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Paper 33
Date: April 16, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ALIGN TECHNOLOGY, INC.,
Petitioner,

v.

DENTAL MONITORING SAS,
Patent Owner.

IPR2024-00110
Patent 11,109,945 B2

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

SZPONDOWSKI, *Administrative Patent Judge*.

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

I. INTRODUCTION

We instituted an *inter partes* review of claims 1, 2, and 4–6 of U.S. Patent No. 11,109,945 B2, issued on September 7, 2021 (Ex. 1001, "the '945 patent"), in response to a Petition (Paper 2, "Pet.") filed by Align Technology, Inc. ("Petitioner"). Paper 7 ("Dec."). During trial, Dental Monitoring SAS ("Patent Owner") filed a Response to the Petition (Paper 16, "PO Resp."), Petitioner filed a Reply (Paper 20, "Reply"), and Patent Owner filed a Sur-reply (Paper 25, "Sur-reply").

We held a consolidated oral hearing in this proceeding and related IPR2024-00052 on January 29, 2025, and a copy of the transcript is entered into the record. Paper 32 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6 (2018). This Decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the claims on which we instituted trial. Petitioner has the burden of proving unpatentability of a claim by a preponderance of the evidence. 35 U.S.C. § 316(e).

Based on the complete record, Petitioner has shown, by a preponderance of the evidence, that claims 1, 2, and 4–6 of the '945 patent are unpatentable.

II. BACKGROUND

A. *Real Parties-in-Interest*

Petitioner identifies itself as the real party-in-interest. Pet. 49. Patent Owner identifies itself as the real party-in-interest. Paper 5, 1 (Mandatory Notices of Patent Owner).

B. *Related Matters*

Petitioner and Patent Owner identify *Dental Monitoring SAS v. Align Technology, Inc.*, No. 3:22-cv-07335-WHA (N.D. Cal.). Pet. 49; Paper 5, 1.

C. *The '945 Patent (Ex. 1001)*

The '945 patent is titled "Method of Evaluating an Orthodontic Aligner," and generally relates to a method for evaluating the shape of an orthodontic aligner "worn by a patient, particularly so as to evaluate how well the shape of the orthodontic aligner conforms to the positioning of the teeth of said patient." Ex. 1001, code (54), 1:5–9.

The '945 patent describes that, conventionally, an aligner is in the form of a removable monobloc appliance made of a transparent polymer, that comprises a tray shaped in such a way to house teeth. Ex. 1001, 1:24–28. "The shape of the aligner is tailored to hold the aligner in position on the teeth while at the same time applying an action towards correcting the positioning of certain teeth." *Id.* at 1:29–31. Conventionally, at the start of treatment, the shapes of the aligners at various stages are determined and manufactured, and the patient changes the aligner at predetermined times. *Id.* at 1:32–36. Then, at regular intervals, the patient visits the orthodontist for a visual inspection so that the orthodontist can check whether the aligner worn by the patient is still suitable for treatment. *Id.* at 1:42–45. One of the goals of the invention claimed in the '945 patent is to reduce the number of visits to the orthodontist, which may be burdensome for the patient. *Id.* at 1:53–61.

The method described in the '945 patent "is aimed at detecting situations in which the free end 22 of a tooth is no longer in contact with the

bottom of the tray, and at measuring the amplitude of this separation."[1] Ex. 1001, 5:43–45, Fig. 3 (illustrating an updated image of a dental arch with aligner 10 and free end 22 of a tooth). Figure 9, reproduced below, shows a method according to the invention.

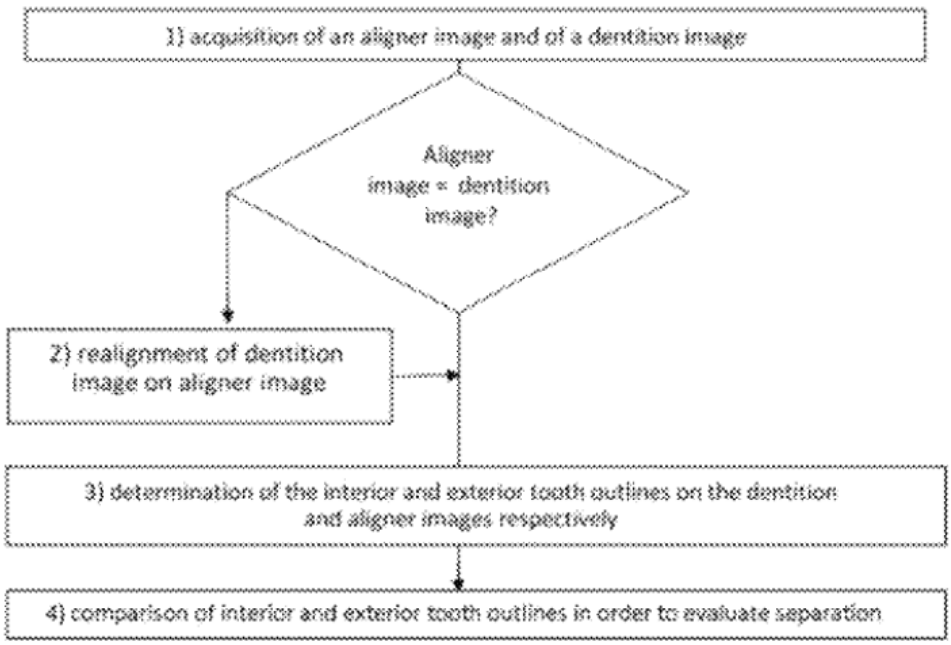

Fig. 9

Figure 9, above, shows steps 1 through 4 of the method in a block diagram.

Step 1 states "acquisition of an aligner image and of a dentition image." Step 1 is performed "at the instant that the evaluation of the shape of an aligner is desired." Ex. 1001, 5:58–60. The images are preferably captured by the patient or someone close to the patient on a mobile phone. *Id.* at 5:61–66. The images allow for the "shape of the aligner [to be] evaluated by comparing an outline of [the] aligner, in its service position, with an outline of the teeth wearing it." *Id.* at 6:7–9. An "aligner image"

[1] The "tray" refers to the interior surface of the aligner. Ex. 1001, 5:1–2.

refers to an image of the aligner in its service position, and a "dentition image" refers to an image of teeth bearing the aligner in the service position. *Id.* at 6:11–14. If the dentition image is the aligner image, then step 2 does not need to be performed. *Id.* at 6:15–21.

Step 2 states "realignment of dentition image on aligner image," and is performed if the dentition image and the aligner image are different, in order to make them comparable. Ex. 1001, 6:22–10:18.

Step 3 states "determination of the interior and exterior tooth outlines on the dentition and aligner images respectively." An "interior tooth outline" delimits the free end of the tooth, while an "exterior tooth outline" delimits part of the aligner. Ex. 1001, 5:10–15. The '945 patent states that "[a] person skilled in the art knows how to process an image in order to isolate an outline," and the processing "involves the well-known application of masks or filters, which come with image processing software." *Id.* at 10:22–25; *see also id.* at 10:28–11:34 (providing a list of "known and preferred methods").

Step 4 states "comparison of interior and exterior tooth outlines in order to evaluate separation." The '945 patent describes two embodiments for comparing the tooth outlines, including, for example determining an "offset score" that can be used to indicate whether there is separation between the tooth and the tray. Ex. 1001, 11:35–13:34.

D. *Illustrative Claim*

Among the challenged claims, claim 1 is independent. Independent claim 1, reproduced below, is illustrative of the claimed subject matter:

> 1. A method for evaluating the shape of an orthodontic aligner worn by a patient, said method comprising the following steps:

> 1) acquisition of at least one two-dimensional image of teeth of said patient, referred to as "updated image", under actual acquisition conditions; at least one updated image referred to as "aligner image", at least partially representing the aligner in a service position in which it is worn by said teeth; and at least one updated image referred to as "dentition image", identical to or different from the aligner image, representing said teeth,
>
> 2) if the dentition image is different from the aligner image, conversion of the dentition image so that it represents said teeth as seen under the acquisition conditions used during the acquisition of the aligner image in step 1);
>
> 3) determination, by means of image processing software, for each of a plurality of teeth represented on the dentition and aligner images, of interior and exterior tooth outlines representing the outline of the free end of said tooth on the dentition and aligner images, respectively;
>
> 4) comparison of the interior and exterior tooth outlines, so as to determine at least one score according to said comparison.

Ex. 1001, 13:59–14:17.

A. *Prior Art and Asserted Challenges to Patentability*

Petitioner asserts that claims 1, 2, and 4–6 are unpatentable based on the following challenge (Pet. 13):

Claims Challenged	35 U.S.C. §[2]	References/Basis
1, 2, 4–6	103	Kim,[3] Invisalign,[4] Salah[5]

In support of its proposed challenges, Petitioner relies on the Declarations of Hassan Foroosh, Ph.D (Exs. 1002, 1048). Patent Owner relies on the Declaration of John Mongan, M.D., Ph.D (Ex. 2028) and Declaration of Budi Kusnoto, D.D.S., M.S. (Ex. 2030). Deposition transcripts have been submitted to the record for Dr. Foroosh (Exs. 2048, 2054, 2065), Dr. Mongan (Exs. 1037, 1051), and Dr. Kusnoto (Exs. 1038, 1052).

III. ANALYSIS

A. *Legal Standards*

A 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 said claimed invention pertains." The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the

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[2] Because the '945 patent issued from a patent application that was filed after March 16, 2013 (Ex. 1001, codes (21), (22)), patentability is governed by the version of 35 U.S.C. § 103 of the Leahy-Smith America Invents Act ("AIA"), Pub L. No. 112–29, 125 Stat. 284 (2011).

[3] Kim, US 2017/0281313 A1, published Oct. 5, 2017 ("Kim," Ex. 1005). Petitioner contends that Kim is prior art to the '945 patent under 35 U.S.C. § 102(a)(2). Pet. 6.

[4] *Invisalign Clinical Monitoring Guide*, Align Technology, Inc. (2003) ("Invisalign," Ex. 1006). Petitioner contends that Invisalign is prior art to the '945 patent under 35 U.S.C. § 102(a)(1). Pet. 7.

[5] Salah et al., WO 2016/066651 A1, published May 6, 2016 ("Salah," Ex. 1008). Petitioner contends that Salah is prior art to the '945 patent under 35 U.S.C. § 102(a)(1). Pet. 8.

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, objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

A patent claim "is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). An obviousness determination based on a combination of references requires finding "both 'that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.'" *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016) (citation omitted); *see KSR*, 550 U.S. at 418. Further, an assertion of obviousness "cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *KSR*, 550 U.S. at 418; *In re NuVasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (a finding of a motivation to combine "must be supported by a 'reasoned explanation'" (citation omitted)).

In an *inter partes* review, a petitioner bears the burden of persuasion to prove "unpatentability by a preponderance of the evidence." *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (quoting 35 U.S.C. § 316(e)). This burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware*, 800 F.3d at 1378 (citing *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326–1327 (Fed. Cir. 2008). Petitioner must explain with particularity how the prior art would

have rendered the challenged claims unpatentable. 35 U.S.C. § 312(a)(3); 37 C.F.R. § 42.104(b)(4) (2024) ("The petition must specify where each element of the claim is found in the prior art patents or printed publications relied upon.").

B. *Level of Ordinary Skill in the Art*

Determining whether an invention would have been obvious under 35 U.S.C. § 103 requires resolving the level of ordinary skill in the pertinent art at the time of the effective filing date of the claimed invention. *Graham*, 383 U.S. at 17. The person of ordinary skill in the art is a hypothetical person who knows the relevant art. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors that may be considered in determining level of ordinary skill in the art include (1) the educational level of the inventor; (2) the types of problems encountered in the art; (3) prior art solutions to those problems; (4) the rapidity with which innovations are made; (5) the sophistication of the technology; and (6) the educational level of active workers in the field. *Daiichi Sankyo Co. v. Apotex, Inc.*, 501 F.3d 1254, 1256 (Fed. Cir. 2007).

Petitioner contends that a person of ordinary skill in the art "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. 12–13 (citing Ex. 1002 ¶¶ 50–51). Petitioner also contends that a person of ordinary skill in the art "could have less education but significant professional experience in one or more of these fields" and "could be a member of an interdisciplinary team." *Id.* at 13.

Patent Owner offers a slightly different definition of the level of ordinary skill in the art. PO Resp. 3–4. Patent Owner contends that a person of ordinary skill in the art:

> 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 image analysis techniques or algorithms. A [person of ordinary skill in the art] ***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. 2028 ¶ 46–49; citing Ex. 2030 ¶¶ 54–57) (emphasis in original). Patent Owner argues that "the relevant field is aligner treatment." *Id.* at 4 (citing Ex. 2030 ¶ 57). According to Patent Owner, it would have been necessary for a person of ordinary skill in the art to consult with an individual having experience in dentistry and/or orthodontics in order to understand Invisalign, Kim, and Salah. *Id.* at 5 (citing Ex. 2030 ¶¶ 56–57; Ex. 2028 ¶ 49); Sur-reply 2.

The parties agree that the proposed levels of ordinary skill in the art are "not materially different." PO Resp. 4; Reply 2. The difference, essentially, is that Patent Owner more explicitly describes the members on the interdisciplinary team, and argues that it would be necessary to consult with such individuals, particularly with persons experienced in dentistry or orthodontics, whereas Petitioner's proposal states that one "could" consult with such individuals. However, Patent Owner's argument that it would be necessary for a person of ordinary skill in the art to consult with an individual having experience in dentistry and/or orthodontics is narrower than Patent Owner's proposed level of skill in the art, which describes

"individuals familiar with medical imaging, dental imaging, dentistry, and/or orthodontics." PO Resp. 4 (emphasis omitted, emphasis added). Neither party presents any argument explaining how the differences in the respective educational backgrounds and work experience in the proposed definitions affect the dispute.

Having considered the parties' respective arguments and the evidence of record, we adopt a modified version of the parties' proposals, and determine for purposes of this Decision that a person of ordinary skill in the art would 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. Further, a person of ordinary skill in the art could have less education but significant professional experience in one or more of these fields, and could be a member of an interdisciplinary team which would have included individuals familiar with medical imaging, dental imaging, dentistry, and/or orthodontics.

Patent Owner argues that Dr. Foroosh is not qualified to testify as a person of ordinary skill in the art and, therefore, his testimony should be given no weight. PO Resp. 5; Sur-reply 2–4 (citing *Kyocera Senco Indus. Tools Inc. v. Int'l Trade Comm'n*, 22 F.4th 1369, 1376–77 (Fed. Cir. 2022)). Several of Patent Owner's arguments rest on Dr. Foroosh's alleged lack of qualifications. *See, e.g.*, PO Resp. 38–41, 44, 46, 55–56. Patent Owner asserts that Dr. Foroosh "has no training or experience with dentistry or orthodontics, and did not consult with such a person to form his opinions." *Id.* at 5 (citing Ex. 2048, 11:9–12; 12:19–22; 13:12–23; Ex. 2054, 124:16–19)). According to Patent Owner, this lack of relevant experience caused

Dr. Foroosh to "misinterpret or ignore portions of" the prior art. *Id.*; *see also id.* at 38–41 (arguing Dr. Foroosh was "unable to understand key portions of Invisalign or explain the meaning of terms appearing on the same pages of Invisalign that he cites"). For example, Patent Owner asserts that Dr. Foroosh testified that he had "no idea" whether the photograph in Invisalign's Figure A is a common position for an aligner, and "could not say how an orthodontist would allegedly measure the separation between tooth and aligner." *Id.* at 5 (citing Ex. 2054, 60:18–61:4, 45:17–19, 74:9–14, 42:4–7, 58:24–59:5, 65:12–13) (emphasis omitted); *see also id.* at 46–47, 49–50 (arguing the same).

We are satisfied that Dr. Foroosh qualifies as a person of ordinary skill in the art. First, Dr. Foroosh has the required educational background, with, for example, a Bachelor of Science in Electrical Engineering, a Master of Science in Electrical Engineering, a Master of Science in Computer Science and Engineering, and a Ph.D in Computer Science. Ex. 1003, 7; Ex. 1002 ¶ 3. Second, Dr. Foroosh has the required work experience, with, for example, research in machine learning, deep learning, and neural networks, image and video processing and analysis, and computer vision. Ex. 1003, 2, 4–8; *see also id.* at 9–13 (list of projects), 14–29 (list of publications), 32 (list of interdisciplinary research); Ex. 1002 ¶¶ 2–5 (describing work experience), 6–9 (describing research experience).

Dr. Foroosh has also been part of interdisciplinary research efforts including those relating to the medical or dental fields, such as, research on the intersection of computer vision and augmented reality in medical and surgical interventions. Ex. 1003, 32; Ex. 1002 ¶ 12. Dr. Foroosh describes a research project, *Modeling and Visualization of Muscoloskeletal Structures*

in Dental CT-Scan (2006–2007), where he "developed algorithms for [three-dimensional ('3D')] registration, modeling and visualization of maxilla and mandible of patients for dental surgery using Computer Aided Tomography (CAT) scanning." Ex. 1002 ¶ 6. He describes another project for the National Science Foundation, which "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." *Id.* ¶ 7. He was also a co-author on *Alignment of Maxillofacial CT Scans to Stone-Cast Models Using 3D Symmetry for Backscattering Artifact Reduction*, Proceedings of Medical Image Understanding and Analysis Conference (MIUA) (2006), and an adviser for a dissertation directed to "*Sub-pixel Registration in Computational Imaging and Applications to Enhancement of Maxillofacial CT Data*," which "focused on registration and alignment of 2D images and 3D digitized data obtained by dental CT scans and dental imprints of a patient." *Id.* ¶¶ 8, 9. Although Dr. Foroosh is not a dentist or orthodontist, we determine that the breadth of his background, as fully set forth in Exhibit 1003, qualifies him to provide testimony from the perspective of a person of ordinary skill in the art. In short, we agree with Petitioner that Dr. Foroosh has "ample experience with medical and dental imaging," as set forth above. Reply 2 (citing Ex. 1002 ¶¶ 6–9; Ex. 1003, 14, 15, 21, 26, 32).

Moreover, we are afforded broad discretion in assigning weight that is to be accorded expert testimony. *See Yorkey v. Diab*, 601 F.3d 1279, 1284 (Fed. Cir. 2010) ("[T]he Board was well within its discretion to give more credibility to [one expert over another] unless no reasonable trier of fact

could have done so."); *see also* CTPG[6] 34–36. In the analysis that follows, when applicable, we weigh the credibility of Dr. Foroosh's testimony, including with respect to Patent Owner's arguments regarding Dr. Foroosh's testimony on the Invisalign reference, and provide our reasons therefore.

C. *Claim Construction*

In an *inter partes* review, we apply the same claim construction standard as would be used by a district court to construe a claim in a civil action involving the validity or infringement of a patent. 37 C.F.R. § 42.100(b). Under that standard, claim terms are generally given their ordinary and customary meaning, as would have been understood by one with ordinary skill, in the art in the context of the intrinsic record including the specification, the prosecution history, and other claims, and extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc). Only those claim terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner provides constructions for the terms "interior tooth outline" and "exterior tooth outline," as recited in claim 1. Pet. 14–15. Specifically,

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[6] Patent Trial and Appeal Board Consolidated Trial Practice Guide (CTPG) (Nov. 2019) (*available at* https://www.uspto.gov/sites/default/files/documents/tpgnov.pdf?MURL=TrialPracticeGuideConsolidated).

Petitioner contends that the Specification of the ’945 patent supports that an “interior tooth outline” refers to a line delimiting a free end of a tooth, and an “exterior tooth outline” refers to a line delimiting a part of an aligner. *Id.* (citing Ex. 1001, 5:10–20). According to Petitioner, Patent Owner urged the same interpretation during prosecution. *Id.* at 15 (citing Ex. 1004, 242[7]).

Petitioner also argues that step 1 of claim 1 (i.e., limitation 1(1)) indicates that “the dentition and aligner images may be the same image, which would be an image depicting both an aligner and a patient’s teeth.” Pet. 14 (citing Ex. 1002 ¶¶ 52–54). In these embodiments, where the aligner image and detention image are not different, Petitioner contends that step 2 of claim 1 (i.e., limitation 1(2)) may be ignored, as that limitation recites “if the dentition image is different from the aligner image.” *Id.* (citing *Fresenius USA, Inc. v. Baxter Int’l, Inc.*, 582 F.3d 1288, 1297–1298 (Fed. Cir. 2009).

In addition, Petitioner contends that step 3 of claim 1 (i.e., “determination, by means of image processing software . . . of interior and exterior tooth outlines . . .”) whether construed as a means-plus-function limitation or not, does not distinguish over the prior art. Pet. 15. However, Petitioner further identifies the corresponding function as “determining interior and exterior tooth outlines” and the corresponding structure “to encompass image processing software, such as any examples identified at EX1001, 10:28–11:34, including any of the methods disclosed by Salah.” *Id.* at 17.

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[7] All references to the page numbers in the prosecution history of the ’945 patent refer to the page numbers inserted by Petitioner in the bottom, right-hand corner of each page in Exhibit 1004.

Patent Owner does not respond to Petitioner's proposed constructions, but provides a construction for the term "shape of an orthodontic aligner," as recited in the preamble of claim 1, arguing that the "shape of an orthodontic aligner" should be construed to mean "the shape of the aligner relative to the shape of the teeth of the patient." PO Resp. 15 (citing Ex. 2028 ¶¶ 125–128). Petitioner responds that Patent Owner does not argue that the preamble is limiting and "makes no arguments relying on its construction," so the claims are "unpatentable regardless of [Patent Owner's] construction." Reply 5.

As described above, Patent Owner does not dispute Petitioner's proposed constructions. As there is no dispute between the parties, and after reviewing the complete record, we determine that express construction of "interior tooth outline," "exterior tooth outline," and "shape of an orthodontic aligner" is not necessary for purposes of this Decision. Further, Patent Owner does not dispute Petitioner's interpretation of limitations 1(1) and 1(2), or Petitioner's identification of the corresponding function and structure in limitation 1(3).

We agree with Petitioner that step 2 of claim 1 recites a conditional limitation, that, if met, is not needed to be performed. *See, e.g., Cybersettle, Inc. v. Nat'l Arbitration Forum*, 243 F. App'x 603, 607 (Fed. Cir. 2007) ("It is of course true that methods steps may be contingent. If the condition for performing a contingent step is not satisfied, the performance recited by the step need not be carried out in order for the claimed method to be performed."). This is supported by the Specification:

> *In one embodiment, the dentition image is the aligner image.* In other words, the same updated image makes it possible not only to see the aligner outline 28 but also to see the dentition outline

> 16, through the aligner (FIG. 3). This single image therefore makes it possible to compare aligner 20 and dentition outlines. *Advantageously, readjustment step 2), described later, is not needed.*

Ex. 1001, 6:15–20 (emphasis added). Further construction of limitations 1(1) and 1(2) is not necessary for purposes of this Decision.

Patent Owner also provides a construction for the term "for each of a plurality of teeth . . . interior and exterior tooth outlines representing the outline of the free end of said tooth," as recited in step 3 of claim 1 (i.e., limitation 1(3)), arguing that it "should be construed as requiring the use of image processing software to determine 'for each of multiple teeth, an interior tooth outline representing the outline of the free end of each of the multiple teeth and an exterior tooth outline representing the corresponding part of the aligner." PO Resp. 16 (Ex. 2028 ¶¶ 129–134). Patent Owner contends that the '945 patent "require[s] not only the use of image processing software to determine contours, but also that the contour belongs to a tooth or an aligner and that the interior and exterior tooth outlines correspond to the same tooth." *Id.* at 17 (citing Ex. 2028 ¶ 130). According to Patent Owner, this is apparent from both the plain language of the claim, other limitations in claim 1 and dependent claim 5, and the specification. *Id.* at 17–19.

Petitioner contends that Patent Owner's proposal "makes no difference to the case presented in the [P]etition, as the [P]etition expressly proposed detecting outlines of the free ends of each tooth (and the corresponding parts of the aligner)." Reply 5–6 (citing Pet. 31–34).

Patent Owner responds that "this construction is significant to the merits, as Petitioner has not shown that its combination can determine

whether a contour pertains to a tooth or an aligner, that is, whether the contour is an interior tooth outline or an exterior tooth outline." Sur-reply 6.

After reviewing the complete record, there is no dispute between the parties that necessitates express construction of limitation 1(3) for purposes of this Decision. That is, the parties do not dispute the scope and meaning of limitation 1(3). Instead, Patent Owner's arguments are directed to whether Petitioner has shown that the combination of references teaches this limitation, which is discussed below. *See* PO Resp. 50–58; Sur-reply 16–19.

D. *Alleged Obviousness Over Kim, Invisalign, and Salah*

Petitioner contends claims 1, 2, and 4–6 would have been obvious over the combination of Kim, Invisalign, and Salah. Pet. 17–46. Patent Owner disputes Petitioner's contentions. PO Resp. 35–60. We first provide overviews of Kim, Invisalign, and Salah, and then we address the parties' arguments.

1. Kim (Ex. 1005)

Kim is titled "Method and System for Providing Remote Teeth Alignment Services and Computer-Readable Medium on Which the Method is Recorded," and is generally directed to "a method and system for providing remote teeth alignment services to remotely advise an appropriate step of a clear aligner using a smartphone of an orthodontic patient, and a computer-readable medium on which the method is recorded." Ex. 1005, code (54), ¶ 1.

In particular, Kim describes:

> a method and system for providing remote teeth alignment services, by which an orthodontist may obtain accurate teeth alignment information using a device, e.g., a smartphone, of an orthodontic patient, may remotely and accurately diagnose the

> condition of the patient based on the teeth alignment information, and may remotely provide information about an accurate step of a clear aligner to be currently worn by the orthodontic patient, thereby greatly reducing a diagnosis time and cost of the orthodontic patient and the orthodontist, the accuracy of diagnosis may be improved by automatically obtaining photos of accurate sizes and locations using various virtual lines, the teeth alignment information may be easily used by the orthodontist by providing the teeth alignment information in the form of report information and classifying the teeth alignment information based on time, teeth alignment may be precisely performed in a customized manner by providing manufacturing information to a clear aligner manufacturer when an additional or modified clear aligner is necessary, interest of orthodontic patients may be increased by disclosing the teeth alignment information of a selected orthodontic patient, and the orthodontic patients may be inspired with a greater desire for aligned teeth by providing benefits to the selected orthodontic patient, and a computer-readable medium having recorded the method thereon.

Ex. 1005 ¶ 10. Figure 1, which depicts "a conceptual view of a system for providing remote teeth alignment services," (*id.* ¶ 26) is reproduced below:

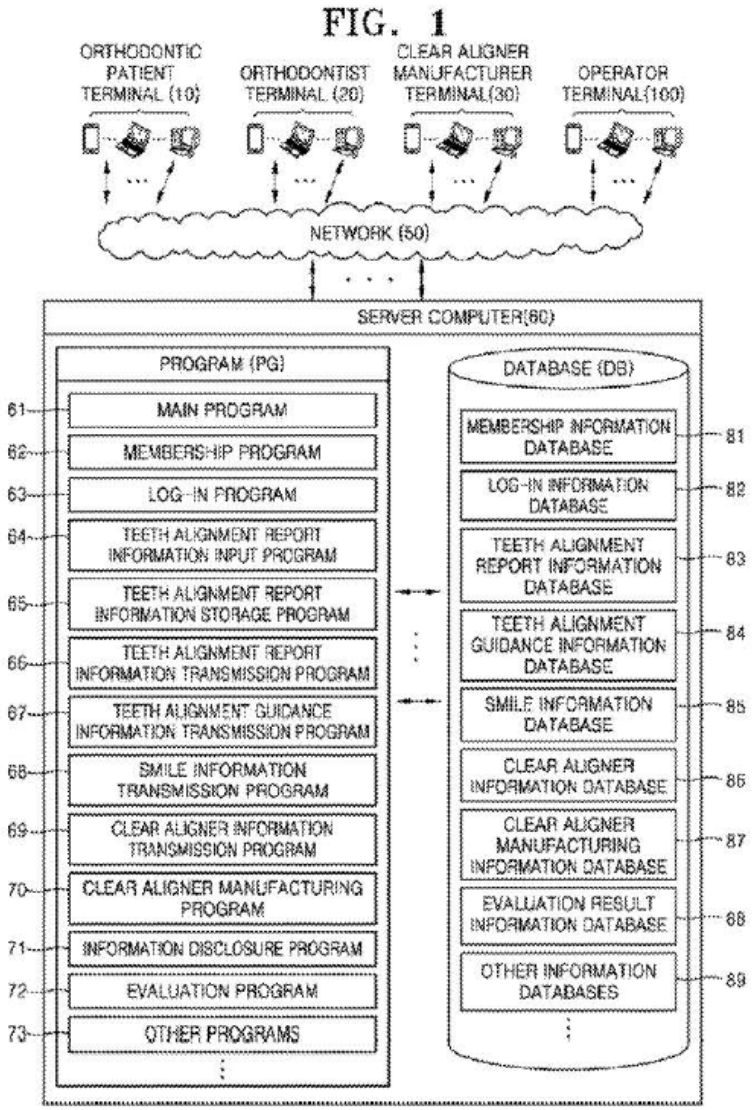

Figure 1, shows, among other things, orthodontic patient terminal 10, orthodontist terminal 20, clear aligner manufacturer terminal 30, operator terminal 100, and server computer 60, all interconnected through network 50. Ex. 1005 ¶¶ 39, 49, Fig. 1. Orthodontic patient terminal 10 may be, for example, a smartphone or mobile device. *Id.* ¶ 42. Orthodontist terminal 20 may, likewise, be a smartphone or mobile device. *Id.* ¶ 44.

According to Kim, the patient may provide "teeth alignment information" to orthodontist terminal 20 by taking a variety of photographs

of the patient's teeth from different angles using orthodontic patient terminal 10. Ex. 1005 ¶¶ 10, 42, 55, 56, 60 80. Orthodontic patient terminal 10 may also send "clear aligner information about a currently worn clear aligner" to orthodontist terminal 20, so that "the orthodontist checks a photo or a video of the clear aligner currently worn by the orthodontic patient, and determines whether the clear aligner is normal and corresponds to an appropriate step." *Id.* ¶ 66; *see also id.* ¶ 10.

2. Invisalign (Ex. 1006)

Invisalign is "intended to help the Invisalign practitioner successfully monitor Invisalign treatments and address issues that may arise between receipt of Aligners from Align to the completion of treatment." Ex. 1006, i. Invisalign provides guidance to monitor treatment progress of patients after aligners have been received and are being worn by the patient. *Id.* at i–iv. For example, the practitioner can "evaluate any fit concerns that may arise" by "[h]av[ing] patients arrive with the previous stage Aligner and the current Aligner." *Id.* at ii. Invisalign includes information on "Managing Aligner fit and seating," and advises that an "Aligner [is] seating poorly" if there is greater than 1 mm gap between the teeth and aligner. *Id.* at 1. Invisalign further states that "Aligners should be fitting well at the end of the 2-week period." *Id.*

3. Salah (Ex. 1008)

Salah is titled "Method for Monitoring Dentition," and is generally directed to "monitoring . . . the appearance of the teeth of a patient." Ex. 1008, codes (54), (57). Salah generally describes methods for monitoring the positioning, shape, and/or appearance of a patient's teeth by

obtaining two-dimensional ("2D") images of a patient's teeth and comparing them to a 3D digital reference model. *Id.* at 1:1–2:19.

Salah's method starts with the creation of a 3D "initial reference model" of the patient's dental arch, then a 2D "updated image" is acquired and analyzed to assess tooth deformation and/or displacement since the "initial reference model," and then the "initial reference model" is modified until a "final reference model" is obtained that corresponds to the updated image. Ex. 1008, 1:28–2:19.

Salah describes that the "updated image" may be a "photograph taken by the patient." Ex. 1008, 2:24, 31:5–7 ("image acquisition can be carried out by the patient himself or by one of their relatives, using a simple cell phone, anywhere, and especially outside a medical, dental or orthodontic practice"); *see also id.* at 27:11–13 ("image acquisition apparatus" . . . "preferably comprises a camera . . . which the user, e.g., the patient or one of their relatives, positions by means of a viewfinder or screen, before operating it"). In order to compare the updated and reference images, Salah describes comparing discriminant information on both images. *Id.* at 40:19–20. "Discriminant information is preferably chosen from the group consisting of *contour information*, color information, density information, a distance information, brightness information, saturation information, reflection information and combinations of these." *Id.* at 34:8–10 (emphasis added). Salah discloses various methods for processing an image to obtain discriminant information, including deep learning. *Id.* at 34:15–36:14.

4. Analysis of Independent Claim 1

Petitioner contends that the combination of Kim, Invisalign, and Salah teaches all the limitations of independent claim 1. Pet. 24–34. Patent

Owner disputes Petitioner's contentions. PO Resp. 35–60. Specifically, Patent Owner argues that Petitioner has not established a motivation to combine the references, and that Petitioner has not shown that the combination teaches limitations 1(3) and 1(4). *Id*. For the reasons set forth below, we determine that, on the complete record, Petitioner has shown by a preponderance of the evidence that independent claim 1 would have been obvious over the combination of Kim, Invisalign, and Salah, and Maninis. We begin by setting forth Petitioner's contentions, and then address Patent Owner's arguments against the combination.[8]

a) Preamble

The preamble recites "[a] method for evaluating the shape of an orthodontic aligner worn by a patient, said method comprising the following steps:" Ex. 1001, 13:59–61.

Petitioner contends that both Kim and Invisalign teach such a method.[9] Pet. 24. According to Petitioner, "Kim teaches evaluating an aligner by reviewing an image of the aligner currently worn by the patient, to determine whether the aligner is normal and appropriate." *Id.* (citing Ex. 1005 ¶ 66). Petitioner also contends that "Invisalign teaches that evaluating a currently-worn clear aligner includes assessing the fit of the aligner, and that this assessment involves determining a distance between the teeth and the aligner when worn by the patient." *Id.* (citing Ex. 1006, 1).

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[8] Patent Owner's arguments directed to limitations 1(3) and 1(4) also challenge the motivation to combine the references.

[9] Petitioner does not argue, one way or the other, whether the preamble is limiting. We make no determination whether the preamble of claim 1 is limiting.

Patent Owner does not dispute Petitioner's contentions. *See generally* PO Resp. After considering the arguments and evidence of the complete record, we determine that Petitioner has shown by a preponderance of the evidence that Kim and Invisalign teach the recited elements of the preamble.

b) Limitation 1(1)

Limitation 1(1) recites:

> acquisition of at least one two-dimensional image of teeth of said patient, referred to as 'updated image', under actual acquisition conditions; at least one updated image referred to as 'aligner image', at least partially representing the aligner in a service position in which it is worn by said teeth; and at least one updated image referred to as 'dentition image', identical to or different from the aligner image, representing said teeth.

Ex. 1001, 13:62–14:3.

(1) Petitioner's Contentions

Petitioner contends that limitation 1(1) would have been obvious over Kim, Invisalign, and Salah. Pet. 25. Petitioner argues that limitation 1(1) may be satisfied by "acquiring only a single image that represents both an aligner worn by a patient's teeth and the patient's teeth themselves." *Id.*

Petitioner contends that Kim teaches that the camera of a patient's smartphone or similar device may be used to acquire photographs "showing a teeth alignment state of the orthodontic patient," which can further include "receiving the clear aligner information about a currently worn clear aligner," enabling the orthodontist to "check[] a photo or a video of the clear aligner currently worn by the orthodontic patient" to "determine[] whether the clear aligner is normal and corresponds to an appropriate step." Pet. 25–26 (citing and quoting Ex. 1005 ¶¶ 55, 56, 66) (alterations in original); *see also id.* at 17–18. Petitioner contends that "Invisalign corroborates Kim's

teachings regarding imaging an aligner in a service position on teeth, showing how such an aligner may be assessed to determine if it fits appropriately." *Id.* at 18. Further, Petitioner argues, "to the extent Patent Owner may argue Kim does not sufficiently describe the aligner currently worn and imaged is in a service position on the patient's teeth, taking such an image would have been readily apparent in view of Invisalign's teachings." *Id.* In addition, Petitioner contends that "Salah similarly teaches acquiring . . . dental images [with a cellphone], including of teeth fitted with orthodontic appliances." *Id.* at 26; *see id.* (citing Ex. 1008, 2:1–2, 27:11–13, 31:4–7, 64:7–12, Fig. 11; Ex. 1002 ¶ 73); *see also id.* at 21–22.

Petitioner contends that "Invisalign confirms that analyzing a two-dimensional image representing a patient's aligner in a service position as well as the patient's teeth (e.g., a photo or video taken by a cellphone, consistent with the teachings of Kim) can produce measurements useful for orthodontic assessment." Pet. 26 (citing Ex. 1006, 1). Petitioner contends that "Invisalign teaches that a large gap between a tooth and an aligner (e.g., more than 1 mm) indicates poor fit" and "further illustrates that such a gap is visually distinguishable in a digital photograph of a patient's teeth." *Id.*; *see also id.* at 18–19 (citing Ex. 1006, 1; Ex. 1002 ¶ 58). Petitioner, therefore, contends that "Invisalign provides a reason to acquire a two-dimensional image of the patient's teeth with an aligner being worn in a service position: by assessing the gap visible between aligner and teeth, Invisalign teaches that it can be determined whether an aligner fits correctly (e.g., is normal and corresponds to an appropriate step), or whether it is seated or fit poorly." *Id.* at 26 (citing Ex. 1002 ¶ 72); *see also* Ex. 1006, 1; *see also* Pet. 19–20.

Petitioner contends that, in view of Kim's and Invisalign's teachings, a person of ordinary skill in the art "would have had reason to analyze images of the teeth of a patient wearing an aligner in a service position to evaluate whether the aligner fit appropriately." Pet. 19–20. According to Petitioner, the proposed "combination would be applying known methods for orthodontic evaluation of aligner fit based upon the appearance of the aligner worn on the patient's teeth, as taught by Invisalign, in order to analyze a photo or video of the aligner worn by the patient, as taught by Kim, predictably providing feedback regarding tooth-aligner separation to aid an orthodontist regarding whether the clear aligner is normal and corresponds to an appropriate step of treatment." *Id.* at 20. Petitioner contends that Kim indicates that "employing such techniques would serve goals including enhancing accuracy, reducing the time and cost of treatment, and facilitating remote assessment." *Id.* (citing Ex. 1005 ¶¶ 8–10, 72).

(2) Patent Owner's Arguments

Patent Owner argues that "Petitioner's motivation to combine Kim with Invisalign is premised on the incorrect assertion that Kim teaches the use of photographs of seated aligners." PO Resp. 36 (citing Ex. 1002 ¶¶ 71–72). More specifically, Patent Owner asserts that Kim's disclosure of clear aligner information "concerns images of the aligner itself, not a patient wearing the aligner." *Id.* (quoting Ex. 1005 ¶ 66). Patent Owner also argues that Dr. Foroosh is not qualified to provide testimony regarding Invisalign because he lacks orthodontic experience, and, is therefore "unable to understand key portions of Invisalign or explain the meaning of terms appearing on the same pages of Invisalign that he cites." *Id.* at 38–39

(citing, e.g., Ex. 2054, 33:14–34:11, 36:5–17, 38:18–39:24; Ex. 1002 ¶ 45). We address each of these arguments in turn.

(3) Analysis

(a) Whether Kim or Kim, Invisalign, and Salah Teaches Acquisition of an Aligner Image

There is no dispute that Kim teaches using a smartphone or mobile device to acquire an image of a patient's teeth. *See, e.g.*, Ex. 1005 ¶¶ 1, 10, 13 (describing "photographing step information, . . . and a front-view teeth photo, a bottom-view low-angle teeth photo, . . . which are taken using a camera of the orthodontic patient terminal"), 42 (describing that the orthodontic patient terminal is not limited to a smartphone and may also be a mobile device), 56, 58 (describing "a teeth contour automatic recognition photographing program 647 for displaying a virtual teeth line on the screen of the orthodontic patient terminal 10 and automatically recognizing and taking a photo of the teeth of the orthodontic patient shown on the screen"). However, in various instances, Kim refers to the "currently worn clear aligner" or a "clear aligner to be currently worn" (e.g., Ex. 1005 ¶¶ 10, 66), and the parties dispute whether this refers to the patient wearing the aligner when the photograph is taken (as Petitioner argues) or whether it simply refers to the aligner by itself that the patient is currently using (as Patent Owner argues). Pet. 18; PO Resp. 36, 54–55; Sur-reply 7–8.

Kim at least *suggests* that a photograph may be acquired while the aligner is being worn. For example, Kim describes that:

> The clear aligner information transmission program 69 may be a program for receiving the *clear aligner information about a currently worn clear aligner from the orthodontic patient terminal 10*, storing the clear aligner information, and transmitting the clear aligner information to the orthodontist

> terminal 20 in such a manner that the *orthodontist checks a photo or a video of the clear aligner currently worn by the orthodontic patient*, and determines whether the clear aligner is normal and corresponds to an appropriate step.

Ex. 1005 ¶ 66 (emphasis added); *see also id.* ¶¶ 13 (teeth alignment report information may include photographs taken using a camera of the orthodontic patient terminal), 14 (teeth alignment report information input program may include various guidance information for taking the photograph), 20 (based on the teeth alignment report information, determining that an additional or modified clear aligner is needed, and transmitting a clear aligner information to a clear aligner manufacturing terminal), 64 (teeth alignment guidance information may include at least one of a clear aligner information about a clear aligner to be worn in a current step among a clear aligner set); *see also id.* ¶¶ 56, 58.

Patent Owner argues that the disclosure in paragraph 66 cited above refers to a photograph of the clear aligner by itself (PO Resp. 36; Ex. 2030 ¶ 74); however, Patent Owner does not identify any disclosure in Kim that describes taking a photograph of the clear aligner by itself. Rather, the photograph provided in the teeth alignment report information in Kim describes photographs taken of the patient's mouth and jaw area. Ex. 1005, ¶¶ 13, 56, 87. Further, Patent Owner's argument that Kim's image is not used for diagnostic or treatment purposes (PO Resp. 37), is not supported by the disclosure in Kim. Paragraph 66 of Kim, reproduced above, explicitly states that "the orthodontist checks a photo or a video of the clear aligner currently worn by the orthodontic patient, and determines whether the clear aligner is normal and corresponds to an appropriate step."

Even if Kim only teaches taking a photograph of the patient's teeth with no aligner in place, we agree with Petitioner that taking the photograph with the seated aligner in place would have been obvious in view of the teachings in Invisalign and Salah. Pet. 18, 19, 21, 26–27; Reply 14. That is, Salah teaches using a cellphone to acquire an image of the patient's teeth while the user is wearing an orthodontic appliance and analyzing that image. Ex. 1008, 27:11–13, 31:4–7, 34:5–36:15, 64:7–12, Fig. 11. And, as Petitioner argues, "Invisalign provides a reason to acquire a two-dimensional image of the patient's teeth with an aligner being worn in a service position: by assessing the gap visible between aligner and teeth, Invisalign teaches that it can be determined whether an aligner fits correctly (e.g., is normal and corresponds to an appropriate step), or whether it is seated or fit poorly." Pet. 26 (citing Ex. 1002 ¶ 72); *see also id.* at 19–20.[10] Patent Owner's arguments that the images in Invisalign were not taken on a cellphone are beside the point (and Invisalign is not relied upon for that teaching), especially given the disclosures in both Kim and Salah that teach acquiring dental images using a cellphone. *See* PO Resp. 44–45.

(b) Whether Dr. Foroosh Failed to Properly Analyze Invisalign

Patent Owner argues that Dr. Foroosh is not qualified to provide testimony regarding Invisalign because he lacks orthodontic experience, and, is therefore "unable to understand key portions of Invisalign or explain the meaning of terms appearing on the same pages of Invisalign that he cites."

[10] Patent Owner argues that Dr. Foroosh is not qualified to offer this opinion. PO Resp. 44. However, for the reasons described in Section III.B. and in Section III.D.4.b.3.a below, we disagree.

PO Resp. 38–39 (citing, e.g., Ex. 2054, 33:14–34:11, 36:5–17, 38:18–39:24; Ex. 1002 ¶ 45). We are not persuaded by Patent Owner's arguments. *See* Reply 9–10.

Patent Owner provides no explanation as to why the terms Patent Owner's counsel chose to ask Dr. Foroosh about during deposition (e.g., "auxiliary," "interproximal reduction," "patient compliance," "unengaged attachment," "scalar") are relevant to the challenged claims of the '945 patent, or the combination as proposed by Petitioner. *See* Reply 10. As described in the Petition, "Invisalign provides a reason to acquire a two-dimensional image of the patient's teeth with an aligner being worn in a service position." Pet. 26 (citing Ex. 1002 ¶ 72). Patent Owner's argument that Dr. Foroosh did not understand the Invisalign reference because he could not provide a dentist's or orthodontist's opinion on what certain medical terms mean is not persuasive. However, we note that in several instances Dr. Foroosh indicated familiarity with the terms. For example, when asked about the term "interproximal reduction," Dr. Foroosh testified that, "I have come across this term back when I was working on imaging sciences on that project; so I am familiar with treatments for, you know, creating spaces between teeth." Ex. 2054, 36:5–10. Dr. Foroosh also testified "I know what scalers are. They're in dentists' offices." *Id.* at 65:12–18.

Patent Owner also argues that Dr. Foroosh disregarded certain portions of Invisalign that describe methods for assessing aligner fit that can only be performed in person (PO Resp. 39–40; Sur-reply 10), but there is no dispute that Invisalign methods were performed in person. *See, e.g.*, Ex. 2054, 66:14–15 (Dr. Foroosh stating that, "I consider Invisalign not a remote

treatment disclosure"), 67:5–7 (Dr. Foroosh stating that, "I understand that Invisalign is not disclosing a remote assessment or treatment"); Ex. 2030 ¶ 58; Pet. 19–20. We further note that, as Petitioner points out (Reply 9), Dr. Kusnoto testified that, "with the exception of the illustration of poor fit," Dr. Foroosh is "getting the terminology correct." Ex. 1052, 44:1–45:11.

(4) Conclusion for Limitation 1(1)

We are persuaded by Petitioner's arguments that the combination of Kim, Invisalign, and Salah teaches limitation 1(1).[11] We address Petitioner's motivation to combine, and Patent Owner's arguments challenging the motivation to combine below.

c) Limitation 1(2)

Limitation 1(2) recites "if the dentition image is different from the aligner image, conversion of the dentition image so that it represents said teeth as seen under the acquisition conditions used during the acquisition of the aligner image in step 1)." Ex. 1001, 14:4–8.

Petitioner contends that "[s]tep 1(2) only applies 'if the dentition image is different from the aligner image.'" Pet. 28. Petitioner contends that, "[f]or the embodiment discussed above for step 1(1), step 1(2) is satisfied because the dentition and aligner images are not different, rendering

[11] Petitioner also relies on Frey to support the argument that "[photographs or videos of teeth of patients wearing aligners, including images taken with cellphones, were known to be useful to analyze for orthodontic assessment purposes." Pet. 20–21 (citing Ex. 1009, 17–27). Our determination does not depend on Petitioner's reliance on Frey. That is, Frey is not necessary to support our determination that Petitioner has shown by a preponderance of the evidence that the combination of Kim, Invisalign, and Salah teaches limitation 1(1). Therefore, we do not address Patent Owner's arguments regarding Frey. *See* PO Resp. 58–60.

the remainder of step 1(2) inapplicable." *Id.* at 29 (citing Ex. 1002 ¶¶ 76–77).

We are persuaded by Petitioner's arguments that the combination of Kim, Invisalign, and Salah teaches limitation 1(2). We address Petitioner's motivation to combine, and Patent Owner's arguments challenging the motivation to combine below.

d) Limitations 1(3) and 1(4)

Limitation 1(3) recites "determination, by means of image processing software, for each of a plurality of teeth represented on the dentition and aligner images, of interior and exterior tooth outlines representing the outline of the free end of said tooth on the dentition and aligner images, respectively." Ex. 1001, 14:9–14. Limitation 1(4) recites "comparison of the interior and exterior tooth outlines, so as to determine at least one score according to said comparison." *Id.* at 14:15–17.

(1) Petitioner's Contentions

Petitioner contends that the combination of Kim, Invisalign, and Salah teach limitation 1(3). Pet. 30.

Petitioner contends that this limitation "is satisfied by determining 'interior and exterior tooth outlines' for a plurality of teeth in [a] single image [representing a dentition and an aligner]." Pet. 29–30. According to Petitioner, this "is satisfied by detecting edge lines representing the free end of a tooth and of a corresponding edge of an aligner in an image depicting both." *Id.*

Petitioner argues that "Salah teaches that dental images may be analyzed to detect 'discriminant information,' which can include contours of objects depicted in the images, including teeth and other intraoral objects

such as gums." Pet. 30 (citing Ex. 1008, 34:5–14, 55:21–56:7). Petitioner points to Figure 6b of Salah, which shows "[a] contour map of detected tooth edges showing the resulting outlines of teeth," and "includes outlines of the free ends of each of a plurality of teeth." *Id.* (citing Ex. 1008, Figs. 6a, 6b, 23:4–8, 34:6–7, 34:5–14). Further, Petitioner argues, Salah's "discriminant information can be used to generate a 'reference map representing the discriminant information,' and Salah provides an example of such a map generated for an image depicting teeth of a patient with an intraoral appliance." *Id.* (citing Ex. 1008, 40:19–21, 64:7–8, Fig. 11; Ex. 1002 ¶ 81). According to Petitioner, "Salah expressly discloses that the contours it describes may be detected using 'image processing software,' which 'can be used, for example, to detect high contrast regions and determines contours.'" *Id.* at 31 (citing and quoting Ex. 1008, 34:11–14).

Petitioner contends that a person of ordinary skill in the art "would have known how to determine the width of such gaps [between the aligner and the edge of the teeth] using image processing software." Pet. 21. Petitioner argues that "[t]he '945 patent and Patent Owner's statements during prosecution confirm that it was known to [persons of ordinary skill in the art] to use image processing techniques, such as those disclosed by Salah, to detect interior and exterior tooth outlines in images of the teeth of patients wearing an aligner." *Id.* at 22 (citing Ex. 1001, 10:22–27; Ex. 1004, 241–242); *see also id.* at 31–32. Dr. Foroosh provides testimony, and an example, that "by using image processing software to detect contours in an image representing a patient's teeth with an aligner worn in a service position on the teeth, the edges of the objects depicted would be detected." *Id.* at 31 (citing Ex. 1002 ¶¶ 83–84).

Petitioner further asserts that

> it would have been obvious to measure the distance between the ends of the patient's teeth and the corresponding edges of the aligner, as taught by Invisalign, using the edge detection image processing techniques taught by Salah to detect the contours of each object in an image depicting the patient wearing the aligner on the patient's teeth, and to thereby identify the size of the gap between the aligner and the teeth. A [person of ordinary skill in the art] would have had reason to use Salah's techniques for contour detection to detect the edges of teeth and aligners, as Invisalign teaches that the gap between the surfaces of teeth and an aligner should be below a threshold value (1 mm), and as Dr. Foroosh explains, a [person of ordinary skill in the art] would have understood that the width of a gap between two objects in a photograph is equivalent to the distance between the two contours defining the objects' edges. In the case of an image of an aligner on teeth, the distances to measure would be the distances from the contour defining the end of the teeth to the contour defining the surface of the clear plastic aligner. EX1002, ¶¶61-63.

Pet. 22–23; *see also id.* at 32–33. Petitioner argues that "[t]he resulting combination would use each reference's teachings to perform substantially the same function as they provide alone, applying Salah's contour detection to detect edges of teeth and aligners to produce a measurement of distance between these surfaces, as taught by Invisalign, to assess whether the imaged aligner fits appropriately for the current step in patient treatment, as taught by Kim." *Id.* at 23. Petitioner contends that a person of ordinary skill in the art "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.*

Petitioner contends that the combination of Kim, Invisalign, and Salah teaches limitation 1(4). Pet. 33.

Petitioner describes this combination as follows:

> As discussed above for step 1(1), Kim teaches checking "a photo or a video of the clear aligner currently worn by the orthodontic patient" to determine "whether the clear aligner is normal and corresponds to an appropriate step." EX1005, ¶66. As part of this assessment, a [person of ordinary skill in the art] would have applied the teachings of Invisalign to assess the distance between the patient's teeth and the aligner. *See* EX1006, 1; *supra* §IV.B.2. And as discussed for step 1(3), this assessment would involve measuring a distance between an outline of each tooth and the corresponding outline for the aligner, using the image processing software of Salah to detect each outline via contour detection. *See* EX1008, 34:11-36:14; *supra* §IV.B.4. The result of this comparison would produce at least one score.

Pet. 33–34. Petitioner asserts that the results of the comparison would produce at least one score consisting of "one or more values indicating the distance from each tooth to the aligner," which "could be a direct measurement of the image (e.g., in terms of pixels) . . . a value comparing the distance of one or more teeth from the aligner to a threshold as taught by Invisalign." *Id.* at 34 (citing Ex. 1006, 1; Ex. 1002 ¶¶ 86–87; Ex. 1008, Fig. 1, 40:22–41:18).

(2) Patent Owner's Contentions

Patent Owner argues that even if a person of ordinary skill in the art "would have been motivated to combine the references as Petitioner proposes . . . the combination . . . would not achieve a method" as recited in limitations 1(3) and 1(4). PO Resp. 50. Specifically, Patent Owner argues, "Kim, Invisalign, and Salah, taken together, do not suggest determining interior and exterior tooth outlines for a plurality of teeth in a single image, and then comparing them to determine a 'score.'" *Id.* at 50–51.

Patent Owner argues that "Salah nowhere suggests the use of image processing to detect aligners, let alone exterior outlines representing the aligners." PO Resp. 51 (citing Ex. 2028 ¶ 160). Further, Patent Owner argues, Salah does not disclose "recognizing which detected contours correspond to teeth as opposed to something else, like an aligner," "recognizing which portions of a detected contour correspond to individual teeth, or whether portions of two contours correspond to the same tooth." *Id.* at 52 (citing Ex 2028 ¶¶ 161–162). According to Patent Owner, Dr. Foroosh's example, where he took the figure of the "Aligner seating poorly, >1 mm" of Invisalign and applied the Canny edge detection taught in Salah, illustrates this because "[t]he result is an image that shows lines corresponding to edges, but not what the edges relate to," and Dr. Foroosh "had to ***manually*** identify and label" the tooth edge, aligner edge, and separation. *Id.* at 52–53 (citing Ex. 1002 ¶ 83; Ex. 2028 ¶ 162; Ex. 2054, 179:25–180:23).

(3) Analysis

Patent Owner's arguments focus on Salah alone, and improperly argue Salah individually rather than addressing the combination as proposed by Petitioner. *See*, *e.g.*, *In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) ("Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references."). As described above, Petitioner relies on the combination of Kim, Invisalign, and Salah to teach limitations 1(3) and 1(4), and Salah *alone* is not relied upon to teach an aligner image or processing an aligner image.

As Petitioner persuasively argues, Salah discloses detecting contours of objects in the mouth, including the teeth and gums. Pet. 30; Reply 14; Ex. 1008, 33:27–34:14, Fig. 6b. Further, Salah's Figure 6b shows outlines of the free ends of each of a plurality of teeth. *See* Pet. 30. Additionally, Salah teaches using image processing to detect the described contours. Ex. 1008, 34:11–36:14. More specifically, Salah states that "[a] person of ordinary skill in the art know[s] how to process an updated image to reveal discriminant information . . . for example, [by using] the application of well-known masks or filters provided by image processing software . . . to detect high-contrast regions and determine contours." *Id.* at 34:11–14. The '945 patent provides essentially the same level of detail regarding image processing as Salah when it states that "[a] person of skilled in the art knows how to process an image in order to isolate an outline . . . for example, [by using] the well-known application of masks or filters, which come with image processing software . . . [and] make it possible to detect the regions of greatest contrast." Ex. 1001, 10:22–27; *see* Pet. 22, 31, 32. Given these teachings in Salah, we are not persuaded by Patent Owner's arguments that "Petitioner has not shown that its combination can determine whether a contour pertains to a tooth or an aligner, that is, whether the contour is an interior tooth outline or exterior tooth outline." *See* Sur-reply. 6.

Petitioner combines the teachings of Kim, Invisalign, and Salah in a manner that uses the image processing as taught by Salah to detect the edges of each of a plurality of teeth and edges of the aligner corresponding to each tooth on an aligner image, as taught by Kim, Invisalign, and Salah, to compute a score (i.e., measurement of the distance). *See* Pet. 22–23, 29–34; Reply 15–18. Patent Owner's arguments directed to Dr. Foroosh's example

where he took Invisalign's figure of the "Aligner seating poorly, >1 mm" and applied the Canny edge detection taught in Salah are not persuasive. As Petitioner argues, the combination is not limited to Canny edge detection, but rather, directed to Salah's disclosure of "image processing software," which both Salah and the '945 patent recognize a person of ordinary skill in the art would know how to use to process an image to isolate an outline. Reply 16–17; Ex. 1002 ¶ 83. We find that Petitioner's arguments explaining how the combination teaches recited limitations 1(3) and 1(4) persuasive, and adopt them as our own. *See* Pet. 22–23, 29–34; Reply 15–18.

(4) Conclusion for Limitations 1(3) and 1(4)

We are persuaded by Petitioner's arguments that the combination of Kim, Invisalign, and Salah teaches limitation 1(3) and limitation 1(4). We further address Petitioner's motivation to combine, and Patent Owner's arguments challenging the motivation to combine below.

e) Motivation to Combine

Patent Owner argues that Petitioner has not shown that a person of ordinary skill in the art would have been motivated to combine the Kim, Invisalign, and Salah. PO Resp. 35–50. We determine that Petitioner has shown, by a preponderance of the evidence, that the combination of Kim, Invisalign, and Salah teaches all the limitations in claim 1, and has persuasively explained why a person of ordinary skill in the art would have been motivated to combine Kim, Invisalign, and Salah, for the reasons explained below. *See* Pet. 17–23, 32–34.

(1) Whether the Proposed Combination is a Product of Impermissible Hindsight

Patent Owner argues that Dr. Foroosh used impermissible hindsight, rather than the motivations and teachings of the art in 2017. PO Resp. 41. In support of this argument, Patent Owner compares Dr. Foroosh's approach in this proceeding to his approach in related IPR2024-00052, where the claims at issue require analysis using deep learning, and Dr. Foroosh relies on Salah to teach use of deep learning in image analysis, and further on teachings relating to deep learning in the Maninis reference.[12] *Id.* at 42. Patent Owner argues that that Dr. Forosh does not explain why a person of ordinary skill in the art "would have been motivated to select two different techniques from Salah for two different patents," and this approach "exposes his improper hindsight-driven approach." *Id.* at 42–43.

We do not find Patent Owner's impermissible hindsight arguments to be persuasive. Patent Owner does not dispute that Salah discloses various processes to detect high-contrast regions and determine contours, including "the following well-known and preferred methods" such as "applying a Canny filter," as well as "not preferred" methods such as "Deeplearning." Ex. 1008, 34–36. In connection with these processes, Salah also states that "[a] person of skill in the art [would] know how to process an updated image to reveal discriminant information . . . for example, [by using] the application of well-known masks or filters provided by image processing software . . . to detect high-contrast regions and determine contours." *Id.* at 34:11–14. As argued by Petitioner, and we agree, "Salah clearly teaches

[12] Maninis et al., *Convolutional Oriented Boundaries: From Image Segmentation to High-Level Tasks*, arXiv.org, published by May 2, 2017.

deep learning and other image processing algorithms are options to determine contours and other discriminant information," and "similar motivations would lead [persons of ordinary skill in the art], at their preference, to either use deep learning . . . or use the other image processing techniques taught by Salah." Reply 13. Therefore, contrary to Patent Owner's arguments, Dr. Foroosh's testimony is based upon the express disclosure of Salah, not hindsight. *See, e.g., In re Gartside*, 203 F.3d 1305, 1319 (Fed. Cir. 2000) (stating that "the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references," which "may come from . . . the teachings of the references themselves") (quoting *In re Dembiczak*, 175 F.3d 994, 998 (Fed. Cir. 1999).

(2) Whether Petitioner Has Established Motivation to Combine Kim, Invisalign, and Salah

Generally, Patent Owner's arguments against the combination of Kim, Invisalign, and Salah (1) address the references separately, rather than in combination as proposed by Petitioner; (2) argue that the references themselves do not teach the motivation to combine; or (3) argue features in the references that are not relied upon by Petitioner for a particular limitation. These types of arguments are not persuasive, and are addressed below. *See*, e.g., *In re Merck*, 800 F.2d at 1097 ("Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references."); *DyStar Testilfarben GmbH v. C.H. Patrick Co.*, 464 F.3d 1356, 1368 (Fed. Cir.

2006) (stating that motivation to combine prior art references may exist "even absent any hint of suggestion in the references themselves").

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to assess aligner fit by using an aligner image. PO Resp. 43. Patent Owner presents several arguments relating to the combination of Kim and Invisalign. Patent Owner argues that "Kim does not disclose the use–or usefulness–of photographs showing seated aligners," but, rather "expressly relates to 'remote teeth alignment services.'" *Id.* (citing and quoting Ex. 1005 ¶ 10; Ex. 2028 ¶¶ 68, 149; Ex. 2030 ¶¶ 71–75); *see also id.* at 54–55, 58. Patent Owner draws a distinction between assessing teeth alignment and assessing aligner fit, arguing that Kim does not purport to provide a new way to assess aligner fit from a photograph, and Invisalign is concerned with in person-analysis, where orthodontists perform certain steps at each appointment that cannot be performed remotely. *Id.* at 43–44 (citing Ex. 2030 ¶ 58); *see also id.* at 54–55.

Moreover, Patent Owner also argues that the images in Invisalign were acquired for purposes of aligner design and manufacture, and Invisalign does not teach analysis of any images. PO Resp. 44 (citing Ex. 1002 ¶ 72; Ex. 2054, 70:2–7, 142:6–16; Ex. 2028 ¶ 150; Ex. 2030 ¶ 68); *id.* at 54 (arguing that Invisalign does not teach analysis of an aligner image). Patent Owner further argues that the images in Invisalign were not acquired on a cellphone. *Id.* at 45 (citing Ex. 2054, 71:11–14, 134:10–135:11; Ex. 2030 ¶ 67); *see also id.* at 56. Further, Patent Owner argues that Invisalign does not suggest using images taken with a cellphone to assess aligner fit, nor does it suggest measuring the separation on an image to assess aligner fit. *Id.* at 45 (citing Ex. 2028 ¶ 88, 90, 150, 151; Ex. 2064 ¶ 4); *see also id.*

at 57. In short, Patent Owner argues "nothing in Kim or Invisalign suggests that the in-person techniques of Invisalign could be successfully replaced with computer-implemented analyses on patient-initiated photographs captured using a cellphone." *Id.* at 46 (citing Ex. 2028 ¶ 152).

Patent Owner also argues against the combination of Kim, Invisalign, and Salah. PO Resp. 48–49. Patent Owner further argues that, "[a]lthough Salah does include one image that shows a device positioned on the teeth, that device" is "not an aligner, which could have been readily removed." *Id.* at 47 (citing Ex. 1008, Fig. 11; Ex. 2028 ¶ 153; Ex. 2030 ¶¶ 83–84); *see also id.* at 54 (arguing that Salah does not teach an aligner and does not disclose analysis of photographs showing an aligner in a seated position in the patient's mouth). Moreover, Patent Owner asserts, "Salah does not describe any method for assessing the fit of any device relative to the teeth." *Id.* at 48. Patent Owner also argues that Petitioner's motivation to combine Kim with Salah is "based on the faulty premise that Kim 'teaches application of ***computer image analysis*** to dental images,'" but "Kim discloses no computer image analysis." *Id.* at 38 (emphasis omitted). Patent Owner also argues that Salah teaches away from the combination because it teaches that "low-contrast" area will produce low quality contours. *Id.* at 48–49.

Patent Owner's arguments incorrectly focus on whether any one of the references individually teaches assessing aligner fit using an image, rather than on Petitioner's proposed combination and reasons explaining why a person of ordinary skill in the art would have been motivated to do so.

Although we recognize that there is a difference between teeth alignment and aligner fit (*see* PO Resp. 43), the record supports a relationship between the two. For example, Kim describes "providing

remote teeth alignment services to remotely advise an appropriate step of a clear aligner using a smartphone of an orthodontic patient." Ex. 1005 ¶ 1; *see also id.* ¶ 66 (stating that the orthodontist "determines whether the clear aligner is normal and corresponds to an appropriate step"). Further, in discussing conventional clear-aligner treatment, Kim states "an orthodontic patient should regularly visit a dental clinic for a long period of time to allow a dentist to accurately check the state of his/her teeth and determine a currently appropriate step of a clear aligner." *Id.* ¶ 8; *see also* Ex. 2030 ¶¶ 46–49 (Dr. Kusnoto testifying that in a conventional in-person analysis, the orthodontist would first visually inspect the current state of dentition and compare that state to the anticipated dentition expected at that point in the treatment, and second assess the aligner treatment); Ex. 1001, 1:42–45 ("At regular intervals, the patient visits the orthodontist for a visual inspection, notably to check whether the movement of the teeth meets expectations and whether the aligner being worn by the patient is still suitable for the treatment."). The record also supports Petitioner's contentions that assessment of an aligner is naturally made when the aligner is worn on the teeth. *See* Reply 7. For example, Dr. Kusnoto testifies that, "[g]enerally, a patient was asked to try on their current aligner, and each aligner was visually and manually examined for large gaps between the aligner and the teeth." Ex. 2030 ¶ 49.

Patent Owner fails to persuasively address Petitioner's motivation to combine the references. *See* Pet. 17–23. Rather, Patent Owner's arguments attack the references individually and fail to persuasively address Petitioner's extensive reasoning. For example, Patent Owner argues that Kim does not suggest providing a new way to assess aligner fit from a

photograph, Invisalign does not indicate that images taken with a cellphone would be suitable for assessing aligner fit, Invisalign does not suggest measuring separation on an image to assess aligner fit, and neither reference suggests that Invisalign's in-person techniques could be successfully replaced with computer-implemented analyses on patient-initiated photographs captured using a cellphone. PO Resp. 43, 45. However, the motivation need not come from the references themselves, *see DyStar*, 464 F.3d at 1356, and these arguments do not directly address Petitioner's stated motivations to combine the references. *See* Pet. 17–23.

Patent Owner's arguments attempting to distinguish *Dystar* are not persuasive. PO Resp. 56–57. Patent Owner argues that *Dystar* does not address the situation where the prior art must be reconfigured for a new purpose, i.e., "a ***brand-new*** technique that is able, for the first time, to assess aligner fit from a patient-created cellphone image, an entirely new type of process, for an entirely new purpose." *Id.* at 57. However, as cited by Patent Owner, *Dystar* states that motivation can arise when the combination "create[s] a faster, cheaper, and more convenient . . . process." *Id.* at 56–57 (citing *Dystar*, 464 F.3d 1356 at 1358). Petitioner provides similar types of reasons for the combination here, citing Kim, that "employing such techniques would serve goals including enhancing accuracy, reducing the time and cost of treatment, and facilitating remote assessment." Pet. 20 (citing Ex. 1005 ¶¶ 8–10, 72). We find that Petitioner's reasoning provides persuasive support that a person of ordinary skill in the art "would have been motivated" to combine the references, and Patent Owner has not persuasively argued otherwise. *See InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014).

Moreover, Patent Owner's focus on Kim and Invisalign does not take into account Petitioner's reliance on Salah, which teaches "application of computer image analysis to dental images for orthodontic treatment purposes." Pet. 21 (citing Ex. 1008, code (57), 8:19–28, 13:24–28, 31:4–9). We do not find persuasive Patent Owner's arguments against the combination of Salah with Kim, for the reasons set forth by Petitioner. Reply 8–9. That is, we agree with Petitioner that Salah teaches application of computer image analysis to dental images for orthodontic treatment purposes, and that Kim also teaches analysis of images on computers. *Id.*; *see also* Pet. 21. As described above, Kim teaches taking a photograph of (at minimum) the patient's teeth on a smartphone, including guidance information on how to take that photograph, and transmitting that photograph to an orthodontist terminal for the orthodontist to check. *E.g.*, Ex. 1005 ¶¶ 55–58, 66. Similarly, Patent Owner's arguments that Salah "does not disclose analysis of photographs showing an aligner in the seated position in a patient's mouth" is not persuasive because again, Petitioner relies on the combination of Kim, Invisalign, and Salah. *See* PO Resp. 54. Likewise, Patent Owner's arguments that "Salah does not describe any method for assessing the fit of a device" are not persuasive because Petitioner does not rely on Salah alone to teach a method for assessing the fit of a device. *See* Pet. 24–26, 30, 34–35.

We are also not persuaded by Patent Owner's argument that Salah teaches away from the combination because it teaches that "low-contrast" area will produce low quality contours. PO Resp. 48–49, 54 (citing Ex. 2028 ¶¶ 154, 164; Ex. 2030 ¶ 84; Sur-reply 11–12. "A reference may be said to teach away when a person of ordinary skill, upon reading the

reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (Fed. Cir. 2009) (quoting *Ricoh Co., Ltd. v. Quanta Comput. Inc.*, 550 F.3d 1325, 1332 (Fed. Cir. 2008)). A reference does not teach away "if it merely expresses a general preference for an alternative invention but does not 'criticize, discredit, or otherwise discourage' investigation into the invention claimed." *Id.* (quoting *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004)).

Relying on testimony from Dr. Kusnoto and Dr. Mongan, Patent Owner argues that, because "aligners contours visually blend with the teeth," they "would not have provided the required strong contrast." PO Resp. 54 (citing Ex. 2030 ¶ 84; Ex. 2028 ¶ 164); *see also id.* at 48–49. We find persuasive Dr. Foroosh's testimony that "Salah does not teach that only maximal-contrast areas can produce useful contours." Ex. 1048 ¶ 16. There is no persuasive evidence in the record that aligners on teeth represent areas of unacceptably low contrast. *See* Reply 10–11 (citing Ex. 1051, 60:6–62:13; Ex. 1048 ¶¶ 13–14, 17). For example, Dr. Mongan testified that he "didn't see a need to run any tests to confirm something that I think was clear to me and was confirmed by . . . [Dr. Kusnoto]" and that an "image with an aligner in a service position would likely have a lower contrast than equivalent image without the aligner there." Ex. 1051, 60:6–14, 62:3–13.

Rather, Dr. Foroosh provided examples of edge detection in an image from Invisalign, as well as images that Dr. Kusnoto asserted would have been representative of aligner fit, using Canny edge detection and bilateral

filtering techniques,[13] which show sufficient contrast to detect edges. Ex. 1002 ¶ 83; Ex. 1048 ¶¶ 16–17. We find persuasive these examples provided by Dr. Foroosh, as to how the combined system would work, and in particular, that "the photographs of Kim, Salah, and Invisalign are ordinary camera images such as those acquired by a cellphone, [so] they show essentially the same thing a person would see when viewing teeth and an aligner in real life. The ability to see a gap and virtually assess it in real life naturally maps over the ability to detect and measure the same gap using computer vision techniques like Salah's various image processing software options for detecting objects and the contours defining the objects' edges ." Ex. 1002 ¶ 83; *see* Ex. 1048 ¶¶ 16–17.

Dr. Foroosh further testifies that "the edges of teeth and aligners, and the gap between them, can be resolved even with simple edge detection techniques," so "[a]pplying more advanced techniques, such as the remaining well-known image processing techniques taught by Salah, would have been expected to resolve the locations of each tooth's edge and the corresponding aligner edges with even greater precision and accuracy." Ex. 1048 ¶ 14. Accordingly, we are not persuaded that Salah teaches away from the combination.

Moreover, we disagree with Patent Owner that the purported benefits of Kim that Petitioner relies upon – enhancing accuracy, reducing the time and cost of treatment, and facilitating remote assessment – only stem from its use of teeth alignment information. PO Resp. 23, 37. Rather, these benefits are a direct result of Kim's ability to provide *remote* teeth alignment

[13] Salah discloses using is Canny edge detection and bilateral filtering techniques. Ex. 1008, 34:11–35:11.

services, where the condition of the patient may be *remotely* and accurately diagnosed, and the information about the accurate step of a clear aligner to be currently worn may be *remotely* provided. Ex. 1005 ¶ 10; *see also id.* ¶¶ 8–9. In fact, the problems described in Kim leading to remote teeth alignment services are nearly identical to the problems described in the '945 patent. Ex. 1005 ¶ 9 (describing that, if a patient is not able to frequently visit the dental clinic, or stops visiting the dental clinic, problems can occur such as increased time and cost); Ex. 1001, 1:53–58 (describing that the need to travel to the orthodontist's is a burden on the patient and can lead to additional expense). These disclosures support Petitioner's reasons to combine the references.

In short, we are persuaded by Petitioner's reasoning, which is supported by testimony from Dr. Foroosh, that the combination, for example, "appl[ies] known methods for orthodontic evaluation of aligner fit based upon the appearance of the aligner worn on the patient's teeth, as taught by Invisalign, in order to analyze a photo or video of the aligner worn by the patient, as taught by Kim[, Invisalign, and Salah],[14] predictably providing feedback regarding tooth-aligner separation to aid an orthodontist regarding whether the clear aligner is normal and corresponds to an appropriate step of treatment." *See* Pet. 20. We are further persuaded by Petitioner's reasoning that "it would have been obvious to measure the distance between the ends of the patient's teeth and the corresponding edges of the aligner, as taught by Invisalign, using the edge detection image

[14] As described above, Petitioner alternatively relies on Kim, Invisalign, and Salah to teach the photo of the aligner worn by the patient. *See* Pet. 17, 18, 21, 22, 25–28.

processing techniques taught by Salah to detect the contours of each object in an image depicting the patient wearing the aligner on the patient's teeth, and to thereby identify the size of the gap between the aligner and the teeth." *Id.* at 22. Petitioner provides extensive persuasive reasons for the combination, such as those as stated in Kim, of "enhancing accuracy, reducing the time and cost of treatment, and facilitating remote assessment," and Invisalign's teachings of "how to evaluate aligner fit." *Id.* at 17–23 (citing Ex. 1005 ¶¶ 8–10, 72).

f) Conclusion Independent Claim 1

Therefore, we determine that, on the complete record, Petitioner has shown by a preponderance of the evidence that independent claim 1 would have been obvious over the combination of Kim, Invisalign, and Salah.

5. Remaining Claims

Petitioner contends that the combination of Kim, Invisalign, and Salah teach the additional limitations of claims 2 and 4–6 and, in support, identifies certain passages and figures in the references and explains their significance with respect to the corresponding limitations. Pet. 34–46. Patent Owner does not separately challenge these contentions. *See generally* PO Resp. We have reviewed Petitioner's contentions, which we find persuasive and adopt as our own. Therefore, we determine that Petitioner has also shown those claims to be unpatentable by a preponderance of the evidence. *Id.*

IV. CONCLUSION[15]

For the foregoing reasons, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 1, 2, and 4–6 of the ’945 patent are unpatentable.

Claims	35 U.S.C. §	References/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 2, 4–6	103	Kim, Invisalign, Salah	1, 2, 4–6	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 2, and 4–6 of the ’945 patent have been shown to be unpatentable; and

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

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

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