaches that the "latest wave of contour detectors takes advantage of deep learning to obtain state-of-the-art results." EX1007, 2. Maninis provides a flexible, "modular" technique and "can incorporate and benefit from future improvements in the base CNN." *Id.* Maninis also achieves improvements relative to "recent approaches to contour detection using deep learning." EX1007, 3, 9 ("Overall, comparing to previous state-of-the-art, we get a significant improvement at a fraction of the computation time (24.37 to 0.79 seconds)."), 11-12 (improved object identification); EX1002, ¶85.
>
> Based on Maninis's flexibility and prospect to improve performance, a [POSITA] would have been motivated to analyze images using a deep learning device as taught by Maninis to improve an image acquisition apparatus as taught by Salah and Carrier. For example, a [POSITA] would have been motivated to adapt Salah and Carrier's image acquisition device to employ a deep learning architecture as taught by Maninis,

> trained on images relevant to Salah's and Carrier's dental imaging applications. Maninis's deep learning architecture would provide specific functionalities required by Salah and Carrier, including the ability to identify objects (such as the required teeth Carrier proposes using image recognition software to identify) and to detect contours (such as the tooth edges Carrier uses to assess alignments), to aid in guiding image acquisition, as taught by Salah.

Id. at 23–24 (citing Ex. 1002 ¶ 86).

Further, we are not persuaded by Patent Owner's argument that Petitioner's proposed reasons to combine the teachings of Salah, Carrier, and Maninis are insufficient, thereby rendering the proposed combination improper. Thus, because the proposed combination involves known elements performing their ordinary functions to produce a predictable result, Petitioner has sufficiently established by a preponderance of the evidence that a POSITA would have appreciated that the proposed combination teaches the limitations of step 1b'.[10] Pet. 27–31.

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[10] It has been held that where the claimed subject matter involves more than the simple substitution of one known element for another or the mere application of a known technique to a piece of prior art ready for the improvement, a holding of obviousness *must* be based on "an apparent reason to combine the known elements in the fashion claimed." *KSR*, 550 U.S. at 417–18. That is, "there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *Id.* at 418 (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Such reasoning can be based on interrelated teachings of multiple patents, the effects of demands known to the design community or present in the marketplace, and the background knowledge possessed by a person having ordinary skill in the art. *Id.* at 417–18.

The U.S. Supreme Court has held "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *KSR*, 550 at 416.

The Court further instructs that:

> Often, it will be necessary for a court to look to interrelated teachings of multiple patents; . . . and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.

Id. at 418.

However, the Court also instructs that "the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *Id*. In addition, the Court instructs, "if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *Id*. at 417. "This is the so-called 'known-technique' rationale. And if there's a known technique to address a known problem using 'prior art elements according to their established functions,' then there is a motivation to combine." *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023) (citing *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 799–800 (Fed. Cir. 2021)).

This precedent controls, and the application of the cited legal principles to the facts of this case provide us with the necessary guidance in the present proceeding. As discussed above, Petitioner demonstrates on the record before us that a POSITA would have been motivated to incorporate Maninis's teaching of using a deep learning architecture to identify

edges/contours in images into the Salah-Carrier image capturing process to enhance the overall quality of images of a patient's dental arch as they are being captured. Pet. Reply 14 (citing Ex. 1006, ¶¶ 5, 54-55, 63; Ex. 1005, ¶¶ 5, 99, 100, 108; Ex. 1002, ¶¶ 49, 112; Ex. 1008, 60:14–29).

After considering Patent Owner's arguments, we find by a preponderance of the evidence that Petitioner's rationale, which is supported by the testimony of Dr. Foroosh, is a sufficient demonstration of a motivation to combine the references with a reasonable expectation of success. *See KSR*, 550 U.S. at 417–18.

10. Step 1c') determination of a value for an image attribute

Independent claim 1 recites "determination, for the analysis image, as a function of the results of the analysis in the preceding step, of a value for an image attribute." Ex. 1001, 32:19–21.

Petitioner argues that the combination of Salah, Carrier, and Maninis teaches these limitations. Pet. 31–36. In particular, Petitioner argues that Salah teaches an acquisition apparatus capable of providing feedback regarding whether a captured image is acceptable and properly positioned. *Id.* at 31 (citing Ex. 1008, 27:21–28:2). According to Petitioner, while Salah does not expressly teach determining the value for an image attribute, a POSITA would have recognized such a step naturally flows from Salah's determination of whether the image is acceptable as it would merely require routine skill. *Id.* at 31–32 (citing Ex. 1002 ¶¶ 110–111).

Petitioner further argues that Carrier provides examples that illustrate such routine image analysis. *Id.* at 32–33 (citing Ex. 1002 ¶¶ 112–115; Ex. 1005 ¶¶ 108, 114, 128; Ex. 1006 ¶¶ 63, 68, 81) (asserting that Carrier

teaches analyzing an image to determine whether detected tooth edges are aligned with those in an overlay by assessing the distance therebetween, and alternatively, using image algorithms to ensure that all required teeth are visible). Petitioner asserts that a POSITA would have understood that Carrier's measured distance teaches the image attribute values because they indicate the presence or absence of required teeth in the image as a whole. *Id.* at 33 (citing Ex. 1002 ¶ 121).

Additionally, Petitioner argues that Maninis further complements the Salah-Carrier combination to teach this limitation. *Id.* at 33–36 (citing Ex. 1002 ¶¶ 117–120, 122; Ex. 1006, Fig. 6B; Ex. 1007, Abstr., 1–2, 5, 11–12; Ex. 1008, Fig. 4d, 54:23–26) (asserting that a POSITA would have been motivated to use Maninis's deep-learning based contour detection techniques to identify and classify objects, thereby enabling users of the Salah-Carrier system to identify individual teeth in the image being captured).

Patent Owner does not specifically respond to these arguments. *See generally* PO Resp.

We have reviewed Petitioner's unrebutted arguments and the underlying evidence, and we find that Petitioner has shown by a preponderance of the evidence that the combination of Salah, Carrier, and Maninis teaches the limitations in step 1c'.

11. Step 1d') comparison of said image attribute value with a setpoint

Independent claim 1 recites "comparison of said image attribute value with a setpoint." Ex. 1001, 32:22–23.

Petitioner argues that the combination of Salah, Carrier, and Maninis teaches these limitations. Pet. 36–37. In particular, Petitioner argues that Salah teaches an acquisition apparatus capable of assessing whether a captured image is acceptable and properly positioned. *Id.* at 36 (citing Ex. 1008, 27:21–28:2). According to Petitioner, while Salah does not expressly teach comparing an image attribute thereof to a setpoint, a POSITA would have recognized such a step as a "routine option" as exemplified by Carrier's teachings discussed above. *Id.* at 36–37 (citing Ex. 002 ¶¶ 123–127) (asserting that a "[POSITA] would naturally have applied Carrier's teaching by determining whether every required tooth was visible or not by comparing a value (the required teeth's visibility or non-visibility) to a setpoint (they must be visible)").

Patent Owner does not specifically respond to these arguments. *See generally* PO Resp.

We have reviewed Petitioner's unrebutted arguments and the underlying evidence, and we find that Petitioner has shown by a preponderance of the evidence that the combination of Salah, Carrier, and Maninis teaches the limitations in step 1d'.

12. Step 1e') sending of an information message as a function of said comparison

Independent claim 1 recites:

> sending of an information message as a function of said comparison, the information message being related to the quality of the image acquired or to the position of the acquisition apparatus in relation to said arch or to the setting of the acquisition apparatus or to the opening of the mouth or to the wearing of a dental appliance, or to a combination thereof, to check whether the analysis image respects the setpoint and, if

> it does not respect the setpoint, to guide the operator in order for him or her to acquire a new analysis image

Ex. 1001, 32:24–33.

Petitioner argues that the combination of Salah, Carrier, and Maninis teaches these limitations. Pet. 37–41. In particular, Petitioner argues that Salah teaches an acquisition apparatus capable of providing written and voice prompts to guide acquisition of an image, to assess the image, and to position the image, as well as to take another photo, as needed. *Id.* at 37–38 (citing Ex. 1008, 27:21–28:2; Ex. 1002 ¶¶ 128–29). Accordingly, Petitioner asserts that Salah teaches sending information messages. *Id.* at 38.

Petitioner further argues that Carrier likewise teaches these limitations. Pet. 38–41 (citing Ex. 1002 ¶¶ 130–139; Ex. 1005 ¶¶ 108, 112–116, 120; Ex. 1006 ¶¶ 63, 67–70) (asserting that Carrier teaches visual, audible and/or tactile indications when the image and the overlay are aligned). Petitioner asserts that a POSITA would been motivated to send messages to guide users in capturing an acceptable image of the patient's dental arch or otherwise to adjust or redo the photo. *Id.* at 40–41.

Patent Owner does not specifically respond to these arguments. *See generally* PO. Resp.

We have reviewed Petitioner's unrebutted arguments and the underlying evidence, and we find that Petitioner has shown by a preponderance of the evidence that the combination of Salah, Carrier, and Maninis teaches the limitations in step 1e'.

Conclusion Regarding Independent Claim 1

For the foregoing reasons, we find Petitioner has shown by a preponderance of the evidence that independent claim 1 is unpatentable under § 103 as obvious over the combination of Salah, Carrier, and Maninis.

13. Dependent claim 7

7.1 Historical Images Having Attribute Values

Claim 7 depends directly on claim 1, in which the step b') comprises: "[step] 1') creation of a learning base comprising more than 1000 images of dental arches, or 'historical images', each historical image comprising an attribute value for at least one image attribute, or 'image attribute value.'" Ex. 1001, 33:10–15.

Petitioner argues that the combination of Salah, Carrier, and Maninis teaches these limitations. Pet. 50–51. In particular, Petitioner argues that, because Maninis teaches pixel-wise annotations of all objects in each image of its training database, a POSITA would have been motivated to create a learning base of more than 1,000 historical images (including at least an image attribute) of dental arches to train a neural network. *Id.* at 51 (citing Ex. 1007, 5–6). Further, Petitioner argues that, in the context of Salah and Carrier, these images would be representative of acquired dental images such that each historical image would have a set of required teeth that are visible. *Id.* (citing Ex. 1002 ¶¶175–177; Ex. 1006 ¶ 81; Ex. 1005 ¶ 128).

Patent Owner argues that Petitioner incorrectly insinuates that training on "semantic contours" as taught by Maninis necessarily requires training on historical images labelled with tooth attribute values. PO Resp. 59. According to Patent Owner, because the neural networks in Maninis that

determine semantic contours are trained only on tooth attribute values (pixel-wise annotations), they are incapable of learning from any image attribute value (including the list of teeth present in the image). *Id.* (citing Ex. 2028 ¶¶ 219–232). Patent Owner asserts that, "although an image attribute value can be determined from the identified tooth attributes values *after* the image has been analyzed, in Dr. Foroosh's proposed combination, the historical images in the learning base *cannot* comprise those same image attribute values—as required by claim 7—only tooth attribute values." *Id.* Patent Owner further argues that the reference to "image attribute value" in claim 7 embodies a global analysis approach, whereas the discussion of tooth zones in claims 2 through 6 pertains to a detailed analysis approach. *Id.* at 60 (citing Ex. 2028 ¶ 219). While Patent Owner acquiesces that an "image attribute value" encompasses a "tooth attribute value," Patent Owner nonetheless seeks to distinguish historical images for the two. *Id.* at 59. In particular, Patent Owner takes the position that such an overlap exists between the two phrases only *after* the image has been analyzed. *Id.* Simply put, Patent Owner argues that, because Maninis's use of images labelled with semantic contours/boundaries to identify the tooth bounded by that contour, teeth identified within the boundaries are tooth attributes, not image attributes. *Id.* at 60–61.

As an initial matter, we note that the disputed claim limitation only requires that each historical image in the learning base include an "image attribute value" (i.e., a value for an attribute of the image). We further note that the claim does not recite a "tooth attribute value" (i.e., a value for an attribute of a tooth). Consequently, we find no basis in the claim for the purported distinction between the two phrases. In our view, an image (e.g.,

a dental arch) being captured includes a plurality of teeth, each individual tooth having one or more attribute values. That is, an "image attribute value" refers to a value for any attribute of the image, and a "tooth attribute value" refers to a value for any attribute (e.g., size, shape, number) of a tooth. *See, e.g.,* Ex. 1001, 26:16–26 (disclosing "an attribute value of the analysis image" may include "tooth attribute values"). Because each included tooth is a part of a dental arch being captured, an attribute of a tooth also constitutes an attribute of the image. *Id.* Although an image attribute can also encompass other characteristics (type, size) of the image as a whole, the claim is not so limiting. It suffices that the historical dental information be sufficient to train the deep learning device to recognize similar dental images. Therefore, we agree with Petitioner that Maninis's disclosure of using pixelwise annotations as historical images, taken in combination with the Salah-Carrier acquisition of dental arches to train the deep learning device to recognize a particular tooth, teaches using both the "tooth attribute values" as well as the "image attribute values" for such training. *See* Pet. 50–51; Pet. Reply 23–24.

After considering Patent Owner's arguments, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Salah, Carrier, and Maninis teaches the limitations in step 7.1.

7.2 Training the Deep Learning Device

Claim 7 recites that step b') of claim 1 comprises "[step] 2') training of at least one deep learning device by means of the learning base." Ex. 1001, 33:16–17.

Petitioner argues that the combination of Salah, Carrier, and Maninis teaches these limitations for the same reasons it identifies above with respect to the limitations of claim 3, step 3(2). Pet. 51. That is, Petitioner argues that "Maninis's deep-learning-based neural network is trained using a training dataset, which is a 'learning base' in the context of the '409 patent." *Id.* at 45 (citing Ex. 1007, 3–4, 7–8; Ex. 1002 ¶¶ 153, 154). Petitioner further argues that, "[i]n the context of Salah and Carrier, a learning base containing annotated historical images of dental arches would be used to train a neural network like Maninis's." *Id.* (citing Ex. 1002 ¶ 155).

Patent Owner does not specifically respond to these arguments. *See generally* PO Resp.

We have reviewed Petitioner's unrebutted arguments and the underlying evidence, and we find that Petitioner has shown by a preponderance of the evidence that the combination of Salah, Carrier, and Maninis teaches the limitations in step 7.2.

7.3 Submitting the Analysis Image to the Deep Learning Device

Claim 7 recites that step b') of claim 1 comprises "[step] 3') submission of the analysis image to the deep learning device for it to determine, for said analysis image, at least one probability relating to said image attribute value." Ex. 1001, 33:18–21.

Petitioner argues that the combination of Salah, Carrier, and Maninis teaches these limitations. Pet. 52. In particular, Petitioner argues Maninis determines probabilities that it uses to detect boundaries between regions and enable identification of objects visible in those regions. *Id.* (citing Ex. 1007, 4–5, 11–12). According to Petitioner, the probabilities relate to the

image attributes as they help to determine whether all required teeth are visible or the distance between the teeth's edges and Carrier's overlay. *Id.* (citing Ex. 1002 ¶¶ 180–182).

Patent Owner argues that Maninis's probability values relate only to "tooth attribute values," and not "image attribute values." PO Resp. 61–64.

Patent Owner's arguments are not persuasive. As previously discussed above in section 7.1, this distinction between these two phrases is immaterial as the latter phrase encompasses the former.

After considering Patent Owner's arguments, we find Petitioner has shown by a preponderance of the evidence that the combination of Salah, Carrier, and Maninis teaches the limitations in step 7.3.

Conclusion Regarding Dependent Claim 7

For the foregoing reasons, we find Petitioner has shown by a preponderance of the evidence that dependent claim 7 is unpatentable under § 103 as obvious over the combination of Salah, Carrier, and Maninis.

14. Dependent Claims 8 and 9

Each of claims 8 and 9 depend directly on claim 1, and further recite that "the learning base is composed according to" six steps. Ex. 1001, 33:22–34:24.

Petitioner asserts that the combination of Salah, Carrier, and Maninis teaches each of these steps. Pet. 52–65. In particular, Petitioner contends that Salah's disclosure of registering a 2D image to a segmented arch model to map individual teeth to different portions of the image, which is then added to a learning base, teaches the steps of claim 8. *Id.* at 52 (citing Ex. 1008, Fig. 1). According to Petitioner, Salah's tooth model of attributes

corresponds to Maninis's annotations reflecting the "ground-truth" for training images. *Id.* at 52–53 (citing Ex. 1002 ¶ 183). Petitioner therefore argues that a POSITA would have been motivated to use Salah's technique to "identify locations of teeth in images to be added to a training library because doing so would enable the training dataset to contain 'carefully localized pixel-wise semantic annotations' by providing a simple mechanism to connect regions of pixels in each image to the 'ground-truth' represented by Salah's tooth models." *Id.* at 53 (citing Ex. 1007, 2, 5–6). Therefore, Petitioner submits that using Salah's image-model registration technique would have enabled a POSITA to leverage information contained in existing patient dental models to label images for training by labeling photographs acquired in conditions similar to those contemplated by Salah and Carrier. *Id.* (citing Ex. 1008, 1:20–21, 31:4–7; Ex. 1002 ¶¶ 184–85).

Patent Owner argues that a POSITA would not have been motivated to create a learning base by altering Salah's method of transferring information from the updated images to the 3D model of patient's teeth, but instead would have transferred information from the 3D model to the updated images, because Petitioner has proffered no motivation to support the proposed alteration of Salah. PO Resp. 64 (citing Ex. 2028 ¶¶ 214–218). According to Patent Owner, because Salah's 3D models or reference images are not labelled with any "tooth attributes," such information would not be available for transfer to the updated images needed to create the learning base of labelled historical images. *Id.* at 65. Further, Patent Owner argues that, because Maninis's learning bases were annotated by humans, a POSITA would not have been motivated to use a computer program that label employed images with pixel-wise contours labeled by a computer

algorithm. *Id.* According to Patent Owner, a POSITA would have wanted to confirm that the contours were accurately applied to the training images, which would undermine any possible motivation to employ Salah because the quality of training images directly impacts the quality of the neural network's analysis. *Id.* at 65–66.

As previously addressed in our discussion of claim 1 above, Petitioner provides ample motivations on the record before us to support the proposed combination of Salah's teachings with those of Carrier and Maninis. Among the rationales highlighted by Petitioner include (1) providing a "simple mechanism to connect regions of pixels . . . to the 'ground-truth,'" (2) "leverag[ing] information contained in existing patient dental models to label images," (3) applying known techniques to achieve efficient annotation, (4) straightforward, predictable process providing annotations used by Maninis. Pet. Reply 24–25 (alterations in original); Pet. 53, 60–61; Ex. 1002 ¶¶ 197–99. These statements of motivation are supported by testimony from Dr. Foroosh, and corroborated by published papers, demonstrating that relevant techniques of labeling using registered data from models were known to POSITAs. *See* Ex. 1002 ¶¶ 38, 199 (citing Ex. 1013, 3689–90; Ex. 1014, 3198, 3200–01).

Further, we agree with Petitioner that Patent Owner's argument regarding Salah not particularly teaching its 3D models being capable of labelling teeth by number constitutes an individual attack against the combination of references because the Petition relies upon well-known labelling techniques in combination with Salah for such teaching. Pet Reply 25; Pet. 56 (citing Ex. 1002 ¶ 190; Ex. 1009 ¶¶ 7, 8, 12). One cannot show non-obviousness by attacking the references individually where the

rejections are based on combinations of references. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986); *see also In re Keller*, 642 F.2d at 426. Additionally, we agree with Petitioner that only routine skill would be required to automatically label images that were previously labelled manually.[11] *See* Pet 60 (citing Ex. 1002 ¶ 198).

After considering Patent Owner's arguments, we determine that Petitioner has shown by a preponderance of the evidence that the combination of the combination of Salah, Carrier, and Maninis teaches the limitations of claims 8 and 9.

For the foregoing reasons, we find Petitioner has shown by a preponderance of the evidence that dependent claims 8 and 9 are unpatentable under § 103 as obvious over the combination of Salah, Carrier, and Maninis.

15. Dependent Claim 14

Claim 14 depends directly on claim 1, and further recited that the "analysis image is analyzed and checked in real-time." Ex. 1011, 34:48–49.

Petitioner argues that the combination of Salah, Carrier, and Maninis teaches this limitation. Pet. 68–69 (citing Ex. 1002 ¶ 226). In particular, Petitioner argues that Carrier's disclosure of conducting its image analysis and checking in real-time by comparing an image of patient teeth to setpoints on an overlay to automatically detect an alignment therewith

[11] Providing an automatic way to replace a manual activity accomplishing the same result is not sufficient to distinguish an automated process over the prior art. *In re Venner*, 262 F.2d 91, 95 (CCPA 1958).

teaches the limitation of claim 14. *Id.* at 69 (citing Ex. 1002 ¶ 227; Ex. 1005 ¶¶ 99, 108; Ex. 1006 ¶¶ 54, 63). Further, Petitioner asserts the following:

> The combination of Salah and Maninis with Carrier to use a deep learning device for the analysis is consistent with Carrier's teaching of real-time analysis. Like Carrier, Salah also provides real-time feedback on alignment. *See* EX1008, 27:21-28:2. Maninis teaches that its deep learning contour detection algorithms produce fast, efficient, and highly-accurate results, categorizing even challenging images in less than 800 ms. EX1007, 1-2; *see id.*, 9, Table 1. Thus, a [POSITA] would have expected Maninis's deep-learning-based neural network to maintain Carrier's capacity for real-time image analysis. EX1002, ¶228.

Id.

Patent Owner argues that the combination of Salah, Carrier, and Maninis does not disclose the "analysis image is analyzed and checked in real-time," as claimed. PO Resp. 66. In particular, Patent Owner reiterates that the proposed combination of Carrier and Maninis with Salah would be inoperable for the intended purpose of performing real-time analysis of an image. *Id.*

As detailed in our discussion of Patent Owner's incompatible/inoperability arguments presented with respect to independent claim 1 above, Petitioner does not propose a bodily incorporation of Carrier and Maninis into Salah's image acquisition system. *See In re Keller*, 642 F.2d at 425. We agree with Petitioner that Carrier's real-time feedback would help guide users of Salah's image acquisition device in capturing a patient's dental arch in real-time while Maninis's deep learning device architecture analyzes the dental arch. Pet. 69. Accordingly, we reiterate that, because Maninis's disclosure of a deep learning device architecture for performing image analysis, taken in combination with Carrier's real-time

guidance for a user of Salah's image acquisition device, is no more than a simple arrangement of old elements with each performing the same function it had been known to perform, yielding no more than what one would expect from such an arrangement, the proposed combination supports a conclusion of obviousness.

After considering Patent Owner's arguments, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Salah, Carrier, and Maninis teaches the limitations of claim 14.

For the foregoing reasons, we find Petitioner has shown by a preponderance of the evidence that dependent claim 14 is unpatentable under § 103 as obvious over the combination of Salah, Carrier, and Maninis.

16. Dependent claims 2–6, 10–13, and 15

Petitioner also contends that claims 2–6, 10–13, and 15, which depend directly or indirectly from independent claim 1, would have been obvious over the combination of Salah, Carrier, and Maninis. Pet. 41–50, 65–70. We have reviewed Petitioner's contentions as to the additional limitations of these dependent claims, and find that Petitioner has shown by a preponderance of the evidence that the combination of Salah, Carrier, and Maninis teaches each of the limitations of these claims. *Id.* We further note that Patent Owner does not separately address the patentability of these claims beyond its arguments as to independent claim 1, as well as to dependent claims 7–9 addressed above. *See* PO Resp.

We have reviewed Petitioner's unrebutted assertions and evidence, and in light of the foregoing, we determine that Petitioner has shown by a

preponderance of the evidence that dependent claims 2–6, and 10–13, and 15 are unpatentable under § 103 as obvious over the combination of Salah, Carrier, and Maninis.

G. Patent Owner's Motion to Exclude

Patent Owner seeks to exclude Exhibits 1022,[12] 1023,[13] 1025,[14] 1026,[15] 1031,[16] and paragraphs 62–67 of Exhibit 1002.[17] PO Mot. Excl. 1–15. Petitioner opposes the motion. Pet. Opp. Mot. Excl. 1–15. Patent Owner filed a reply to the opposition. PO Reply Mot. Excl. 1–5.

1. Whether Exhibits 1022, 1023, 1025, and 1026 Lack Authenticity

Patent Owner argues that, because Petitioner offered Exhibits 1022, 1023, 1025, and 1026 as archival webpages obtained from the Internet Archive, but offers no evidence to authenticate their respective archival dates, each of said Exhibits is inadmissible as inauthentic and should be excluded. PO Mot. Excl. 8–9 (citing *Standard Innovation*[18]). In particular, Patent Owner argues that, as in *Standard Innovation*, Petitioner did not provide testimony regarding "the reliability and functioning of the Internet

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[12] Arxiv.org Submission Help Page.
[13] Arxiv.org Article Replacement Help Page (2017).
[14] Arxiv.org Author Search Page for Luc Van Gool.
[15] Arxiv.org Article Replacement Help Page (2016).
[16] Declaration of Nathaniel E. Frank-Wright.
[17] Declaration by of Dr. Hassan Foroosh.
[18] *Standard Innovation Corp. v. Lelo, Inc.*, IPR2014-00148, 2015 WL 1906730, *5-6 (PTA.B Apr. 23, 2015) (citing *U.S. v. Bansal*, 663 F.3d 634, 667-68 (Fed. Cir. 2011)); alternative citation *Standard Innovation Corp. v. Lelo, Inc.*, IPR2014-00148, Paper 42 (PTAB Apr. 23, 2015) (Final Written Decision).

Archive," nor a witness with personal knowledge that Exhibits 1022, 1023, 1025, and 1026 are the product of any such functionality. *Id.* at 9. Further, Patent Owner argues that, as in *Standard Innovation*, Petitioner provided no evidence regarding the significance and reliability of any created and modified dates in these exhibits. *Id.* Patent Owner emphasizes that none of the cited Exhibits contains a facially recognizable date and that Dr. Foroosh's mere assertion of what the archival dates are is simply insufficient to authenticate those Exhibits. *Id.* (citing Ex. 1002 ¶¶ 62–67).

In response, Petitioner argues that each of Exhibits 1022, 1023, 1025, and 1026 has been authenticated because Exhibit 1031 indisputably meets the requirements for (1) the "reliability and functioning of the Internet Archive," and (2) "facially recognizable date." Pet Opp. Mot. Excl. 5–6. In particular, Petitioner asserts the following:

> EX1031 indisputably meets these requirements, as Mr. Frank-White explains the reliable functioning of the Internet Archive's Wayback Machine and explains how each page's URL reflects its archiving date. EX1031. He also provides copies of each exhibit and its corresponding URL. *See id.*, Ex. A. This alone satisfies the authenticity requirements for each exhibit. *See also supra* §II. PO's motion is silent on EX1031 when arguing EX1022, EX1023, EX1025, and EX1026 lack authenticating testimony.
>
> Furthermore, EX1030 is another declaration from Mr. Frank-White (which [Patent Owner] has not moved to exclude), and which provides the same testimony regarding the regular practices of the Internet Archive and the meaning of its URLs. Each of EX1022, EX1023, EX1025, and EX1026 contains the URL from which it was printed in its header, as [Patent Owner] notes. *See* MTE, 3-5. The same URLs from which each page was printed were provided by Dr. Foroosh in his original declaration (EX1002, p. 126 (Appendix of Exhibits)), as well as in Petitioner's exhibit list. *See also* EX1002, ¶¶65-67 (describing each archived page). Mr. Frank-White's explanation of the Internet Archive's functionality (*see* EX1030;

> EX1031) shows that these URLs confirm the archiving dates of EX1022, EX1023, EX1025, and EX1026 (May 3, 2017; July 18, 2017; July 8, 2017; and Sep. 8, 2016, respectively).

Id. at 6–7.

According to Petitioner, the reliability of Internet Archive's Wayback Machine to show dates of publication cannot be questioned because the U.S. Court of Appeals for the Federal Circuit has approvingly noted that various district courts have taken judicial notice that archived webpages constituted "facts that can be accurately and readily determined from sources whose accuracy cannot reasonably be questioned." *Id.* at 7 (citing *Valve Corp. v. Ironburg Inventions Ltd.*, 8 F.4th 1364, 1374 (Fed. Cir. 2021) (quoting Erickson v. Neb. Mach. Co., No. 15-CV-01147-JD, 2015 WL 4089849, at *1 n.1 (N.D. Cal. July 6, 2016)).

Patent Owner's arguments that Exhibits 1022, 1023, 1025, and 1026 lack authenticity are not persuasive. Petitioner produces a Declaration by Dr. Foroosh attesting under oath about his own personal knowledge of arXiv.org's routine business practice at the time and an express intent to publish. Ex. 1002 ¶¶ 62–67, 234, 235. Moreover, Petitioner produces a Declaration by Mr. Frank-White, the Records Request Processor at the Internet Archive, attesting under oath his own personal knowledge of true and accurate copies of screenshots of the Internet Archived records and the archived files for the URLs and the dates specified in the Exhibit. Ex. 1030. Additionally, Petitioner produces a second Declaration by Mr. Frank-White attesting under oath the functioning of the Internet Archive's Wayback Machine and further explaining how each archived page's URL reflects its archiving date. Ex. 1031.

We do not agree with Patent Owner that Exhibit 1031 was served untimely as supplemental evidence in response to the authenticity objections. PO Reply Opp. Mot Excl. 1 (citing 37 C.F.R. 42.64(b)(2); PTAB Trial Practice Guide 2019, 79; *Standard Innovation*). Although we agree with Patent Owner that *Vidstream*[19] did not create a per se rule that allows the belated submission of a Declaration, we note that the holding in *Vidstream* nonetheless permits the submission of evidence in a reply supporting the prior art status of an asserted reference, especially when, as here, Patent Owner challenges whether Maninis qualifies as prior art to the '409 patent in the Patent Owner Response. *Id.* at 1–2. In *Vidstream,* our reviewing court confirms that under our rules

> [a] petitioner in an *inter partes* review proceeding may introduce new evidence after the petition stage if the evidence is a legitimate reply to evidence introduced by the patent owner, or if it is used to document the knowledge that skilled artisans would bring to bear in reading the prior art identified as producing obviousness.

Vidstream , 981 F.3d at 1065.

In light of the foregoing Declarations, and supporting Exhibits filed by Petitioner, we find that Petitioner has demonstrated by a preponderance of the evidence that Exhibits 1022, 1023, 1025, and 1026 are true and accurate versions of documents downloaded using the Internet Archive's Wayback Machine. Accordingly, we are satisfied that Exhibits 1022, 1023, 1025, and 1026 have thereby been authenticated by the testimony of Mr. Frank-White. Ex. 1031. For these reasons, we decline to exclude or disregard Exhibits 1022, 1023, 1025, and 1026 as lacking authenticity.

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[19] *Vidstream LLC v. Twitter, Inc.*, 981 F.3d 1060, 1064-65 (Fed. Cir. 2020).

2. Whether Exhibits 1022, 1023, 1025, and 1026 are Inadmissible Hearsay.

Patent Owner argues that Exhibits 1022, 1023, 1025, and 1026 should be excluded as inadmissible hearsay because they are out-of-court statements by arXiv.org that appear in archival webpage exhibits, and not in a qualifying Declaration. PO Mot. Excl. 9. Patent Owner asserts that, because Petitioner and its declarant, Dr. Foroosh, offered these statements and depended on these exhibits "to prove the truth of the matter asserted in the statement[s]" (including the alleged policies of arXiv.org and the alleged date as of which the arXiv.org webpages were archived), they are inadmissible hearsay that should be excluded. *Id.* at 10 (citing Fed. R. Evid. 801 (c), *Standard Innovation Corp.*).

Petitioner counters that the Exhibits (copies of archived webpages generated and maintained by Internet Archive) are admissible at least under the business records exception (Fed. R. Evid. 803 (6)) based at least on Mr. Frank-White's Declarations. Pet. Opp. Mot. Excl. 7. According to Petitioner, to the extent that they are hearsay, they are admissible under hearsay exceptions set forth in Fed. R. Evid. 803(3), 803(6), and 807. *Id.* at 7–8. First, Petitioner argues that Patent Owner's hearsay arguments do not apply to Exhibit 1025, as it is not one of the four Exhibits upon which Petitioner relies to establish arXiv.org's actual publication policy as of their putative archival dates. *Id.* at 8. According to Petitioner, because Exhibit 1025 is a page showing the arXiv.org publications of Dr. Luc van Gool, one of the Maninis authors, Patent Owner's argument that it is hearsay is misplaced. *Id.* at 8–9. Second, Petitioner argues that Exhibits 1022, 1023, Exhibit 1026 are also admissible for non-hearsay purposes as they

collectively show the policies that arXiv.org communicated to authors. *Id.* at 9. In particular, Petitioner argues that these three Exhibits indicate that submitted papers would be published within one business day of submission. *Id.* According to Petitioner, because these three Exhibits express the intentions or plans of arXiv.org to publish papers within one day of submission, the statements contained therein constitute an exception to the hearsay rule under Fed. R. Evid 803(3). *Id.* at 9–11. ((citing *Catalan v. GMAC Mortg. Corp.*, 629 F.3d 676, 694 (7th Cir. 2011) (written statements describing bank's intentions admissible as non-hearsay); *Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1569 (Fed. Cir. 1988) ("Evidence of routine business practice can be sufficient to prove that a reference was made accessible before a critical date.")). Further, Petitioner asserts that these three Exhibits are also admissible under the 803(6) exception to the hearsay rule because they relate to Dr. Foroosh's explanation about how arXiv.org operates based on his own experience using the site, including uploading multiple papers on the site in May 2017. *Id.* at 11 (citing *Samsung Elecs. Co. v. Huawei Techs. Co.*, IPR2017-01487, Paper 45 at 17–20 (Dec. 10, 2018) (indicating that there is no requirement of custodian testimony from an employee of the record-keeper; it suffices under Rules 803(6) and 902(11) that a person understand the system used). Furthermore, Petitioner argues that, to the extent any of Exhibits1022, 1023, 1025, and 1026 are found to be hearsay not subject to a hearsay exception, they are admissible under the residual hearsay rule. Fed. R. Evid. 807. *Id.* at 12.

Patent Owner's arguments that Exhibits 1022, 1023, 1025, and 1026 should be excluded as inadmissible hearsay are not persuasive. At the

outset, we do not agree with Patent Owner's assertion that Exhibits 1022, 1023, 1025, and 1026 are out-of-court statements by arXiv.org that appear in archival webpage exhibits, and not in a qualifying Declaration. As noted above, Petitioner produces a qualifying Declaration by Dr. Foroosh attesting under oath about his own personal knowledge of arXiv.org's routine business practice at the time and an express intent to publish. Ex. 1002 ¶¶ 62–67, 234, 235. In particular, paragraphs 62 through 67 of Dr. Foroosh's Declaration discusses each of these four Exhibits to corroborate the publication policy of arXiv.org, as well as how they support Petitioner's position that the Maninis reference was published before the priority date of the '409 patent. *Id.* Because these four Exhibits were discussed in a qualifying Declaration, we do not agree with Patent Owner that they are inadmissible hearsay. *See also* Fed. R. Evid 703 ("If experts in the particular field would reasonably rely on those kinds of facts or data in forming an opinion on the subject, they need not be admissible for the opinion to be admitted.").

Further, even if these four Exhibits are hearsay, we agree with Petitioner that they are admissible under the hearsay exception category because they are provided to express the intentions or plans of arXiv.org to publish papers within one day of submission. Fed. R. Evid. 803(3); *Catalan*, 629 F.3d at 694. In *Catalan*, our reviewing court held that so long as the out-of-court statements were made with personal knowledge, the declarant's statement is admissible to help explain the declarant's intention. *Id.* at 696. In this case, as explained in his Declaration, Dr. Foroosh relates his personal knowledge of the arXiv.org's policy, which stipulates an intent to publish articles within one business day of submission according to the website's

routine business practice. Ex. 1002 ¶¶ 62–66 (citing Ex. 1022; Ex. 1023; Ex. 1026). *See also Fed. R. Evid.* 406 ("Evidence of a person's habit or an organization's routine practice may be admitted to prove that on a particular occasion the person or organization acted in accordance with the habit or routine practice.").

We do not agree with Patent Owner that Petitioner relies upon statements of what arXiv.org does presently, not what it intends to do in the future. PO Reply Opp. Mot. Excl. 3. The specific statements pointed out by Patent Owner in Exhibits 1022, 1023, and 1026 are different from the statements in these Exhibits discussed in the Foroosh Declaration and relied upon by Petitioner. *Id.* As discussed above, Petitioner relies primarily upon the statement that submitted articles are published on arXiv.org within one business day of submission; and that Maninis was submitted on April 30, 2017 to arXiv.org and, therefore, Maninis was publicly available on arXiv.org no later than May 3, 2017. For these reasons, we decline to exclude or disregard Exhibits 1022, 1023, 1025, and 1026 as inadmissible hearsay.

3. Whether Exhibit 1031 Is Untimely Supplemental Evidence

After institution, Patent Owner filed a first set objections to evidence (Paper 13), including an objection to Exhibit 1007 (the Maninis reference) under FRE 402/403 that Petitioner "has failed to demonstrate that it is prior art." In its Patent Owner Response, Patent Owner argues that Petitioner has not demonstrated that Maninis is prior art to the '409 patent. *See* PO Resp. 35–37. Petitioner responded by filing its Reply addressing the prior art status of Maninis, together with the Nathanael E. Frank-Wright

Declarations. Pet. Reply 6; Exs. 1030, 1031. Thereafter, Patent Owner filed a second set of objections to evidence (Paper 24), including an objection to Exhibit 1031 under Fed. R. Evid. (FRE) 105, FRE 402/403, FRE 801/802, and FRE 901. With this procedural posture in mind, we understand Petitioner to have relied on the Frank-Wright Declarations as reply evidence to rebut Patent Owner's argument that Petitioner has not demonstrated that Maninis is prior art to the '409 patent.

Patent Owner argues that, by filing Exhibit 1031 with Petitioner's Reply, it is untimely supplemental evidence because it was filed after the ten (10) business days response period has lapsed, as provided by 37 C.F.R. § 42.64(b)(2).[20] PO Mot. Excl. 10–11. More particularly, Patent Owner contends that Petitioner seeks to circumvent the deadline by filing that supplemental evidence with the Reply. *Id.* at 11–12 (citing *Toshiba Corp. v. Optical Devices, LLC*, IPR2014-01446, Paper 31, 32 (PTAB Mar. 9, 2016) (Final Written Decision); *Standard Innovation*, 2015 WL 1906730, *4-5).

Petitioner counters that Patent Owner's sole basis for the requested exclusion of Exhibit 1031 is that its filing was untimely supplemental evidence. Pet. Opp. Mot. Excl. 3–4. According to Petitioner, Patent Owner's failure to cite any Federal Rule of Evidence in its argument for exclusion of Exhibit 1031 is sufficient to deny the requested exclusion. *Id.* at 4. Further, Petitioner asserts that Patent Owner's reliance upon *Toshiba* and *Standard Innovation* is misplaced because the Federal Circuit's holding in *Vidstream* is the controlling authority on this issue. *Id.* (citing *Advanced*

[20] *See* 37 C.F.R. § 42.64(b)(2) (authorizing a party relying on evidence to which an objection is timely served to respond to the objection by serving supplemental evidence within ten business days of service of the objection).

Micro Devices, IPR2019-01526, Paper 37 at 101–103 (PTAB Mar. 10, 2021) (Final Written Decision)).

Patent Owner's arguments that Exhibit 1031 is untimely supplemental evidence that requires exclusion are not persuasive. As discussed above, Patent Owner presented arguments challenging the dissemination and public accessibility of Maninis in its Patent Owner Response. *See* PO Resp. 35–37. Petitioner submitted the Frank-Wright Declarations (Exs. 1030, 1031) and supporting exhibits with its Reply, specifically in response to Patent Owner's challenges to the dissemination and public accessibility of Maninis raised in Patent Owner's first set of objections to evidence and the arguments raised in the Patent Owner Response. We find that this new evidence is permissible here because it was filed timely in response to arguments raised in Patent Owner's Response. *See Cooler Masters Co. v. Aavid Thermalloy LLC*, IPR2019-00337, Paper 49 at 32 (PTAB June 4, 2020) (Final Written Decision). Also, the new evidence did not amount to, or result in, a change to Petitioner's theory in the case, and is relied on to further support Petitioner's initial position raised in the Petition that Maninis qualifies as a prior art printed publication. Thus, we do not agree with Patent Owner that Exhibit 1031, submitted with the Reply, was improper as untimely. Our determination in this regard is further supported by our reviewing court's holding in *Vidstream*, which stated that the "PTAB was within its discretion in considering evidence that petitioner first submitted with its reply briefs and did not initially provide with its petitions for *inter partes* review." *Vidstream* , 981 F.3d at 1065.

We agree with Petitioner that the non-precedential decisions in *Toshiba Corp.* and *Standard Innovation* relied upon by Patent Owner to

support these arguments are neither controlling nor persuasive on this issue. *Toshiba Corp.* and *Standard Innovation* are non-precedential Board decisions issued in 2016 and 2015, respectively, which was before a patent owner was permitted to file a sur-reply as a matter of right. *See* Consolidated Trial Practice Guide[21] at 73–74 (Nov. 21, 2019) (which is the first trial practice guide that explained a patent owner is permitted to file a sur-reply as a matter of right). Consequently, we determine that, consistent with the Federal Circuit's holding in *Vidstream*, Exhibit 1031 was timely presented with the Reply because Patent Owner was provided with a fair opportunity to depose Mr. Frank-Wright prior to filing its Sur-Reply and, if necessary, address his cross-examination testimony therein. Patent Owner did not take advantage of that opportunity. In any event, even if Exhibit 1031 constitutes supplemental evidence that should have been served in response to the first set of objections to evidence long before it was filed with the Reply, the panel excuses Petitioner's late action under 37 CFR 42.5(c)(3). For these reasons, we decline to exclude or disregard Exhibit 1031 as untimely supplemental evidence.

4. Whether Exhibit 1002 ¶¶ 62-67 Lacks Foundation and is Improper Opinion Testimony

Patent Owner argues that the Board should exclude paragraphs 62 through 67 of Exhibit 1002 because Dr. Foroosh lacks sufficient knowledge and/or perception to rationally support the opinions he draws regarding Maninis's publication and the practices of arXiv.org. PO Mot. Excl. 13 (citing Fed. R. Evid 701(a), 602). In particular, Patent Owner argues that,

[21] *Available at* https://www.uspto.gov/TrialPracticeGuideConsolidated.

because Dr. Foroosh has no personal knowledge regarding Maninis's publication date, his testimony including his occasional and anecdotal experience does not provide a sufficient basis for his opinion regarding the consistency, reliability or promptness of arXiv.org publication practices. *Id.* Consequently, Patent Owner asserts that his testimony is inadmissible as lacking foundation and as improper lay opinion testimony. *Id.* Further, Patent Owner argues that Dr. Foroosh's opinions are likewise inadmissible as expert testimony because Petitioner has not demonstrated that Dr. Foroosh is qualified as an expert in the policies of arXiv.org or in their likely application to Maninis. *Id.* at 14 (citing Fed. R. Evid. 702, 703). In particular, Patent Owner argues that Petitioner has not demonstrated that Dr. Foroosh has the requisite specialized knowledge, training, experience or skill in the policies of arXiv.org, nor does he have any personal knowledge regarding the Maninis's publication date. *Id.* According to Patent Owner, even if Dr. Foroosh is qualified as an expert, his opinions regarding Maninis's publication date are not the result of any disclosed principle or methodology, but rather they are purely speculative based on his acceptance of the hearsay in Exhibits 1022, 1023, 1025, and 1026. *Id.* at 14–15.

In response, Petitioner argues that paragraphs 62 through 67 of Dr. Foroosh's Declaration describe arXiv.org's publication practices based on his personal experience, which confirms the mechanical process by which the policies described in Exhibits 1022, 1023, 1025, and 1026 were being regularly followed. Pet. Opp. Mot. Excl. 11–12. According to Petitioner, these archived documents are more probative than any other reasonably available evidence regarding what the policies at the time were, since they are direct, contemporaneous, public statements of those policies by

arXiv.org itself. *Id.* at 12. Therefore, Petitioner asserts that these Exhibits provide the requisite foundation for Dr. Foroosh's discussion of them in paragraphs 62–67 of the Declaration. *Id.* at 13. In particular, Petitioner asserts that Dr. Foroosh's expertise as a computer scientist provides the requisite foundation to offer the testimony about arXiv.org's routine publication practices. *Id.* More particularly, Petitioner asserts that Dr. Foroosh's discussion of how the file's metadata of the Maninis paper corroborates its date of creation and last modification as April 30, 2017. *Id.* (citing Ex. 1002 ¶ 66; Ex. 1029 ¶ 3). Likewise, Petitioner argues that Dr. Foroosh's own personal knowledge of arXiv.org's publication practices help establish the foundation for arXiv.org's routine business practices. *Id.* at 13–14 (citing Fed. R. Evid 406, 701–703; Ex. 1002 ¶ 63). According to Petitioner,

> At minimum, Dr. Foroosh's experience in disseminating papers via arXiv.org provides him with "specialized knowledge" to help determine facts in issue, and his discussion in ¶¶62-67 bases his opinions on sufficient facts or data, applied reliably to the facts of the case. Fed. R. Evid. 702. . . . Dr. Foroosh's personal knowledge and experience with arXiv.org corroborates its manner of publication, confirming the date on which Maninis was publicly available for download. *See* EX1002, ¶¶62-67. Dr. Foroosh's personal experience as an author who published papers on arXiv.org is admissible evidence of the practices followed by arXiv.org when Maninis was submitted for publication. *See id.*

Id. at 14–15.

We agree with Petitioner that Dr. Foroosh's testimony in paragraphs 62–67 is admissible. As discussed above, Petitioner produces a Declaration by Dr. Foroosh attesting under oath about his own personal knowledge of arXiv.org's routine business practice at the time and an express intent to

publish. Ex. 1002 ¶¶ 62–67, 234, 235. Petitioner substantiates this particular testimony by producing archived copies of the arXiv.org website from 2016 and 2017 reflecting the "policy" of arXiv.org to endeavor to publish articles shortly after they are submitted. Ex. 1022; Ex. 1023; Ex. 1026. Because paragraphs 62 through 67 of the Foroosh Declaration discuss the routine business practice of arXiv.org as corroborated by Exhibits 1022, 1023, 1025, 1026, and 1029, and these paragraphs further include Dr. Foroosh's technical analysis of the file's metadata included in Maninis,[22] we find that Petitioner has established by a preponderance of the evidence paragraphs 62 through 67 of the Declaration are supported by sufficient foundation, and that Dr. Foroosh's Declaration about the routine publication practices of arXiv.org admissible. ; *see also Cooler Masters Co. v. Aavid Thermalloy LLC*, IPR2019-00337, Paper 49 at 30, 37–38 (testimony of routine business practice of Japanese Patent Office sufficient to establish publication). For these reasons, we decline to exclude paragraphs 62 through 67 of Exhibit 1002.

III. CONCLUSION

For the reasons discussed above, Petitioner has shown by a preponderance of the evidence that claims 1–15 of the '409 patent are unpatentable.[23]

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[22] Because Maninis (Ex 1007) qualifies as a prior art printed publication (*see* section E.2 above), we do not reach Patent Owner's argument as to whether Exhibit 1021 is a duplicate of Exhibit 1007. PO. Mot. Reply Mot. Excl. 5.

[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*

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–15	103	Salah, Carrier, Maninis	1–15	

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–15 of the '409 patent are unpatentable;

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

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of this Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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).

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