

Filed on behalf of: Align Technology, Inc.

By: Matthew A. Argenti (margenti@wsgr.com)
Michael T. Rosato (mrosato@wsgr.com)
Patrick M. Medley (pmedley@wsgr.com)

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ALIGN TECHNOLOGY, INC.,
Petitioner,

v.

DENTAL MONITORING SAS,
Patent Owner.

Case No. IPR2024-00052
Patent No. 11,049,248

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

TABLE OF CONTENTS

	<u>Page</u>
I. Introduction.....	1
II. Level of Skill	2
III. Claim Construction.....	5
A. “tooth attribute”	5
B. “image attribute”	7
IV. Maninis is Prior Art	7
V. The Challenged Claims are Unpatentable as Obvious over Kim, Invisalign, Salah, and Maninis	8
A. PO Mischaracterizes the Petition’s Proposed Combination	9
B. POSAs had Reason to Combine Kim, Invisalign, Salah, and Maninis.....	12
1. PO’s Arguments Regarding Prior Art Interpretation Fail.....	12
2. PO Fails to Undercut Frey’s Relevance.....	17
C. The Prior Art Discloses the Claimed Analysis Step	19
1. PO’s Hindsight Arguments Fail.....	19
2. PO’s Motivation Arguments Fail.....	20
D. Claims 7-8 and 14.....	24
VI. Conclusion	26
VII. Certificate of Compliance.....	27
VIII. Appendix – Petitioner’s Updated Exhibit List	28

I. INTRODUCTION

The petition established that claims 1-2, 4, 7-8, and 13-16 (“Challenged Claims”) of the ’248 patent were obvious over the teachings of the prior art, as illustrated by Kim, Invisalign, Salah, and Maninis.

In response, Patent Owner (“PO”) attacks references individually instead of addressing the proposed combination as a whole and reinterprets or mischaracterizes the references to avoid their plain teachings. PO also proposes claim constructions and an alternative level of skill that do not materially affect patentability, raises unpersuasive challenges to prior art status, and misinterprets both the claims and the petition. As discussed below, none of PO’s arguments have merit.

PO does not dispute—indeed readily admits—that aligner fit assessment was a routine part of orthodontic aligner treatment long before the priority date. The prior art shows that analyzing separation between teeth and aligner was part of that assessment. Yet PO would have the Board conclude that it was inventive to perform this common assessment using a cellphone, despite the prior art of record undisputedly showing that it was also well-known to capture images on a

cellphone for remote analysis during dental treatment.¹ Under a proper assessment considering the teachings of the cited references as a whole, the challenged claims are irrefutably obvious.

II. LEVEL OF SKILL

PO proposes a different level of skill, but also asserts that its proposal is “not materially different.” POR, 3-5. Thus, PO’s proposal does not undermine the obviousness of the ’248 patent’s claims. EX1048, ¶¶5-9.

Nonetheless, PO proposes to dismiss Dr. Foroosh’s opinions because he did not consult a dental professional, suggesting that Dr. Foroosh misunderstood terms in the prior art. *Id.*; EX2030, ¶57. As an initial matter, PO’s definition does not require consultation with a dental professional and is instead satisfied by familiarity with, e.g., medical imaging. POR, 3. Dr. Foroosh has ample experience with medical and dental imaging. *E.g.*, EX1002, ¶¶6-9; EX1003, 14, 15, 21, 26, 32. Beyond that, PO made similar arguments in IPR2023-01369 that Dr. Foroosh lacked such understanding of a dental professional. Align responded by presenting

¹ Confirming the routine and conventional nature of the claimed subject matter, claim 14 of the ’248 patent was held ineligible in district court, and PO subsequently stipulated that this holding also applies to claim 1. EX1050.

testimony from a dental professional, Dr. Maureen Valley, demonstrating that PO's criticisms relating to Dr. Foroosh's understanding of dental concepts were unfounded. *See* IPR2023-01369, Paper 23 (citing Valley declaration as EX1035).

PO's dental expert, Dr. Kusnoto, confirmed the deficiency of PO's arguments, admitting that Dr. Foroosh correctly understood the terms used in each of the Kim, Invisalign, and Salah grounds references, as well as the Frey blog reference, taking issue only with the interpretation of an image in Invisalign. *See* EX1052, 43:23-44:12 (no terms misunderstood in Kim), 44:16-45:11 ("Are there any terms from the Invisalign reference, Exhibit 1006, that you believe Dr. Foroosh interpreted differently than a dental professional would have? ... I think with the exception of the illustration of poor fit, okay, for the most part he's getting the terminology correct."), 45:18-24 (regarding Salah, "I think for the most part he also get it correct"), 46:3-47:25 ("no disagreement in term of terminology" for Frey). Indeed, Dr. Kusnoto admitted that a person with qualifications like Dr. Foroosh, such as "a researcher, imaging scientist, who has work[ed] a lot in this field...can certainly know the relevant of the aligner's treatment." EX1052, 27:7-28:6; *see* EX1002, ¶6-13 (extensive research experience in imaging science,

including medical and dental imaging); EX1003; EX2048, 12:23-15:5, 16:19-10 (dental and medical imaging experience); EX2054, 32:20-33:3 (same).²

PO also asserts that the relevant field is “aligner treatment” (POR, 4), disagreeing with the ’248 patent’s own statement that the relevant field was “dental arch image analysis.” EX1001, 1:6-7; EX2054, 123:13-24. Dr. Kusnoto did not dispute this disclosure in his deposition. EX1052, 22:20-23:3. Dr. Kusnoto conceded that his opinion regarding relevant field was limited to the “clinical application” of what was claimed, and that “there are many other nuance here of the invention that not directly related to the aligners, even though at the end it relates to it.” EX1052, 21:4-22:18. By focusing on a context where the claimed invention may be applied, rather than on the “embodiments, function, and structure of the claimed invention,” PO distorts the relevant field to inject a seeming requirement of orthodontic expertise. *In re Bigio*, 381 F.3d 1320 (Fed. Cir. 2004); *see also In re Wood*, 599 F.2d 1032, 1036 (C.C.P.A. 1979) (refusing to credit

² Further undercutting PO’s position, PO’s non-dental expert, Dr. Mongan, conceded that he had formed his opinions regarding the Kim reference before even consulting Dr. Kusnoto. EX1051, 29:15-31:15.

Applicant’s assertions of relevant field contrary to “statements made in their own specification”).

Further, as discussed below in more detail, the errors PO purports to identify involving dental knowledge fail to withstand scrutiny. *Infra* §§V.B-C.

Accordingly, PO’s arguments attacking Dr. Foroosh’s expertise fail.

III. CLAIM CONSTRUCTION

PO proposes constructions for four terms. The construction of “deep learning device” does not distinguish over the combination proposed in the petition. PO does not argue that “shape of an orthodontic aligner” is limiting, and in any event makes no arguments relying on its construction. The claims are thus unpatentable regardless of PO’s constructions. *See Real Time 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.’” (alteration in original) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))). The constructions of tooth attribute and image attribute are addressed below.

A. “tooth attribute”

PO asserts that “tooth attribute” should be “construed as: attribute of a tooth,” rather than an “attribute related to a tooth,” and that attributes specifying the relative positions of the tooth or aligner cannot be tooth attributes. POR, 13-14.

PO points to a list of exemplary tooth attributes but ignores both the claims and the relevant parts of the specification. Claim 1 recites a “tooth attribute relating to a separation between” a tooth and aligner represented in an image, and the specification provides examples such as “maximal” or “mean separation along the free edge of the tooth.” EX1001, 28:48-55, claim 1. PO provides no explanation of how such separations can be tooth attributes under its construction, or how the *location* of a tooth’s free edge from which those attributes are derived would not also be a tooth attribute.

PO also argues that the location of a tooth’s edge cannot be a tooth attribute because an edge would “correspond to the outline of the claimed ‘analysis tooth zone.’” POR, 14. This fails for several reasons. First, the claim does not equate the analysis tooth zone with the tooth—the zone must merely partially contain a tooth. EX1001, claim 1 (“tooth attribute of an ‘analysis tooth zone’ representing, at least partially, a tooth on said analysis image”). Second, a zone’s outline is not the same thing as the zone—a zone is an area, an outline is a line. Third, even if the zone represented *only* the tooth, the relevant edge of the tooth (e.g., occlusal edge) would only coincide with one part of such an outline.

Finally, PO relies on Dr. Mongan’s testimony that an edge of a tooth cannot be a tooth attribute because it would be quantified with multiple numerical values. POR, 14 (citing EX2028, ¶¶146-47). However, the specification expressly includes

examples of an “attribute value” consisting of multiple numerical values. EX1001, 26:8-10 (image attribute value as list). Confronted with this disclosure in cross-examination, Dr. Mongan abandoned his construction, admitting his opinion “that the tooth attribute doesn’t represent a set of values may not have been correct.” EX1051, 112:3-20. Accordingly, PO’s attempt to narrow the term “tooth attribute” to exclude locations of tooth or aligner edges should be rejected.

B. “image attribute”

PO’s construction of “image attribute” is premised entirely on its mistaken construction of “tooth attribute.” PO’s rejection of an image attribute being a list of tooth attributes (such as locations of each tooth and/or each corresponding aligner part) is contrary to the specification, which plainly allows such a list to be an image attribute. See EX1001, 26:8-10. PO’s construction should thus be rejected.

IV. MANINIS IS PRIOR ART

The POR argues that Maninis is not prior art; however, PO’s arguments fail as a matter of law and fact.

PO concedes that Maninis was submitted to arXiv.org for publication on April 28, 2017, over two months before the ’248 patent’s earliest claimed priority date. POR, 40. Contrary to PO’s assertion, the evidence showing arXiv.org’s practice and express intent to publish is neither unauthenticated nor inadmissible hearsay. See Pet., 10; EX1022; EX1031; EX1032; EX1002, ¶¶53-59; *see also*

EX1023 (no modification after announcement); EX1026 (same); *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.”). And PO offers no rebuttal to Dr. Foroosh’s testimony confirming his personal knowledge of arXiv.org’s routine practice at the time. See EX1002, ¶¶53-59; cf. *Cooler Masters Co. v. Aavid Thermalloy LLC*, IPR2019-00337, Paper 49 at 30, 37-38 (testimony of routine practice of Japanese Patent Office sufficient to establish publication).

PO speculates that there may have been some delay in publication but offers no evidence suggesting any deviation from typical practice occurred. POR, 40-42. PO also 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, nor Dr. Foroosh’s testimony that metadata indicates a creation date consistent with publication according to arXiv’s policies. See EX1025; EX1031; EX1002, ¶57.

V. THE CHALLENGED CLAIMS ARE UNPATENTABLE AS OBVIOUS OVER KIM, INVISALIGN, SALAH, AND MANINIS

The POR addresses only independent claims 1 and 15 and dependent claims 7-8 and 14. As discussed below, PO fails to rebut the petition’s showing of obviousness for any challenged claim.

A. PO Mischaracterizes the Petition's Proposed Combination

PO characterizes the petition as having proposed a combination of Kim, Salah, Invisalign, and the “Maninis COB neural network.” POR, 42-46. PO then asserts that the COB neural network is incapable of being used to achieve the outcomes described in the petition, allegedly undermining motivation to combine and rendering the combination inoperable. *Id.* However, the petition materials never used the term “COB neural network.” As Dr. Mongan admits, he introduced the term to act as a synonym to a “COB” component discussed in part of Maninis. *See* EX1037, 104:11-19, 107:2-17; *see also id.*, 103:14-104:10 (admitting that although Dr. Foroosh does not use the term, Dr. Mongan equates Dr. Foroosh’s reference to “Maninis” with what Dr. Mongan calls “Maninis’s COB neural network”); EX1051, 64:13-65:23 (same interpretation as in IPR2023-01369); EX1048, ¶¶10-12. Indeed, Dr. Mongan admits that his term “COB neural network” *excludes* the disclosure in Maninis of “coupling COB with different networks or different pipelines that are not themselves COB.” EX1037, 118:13-119:11; *see also* POR, 32-38 (interpreting “COB neural network” to exclude Maninis’s teaching (EX1007, 11-13) to use COB as an element of an object detection pipeline).

This is not a trivial distinction, as the petition expressly and repeatedly relied on the teachings of Maninis that PO excludes from consideration. The petition

repeatedly cites to that section of Maninis (section 6, pages 11-13) when explaining that Maninis uses neural networks not only to detect contours, but also uses the regions identified by those contours to classify objects. *See, e.g.*, Pet., 10, 25, 37-38, 45, 53 (each citing Maninis’s object-classification section); EX1002, ¶¶59, 75, 77, 101-02. Pointing to techniques Maninis discloses to identify and classify objects, the petition argued that “a POSA would have been motivated to use those techniques to identify teeth and aligners depicted in orthodontic images by detecting their contours and identifying the objects found within each contour,” including identifying “teeth, aligners, and the gaps between them.” Pet., 38; EX1002, ¶102; EX1048, ¶¶12-14.

By excluding those teachings from consideration, PO leaves the petition’s actual argument unaddressed, attacking instead a strawman. This defect pervades the POR, as it repeatedly advances arguments regarding what “Maninis’s COB neural network” can or cannot do, rather than addressing the teachings of Maninis relied on by the petition. *E.g.*, POR, 1, 27, 29-32, 38-41, 49. Because it does not address the petition ground, PO’s argument fails. EX1048, ¶¶14-17.

PO also suggests that Maninis’s teachings regarding object classification must be ignored because Maninis refers to known techniques first “described by *different* authors in *different* papers.” POR 44-45 (emphasis original). Yet this does not negate that Maninis expressly describes using those prior art techniques.

See also Gen. Elec. Co. v. Raytheon Techs., 983 F. 3d 1334, 1352 (Fed. Cir. 2020) (improper to “dissect[] prior art references into collections of individual elements, requiring a party showing obviousness to re-do the work already done in the prior art reference”). Indeed, Maninis provides more detail regarding object classification than the ’248 patent. *Cf. SRI Int’l, Inc. v. Internet Sec’y Sys., Inc.*, 511 F.3d 1186, 1194 (Fed. Cir. 2008) (lower enablement standard for prior art met where disclosure in specification no better). *Compare* EX1007, 11-12 (detailed explanation of use of various algorithms, including neural networks, for semantic boundaries and object classification), *with* EX1001, 16:26-63 (listing names of “networks specializing in the location and detection of objects in an image” without further details). PO cites no authority requiring submission of earlier references introducing the techniques taught by Maninis; indeed, any such requirement would lead to an endless recursion of cited references being submitted.

While PO’s arguments can be rejected as falsely premised on excluding Maninis’s object classification teachings, PO also attacks Dr. Foroosh’s credibility by arguing he did not understand Maninis. *See* POR, 40-41. In the cited deposition testimony, he was asked whether the “the results reported in Table 3” of Maninis included “object recognition,” and specifically identifying “contours or boundaries

as associated with a particular object.” EX2048, 211:20-212:15.³ As he correctly answered, they do—that section of Maninis discloses performing “object boundary detection” for which “detections are focused on the 20 object classes,” and resulting boundaries of detected objects are shown in the last row of Fig. 10. *See* EX1007, 7-9, Fig. 10; EX2048, 131:22-132:11 (agreeing that in Fig. 10, two sheep have been detected as two objects). Thus, Dr. Foroosh correctly testified that the boundaries were associated with a particular object—even if the assignment of the object’s label occurs in the subsequent step of analysis. *See* EX1007, 9-12 (using COB as object proposals to generate semantic boundaries).

B. POSAs had Reason to Combine Kim, Invisalign, Salah, and Maninis

PO raises several arguments against POSAs’ rationale to combine Kim, Invisalign, Salah, and Maninis, but each fails, as discussed below.

1. PO’s Arguments Regarding Prior Art Interpretation Fail

Rather than address the motivation presented in the petition (*e.g.*, Pet., 20-27), the POR attacks caricatures of those arguments and Dr. Foroosh’s understanding of terms taught in Kim, Invisalign, and Salah. POR, 16-30, 47-56. First, PO misconstrues the references themselves. Second, PO mischaracterizes the

³ A version of this transcript with errata is provided as EX1049.

petition's arguments. Third, PO baselessly attacks Dr. Foroosh's focus on aspects relevant to remote assessment (the purpose of the proposed combination), rather than steps that would require in-office treatment. And finally, PO advances mistaken and unsupported attacks on the feasibility of the combination. These arguments neither undermine the rationale advanced in the petition nor Dr. Foroosh's testimony.

To begin with, PO misconstrues Kim. PO argues that there is no motivation to combine Kim with Invisalign because, in PO's view, Kim's teaching to obtain and check "a photo or a video of the clear aligner ***currently worn by the orthodontic patient***" does not disclose an image of the clear aligner on the patient's teeth. EX1005, ¶66; POR, 47. This contradicts Kim's plain statement, based only on *ipse dixit* from PO's experts. Despite PO's arguments, Kim does not limit the dentist's assessment of the image to whether the aligner is damaged or worn out of sequence. POR, 20; EX2030, ¶74. Moreover, the other prior art of record, including Invisalign, confirms that assessments of whether an aligner is (in Petitioner's words) "in working condition" are naturally made when the aligner is worn on the teeth. POR, 20; EX1006. In contrast, PO points to no evidence supporting the assertion that photos of aligners on their own provided dental practitioners with meaningful information during treatment.

Nor can PO demonstrate that aligner fit is not a relevant consideration in Kim. Indeed, while Dr. Kusnoto, to support this conclusion, emphasizes that “[a]ssessing aligner fit is different from assessing teeth alignment” (EX2030, ¶76), he admitted that these two assessments were usually done together, with aligner fit being routinely assessed to track progress. EX2030, ¶¶46-48; EX1052, 29:10-30:15, 31:16-32:16. Likewise, PO’s assertion that dental practitioner input is essential to understanding Kim’s disclosure doesn’t hold water: Dr. Mongan admitted reaching his conclusions regarding this teaching in Kim without even consulting Dr. Kusnoto. *See* EX1051, 29:15-31:15.

In any event, the case advanced in the petition does not depend solely on Kim’s disclosure of capturing images of aligners in a service position. PO ignores the petition’s argument that, regardless of whether Kim is interpreted to expressly disclose this, doing so would have been “readily apparent in view of Invisalign’s teachings” showing how properties useful in assessing aligner fit are visible in images of teeth with aligners in a service position, to apply known evaluation methods for aligner fit to analyze a photo or video of the aligner worn by the patient. Pet., 20-22.

PO further misconstrues the motivation to combine Kim with Salah. PO asserts that the petition presented **no** reason to combine Kim and Salah other than an assertion that Kim teaches computer image analysis, which PO contends is

inaccurate. POR, 48. This is wrong for multiple reasons. First, PO has selectively omitted the full statement in the petition materials, which was “Like Kim, Salah teaches application of computer image analysis to dental images for orthodontic treatment purposes.” Pet., 24; EX1002, ¶74. It is undisputed that Salah teaches such computer image analysis. Kim also teaches analysis of images on computers: a “photo or video” is transmitted to an “orthodontist terminal” (computer, *see* EX1005, Fig. 1) where a doctor can analyze it (“the orthodontist checks [the] photo or video”). EX1005, ¶66. While Kim does not detail all methods for such analysis, the petition explained that POSAs would have known how to perform assessments suggested by Kim and Invisalign using image processing software such as that taught by Salah for edge detection. Pet., 23-24; EX1002, ¶¶72-74. PO fails to address, much less rebut, this rationale.

PO also fails in its attempt to attack Dr. Foroosh’s understanding of the references. PO asserts that Dr. Foroosh misunderstood various dental teachings of Kim, Invisalign, and Salah, but as noted above, Dr. Kusnoto conceded that Dr. Foroosh correctly understood the terms used in each of these references. *See* EX1052, 43:23-47:25; *supra* §II. For example, PO relies on Dr. Kusnoto’s testimony that Dr. Foroosh misunderstood Salah’s teaching to acquire cellphone images of teeth, including teeth fitted with orthodontic appliances. EX2030, ¶83 (quoting a sentence in EX1002, ¶89); *see* POR, 28-29, 54-55. But in cross-

examination, Dr. Kusnoto admitted that Dr. Foroosh was correct in his statement. 54:20-55:19 (“Q: And the sentence reads ‘Salah similarly teaches acquiring dental images with a cellphone, including of teeth fitted with orthodontic appliances.’ That sentence is accurate, correct? A: Yes.”). PO also highlights various terms in Invisalign that Dr. Foroosh allegedly ought to have considered, but PO does not argue that any of these terms would have a bearing on the proposed combination. POR, 49-51.

PO’s attack on Dr. Foroosh’s focus on aspects relevant to image analysis reflects a broader problem with PO’s case: it ignores the fact that the combination is directed to remote image analysis of dental images. By suggesting Dr. Foroosh ought to have focused on physical in-office treatment actions (POR, 50), rather than aspects quantifiable in images, PO ignores the perspective of a POSA looking to improve and implement **remote treatment** techniques like those taught in Kim and Salah by focusing on measurements that can be performed remotely on images, such as Invisalign’s aligner fit measurements.

PO also argues (POR, 50-53) that the example used by Invisalign to show poor aligner fit was not representative, and that, according to Dr. Kusnoto, in more representative images “the [tooth-aligner] separation cannot be assessed with precision.” EX2030, ¶¶61-63. First, this argument seeks to rewrite the Invisalign reference by ignoring its plain illustration of such an assessable separation. Further,

PO's assertion is unsupported: Dr. Kusnoto provides no analysis of any of the images he calls more representative. *See id.* It is also wrong. As Dr. Foroosh explains and shows, detecting relevant edges in those images would have been straightforward, even with techniques much less advanced than the deep learning techniques taught by Salah and Maninis. EX1048, ¶¶18-21.

PO lastly asserts that images of aligners worn on teeth would be low-contrast, and that Salah teaches away from such imaging. POR, 55-56. PO is wrong. Salah's disclosure merely observes that higher-contrast areas can produce higher-contrast contours, not that maximal contrast is essential. *See* EX1008, 60:17-61:3; EX1048, ¶¶22-24. This falls far short of a teaching away. Under cross-examination, Dr. Mongan conceded he had done no tests or analysis to support his claim that aligners would have unacceptably low contrast, and he admitted that he merely meant they would have lower contrast than teeth alone. EX1051, 60:6-14, 62:3-13. Indeed, Dr. Foroosh confirms and demonstrates that images of aligners worn on teeth have sufficient contrast to reliably detect edges, and Maninis teaches how to use differences in contour strength to hierarchically subdivide images. *See* EX1002, ¶¶102-03; EX1048, ¶¶20-21, 24; EX1007, Abstract, 3-5.

2. PO Fails to Undercut Frey's Relevance

PO argues that the Frey exhibit should be disregarded as non-prior art under 35 U.S.C. § 102(b)(1). POR, 56-58. This argument fails.

First, Frey is not a grounds reference. References are relevant to show many aspects, including level of skill and motivations of POSAs regardless of their prior art status. *See, e.g., Yeda Res. v. Mylan Pharms., Inc.*, 906 F.3d 1031, 1041-42 (Fed. Cir. 2018); Pet., 23-24 (Frey confirms motivation).

PO's prior-art argument also fails on its own terms. Section 102(b)(1) allows elimination of prior art disclosures by another if it was "obtained...directly or indirectly from the inventor[s]" or if the inventors had previously disclosed the subject matter publicly. PO asserts that Dr. Frey had met with unspecified parties from Dental Monitoring and seen unspecified Dental Monitoring marketing materials. POR, 56-57. Dental Monitoring is not an inventor. PO presents no evidence regarding whether any of these unspecified disclosures were obtained directly or indirectly from the inventors of the '248 patent. PO argues the '248 patent "confirms" the exception applies (POR, 57), but PO offers no inventor testimony or other evidence as to which, if any, claim elements derived from the inventors as opposed to other sources or being well known in the art. Thus, PO fails to establish the applicability of either 102(b)(1) exception to the Frey publication.

Further, PO's claims are undermined by its own evidence. In the earlier blog post PO points to, Dr. Frey describes Dental Monitoring's photo monitoring plan, which includes remote patient-acquired intra-oral images, with Invisalign patients

taking photos “with aligners in place.” EX2053, 6. Far from identifying these offerings as new, Dr. Frey states regarding Dental Monitoring’s various photo monitoring plans that “[w]e routinely do this for international and out-of-state patients already.” EX2053, 7.

C. The Prior Art Discloses the Claimed Analysis Step

PO advances several arguments against the proposed combination of references, but each argument fails.

1. PO’s Hindsight Arguments Fail

PO accuses Dr. Foroosh of hindsight because he opined on the obviousness of deep learning as claimed in the ’248 patent, but not for the ’945 patent, which does not claim deep learning. POR, 58-60. This argument is implausible on its face, as PO itself proposed different levels of skill for the different patents, with the ’248 requiring familiarity with “machine learning or artificial intelligence” and the ’945 substituting familiarity with “image analysis techniques or algorithms.” POR, 3; IPR2024-00110, Paper 16 at 3-4.

Moreover, PO mischaracterizes the testimony. Dr. Foroosh made it clear that he was not guided by whether the claims recited deep learning; rather, similar motivations would lead POSAs, at their preference, to either use deep learning (rendering the ’248 patent obvious) or use the other image processing techniques taught by Salah (rendering the ’945 patent obvious). *See* EX2054, 158:8-159:1 (“I

mean I don't care whether they're in the claims or not...." A POSA could say "I don't want to do deep learning. I want to go a different route. I'm going to use other disclosures of image analysis, methods of Salah....[T]here is motivation for that, and...that combination would also work."); *see also id.*, 159:2-160:1. Salah clearly teaches deep learning and other image processing algorithms are options to determine contours and other discriminant information, including detecting objects. EX1008, 34:5-36:14. Motivations to use known options are non-exclusive, and PO cannot impart patentability to obvious claims by reciting them individually.

2. PO's Motivation Arguments Fail

PO's arguments against Maninis's benefits fall flat. POR, 60-63.

PO suggests (POR, 60) that Salah's identification of deep learning as a non-preferred option would undermine motivation, but this argument is legally unsound. *E.g., In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004) (no requirement that combination be preferred); *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994) (combination obvious despite being described as inferior).

PO also quotes Salah as saying its analysis is "best carried out...on the patient's own device," allegedly discouraging POSAs from using deep learning due to resource constraints. POR, 60. PO omits a citation for this quote, as it has been edited to misrepresent Salah. *See also id.*, 27 (providing incorrect citation to

Frey (EX1009) for similarly edited quotation). In fact, Salah teaches its techniques are “best carried out either on the patient’s own device, preferably using the device used in step b), or with an app at a dental professional’s office, or with a dedicated third-party server.” EX1008, 33:6-8. These omitted options align with Kim’s teaching of analysis on an orthodontist’s computer (EX1005, ¶66), which PO does not contend would be subject to any resource constraints.

Regarding Maninis, PO suggests that a POSA would not have looked to the reference because “it contains no reference to the field of dental imaging or analysis.” POR, 30; *see id.*, 60. Dr. Mongan admitted that his analysis regarding Maninis is based on his assumption that “a POSA would not have known of Maninis” because it is an academic paper and does not teach analyzing “dental or orthodontic images.” EX2028, ¶196; *see* EX1051, 99:25-100:18 (discounting Maninis because he saw “no reason for it to stand out to a POSA” and secondarily because “it’s an academic paper”), 101:14-103:9. This improperly narrows the scope of relevant prior art. Dr. Mongan asserted there was “no connection that would bring [Maninis] to the attention of someone working from Kim, Invisalign, and Salah” because Maninis did not “mention[] dental applications,” despite Salah teaching using deep learning for the applications (such as contour detection) taught by Maninis. EX1051, 97:25-98:12. By presuming that “a POSA would not have known of Maninis” (EX2028, ¶196), Dr. Mongan has failed to properly determine

“the scope and content of the prior art.” *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966).

PO further speculates (POR, 61-62) that the improvements realized in Maninis might not provide similar improvements when performing a similar function in the proposed combination. But Maninis would be providing functions taught in Salah for contour and object detection, and PO gives no reason that the improvements in these functions would not carry over to the application in the proposed combination or that a POSA would not, at minimum, be motivated to achieve such improvements with a reasonable expectation of success. Pet., 24-26, 36-41; *see also* EX1007, 11-12, Tables 4-7 (improved performance when using COB in object classification pipeline).

PO also suggests training costs would have deterred POSAs from using deep learning as taught in Maninis. POR, 55-56. These economic arguments cannot rebut the petition’s showing of obviousness, as they raise no issue of technological feasibility. *See Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1013 (Fed. Cir. 1983).

The training cost arguments also fail on their own terms, as PO makes only vague allegations of high costs, exaggerates even those, and fail to consider known techniques to reduce labeling costs.

First, PO's cost estimates are vague. Dr. Mongan vaguely asserts that a POSA "would have recognized the significant time and cost associated with creating such a learning base," but he does not say they would have been deterred. EX2028, ¶140. And Dr. Kusnoto likewise offers no opinion that a POSA would have been deterred by costs of preparing a learning base. *See* EX2030, ¶¶88-89; EX1048, ¶¶25-26.

Second, even those costs PO attempts to quantify are exaggerated. PO cites Dr. Foroosh as stating that the proposed combination in this case would include 10,000 images; however, his actual conclusion was that "more than 1000 images" would be used, and in deposition he answered "it could be less or more" than 10000 images, but he "cannot put some hypothetical number on that" and did not in his declaration. EX1002, ¶100; EX2054, 154:3-14. Indeed, no claim requires 10,000 images, and only claims 7 and 8 require 1,000. Dr. Kusnoto not only misquotes Dr. Foroosh to arrive at this same number, but also discusses costs of image anonymization that include costs such as image redaction that he has admitted are unnecessary for images of patients' mouths. *See* EX2030, ¶¶87-88; EX1038, 86:24-90:23, 88:16-21, 81:20-25; EX1048, ¶¶30-31.

Finally, to the extent costs were a concern, various cost-saving measures were well-known to POSAs. EX1048, ¶¶27-29 (citing EX1033, 1-2; EX1043, 2-6; EX1044, Abstract, 3-4; EX1047, 373-74, 381-83). PO ignores any such measures.

The POR also identifies nothing in the '248 patent teaching improved cost-savings relative to the state of the art. At bottom, PO fails to justify why costs would deter POSAs from arriving at the claimed invention.

D. Claims 7-8 and 14

PO argues regarding claims 7 and 14 that an image with labels indicating the locations of the edges of each tooth, or each corresponding edge of the aligner, the gaps between the teeth and the corresponding edges of the aligner, do not meet the requirement that a “tooth attribute value is assigned” to historical tooth zones representing the teeth. POR, 63-66. For claim 8, PO argues that an image labeled with a set of labels identifying each specific tooth or aligner edge, or a tooth with labels indicating whether or not a tooth-aligner gap exists in the image, does not comprise an attribute value for an image attribute. POR, 66-70.

PO's arguments regarding tooth attribute values are premised on its misinterpretation of the recited “tooth attribute” values. *Supra* §III. Claims 7 and 14 recite a “tooth attribute relating to a separation between the tooth represented by the historical tooth zone considered, and the aligner represented.” As explained in the petition, a tooth zone can be a “a region containing a tooth alone or a region containing a tooth and an aligner surface separated by a gap.” Pet., 40-41. PO ignores this when equating edges of teeth or aligners with the outline of zones. Not only are the edges of teeth and aligners in such a region tooth attributes related to

the tooth-aligner separation, but the petition also noted that a “labeled gap is literally a label of the separation” recited. Pet., 46-47. Furthermore, PO ignores the petition’s explanation that the images would include pixelwise labels indicating “the pixels corresponding to teeth, the pixels corresponding to aligners, and the pixels corresponding to the gap between the two” (Pet., 46-47), asserting instead that the images would merely include labels on the contours between these pixels. See POR, 64.

PO’s arguments regarding claim 8 (POR, 66-70) are premised on its misunderstanding of the tooth attributes discussed for claims 7 and 14. A labeled set of tooth attribute values is an image attribute value. *Supra*, §III.B; EX1001, 26:8-10. So images labeled with the tooth attribute values for each tooth represented also comprise an image attribute value as recited. Pet., 51-52. Further, the labeling of whether a gap is present in the image indicates a value for an “image attribute relating to a separation” between teeth and aligner, as an image with a gap (separation) will be labeled with a value indicating that the gap is present. *Id.* PO argues that including such labels on pixels should not count, because “the device would neither be trained on an attribute relating to the whole image, nor output a value relating to the whole image.” POR, 68. This is not a claim limitation. Claim 8 requires that images for training comprise at least one image attribute value—which the proposed images do—and that the device

determine a “probability relating to said image attribute value.” As the petition explained, Maninis determines probabilities to “detect boundaries between regions and enable identification of objects visible in those regions.” Pet., 53. These probabilities relate to the image attribute value as explained in the petition. *Id.*; see also EX1002, ¶¶139-44.

VI. CONCLUSION

For the reasons set forth above, claims 1-2, 4, 7-8, and 13-16 of the ’248 patent are unpatentable and should be canceled.

Respectfully submitted,

Dated: October 4, 2024

/ Matthew A. Argenti /
Matthew A. Argenti, Lead Counsel
Reg. No. 61,836

VII. CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. §42.24(d), the undersigned certifies that this Reply complies with the type-volume limitation of 37 C.F.R. §42.24(c). The word count application of the word processing program used to prepare this Reply indicates that the Reply contains 5,593 words, excluding the parts of the brief exempted by 37 C.F.R. §42.24(c).

Dated: October 4, 2024

/ Matthew A. Argenti /
Matthew A. Argenti, Lead Counsel
Reg. No. 61,836

VIII. APPENDIX – PETITIONER’S UPDATED EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 11,049,248 to Salah et al.
1002	Declaration of Dr. Hassan Foroosh
1003	Curriculum Vitae of Hassan Foroosh, Ph.D.
1004	U.S. Patent Application No. 16/030,137 File History
1005	U.S. Patent Pub. No. 2017/0281313 to Taewon Kim
1006	Align Technology, Invisalign Clinical Monitoring Guide (2003) (archived September 26, 2003, at http://web.archive.org/web/20030926024959/http://www.invisaligncec.com:80/consistent/pdfs/ICMG_Final.pdf)
1007	Maninis et al., “Convolutional Oriented Boundaries: From Image Segmentation to High-Level Tasks,” <i>arXiv.org</i> (Apr. 28, 2017)
1008	Translation of PCT Pub. No. WO 2016066651 to Salah et al.
1009	Scott Frey, Blog – The Ortho Cosmos, (archived May 4, 2017 at http://web.archive.org/web/20170504155213/http://theorthocosmos.com:80/blog)
1010	Declaration of Nathaniel E. Frank-Wright
1011	Declaration of Mitra Derakhshan
1012	PCT Pub. No. WO 2016066651 to Salah et al.
1013	Ben Weiss, “Fast median and bilateral filtering,” ACM SIGGRAPH 2006 Papers (2006)
1014	Intentionally Left Blank

1015	Krizhevsky et al., “ImageNet Classification with Deep Convolutional Neural Networks,” <i>Advances in Neural Information Processing Systems</i> 25 (2012)
1016	Patrick Cavanaugh, “Visual Cognition” <i>Vision Research</i> 51 (2011)
1017	Prasad et al., “Learning Class-specific Edges for Object Detection and Segmentation,” <i>Computer Vision, Graphics and Image Processing: 5th Indian Conference, ICVGIP 2006</i> (2006)
1018	Intentionally Left Blank
1019	Intentionally Left Blank
1020	United States District Courts — National Judicial Caseload Profile, available at https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distprofile0331.2023.pdf (March 2023)
1021	Maninis et al., “Convolutional Oriented Boundaries: From Image Segmentation to High-Level Tasks,” <i>arXiv.org</i> (Jan. 17, 2017)
1022	<i>arXiv.org Submission Help Page</i> , https://arxiv.org/help/submit (as archived May 3, 2017, at https://web.archive.org/web/20170503071322/https://arxiv.org/help/submit)
1023	<i>arXiv.org Article Replacement Help Page</i> , https://arxiv.org/help/replace (as archived July 18, 2017, at https://web.archive.org/web/20170718173822/https://arxiv.org/help/replace)
1024	<i>COB - Convolutional Oriented Boundaries</i> , http://people.ee.ethz.ch/~cvlsegmentation/cob/ (as archived May 3, 2017, at http://web.archive.org/web/20170503233424/http://people.ee.ethz.ch/~cvlsegmentation/cob/)
1025	<i>arXiv.org Author Search Page for Luc van Gool</i> , https://arxiv.org/find/cs/1/au:+Gool_L/0/1/0/all/0/1 (as archived July 8, 2017, at https://web.archive.org/web/20170708002617/https://arxiv.org/find/cs/1/au:+Gool_L/0/1/0/all/0/1)

1026	<i>arXiv.org Article Replacement Help Page</i> , https://arxiv.org/help/replace (as archived September 8, 2016, at https://web.archive.org/web/20160908205209/https://arxiv.org/help/replace)
1027	Joint Stipulation and Proposed Order (Dkt. No. 73), <i>Dental Monitoring SAS v. Align Technology, Inc.</i> , No. 3-22-cv-07335-WHA (N.D. Cal.)
1028	Align Technology, Inc.’s. Stipulation re: Challenged Claims in IPR2024-00052 (Dkt. No. 117), <i>Dental Monitoring SAS v. Align Technology, Inc.</i> , No. 3-22-cv-07335-WHA (N.D. Cal.)
1029	Second Declaration of Dr. Hassan Foroosh (Served, not filed)
1030	Second Affidavit of Nathaniel E Frank-White (Served, not filed)
1031	Third Affidavit of Nathaniel E Frank-White
1032	Fourth Affidavit of Nathaniel E Frank-White
1033	Rajkomar et al., “High-Throughput Classification of Radiographs Using Deep Convolutional Neural Networks,” <i>J. Digital Imaging</i> , 30, 95-101 (Feb. 2017)
1034-36	Intentionally Left Blank
1037	Deposition Transcript of Dr. John Mongan (July 23, 2024)
1038	Deposition Transcript of Dr. Budi Kusnoto (Aug. 9, 2024)
1039-42	Intentionally Left Blank
1043	Dong-Hyun Lee, “Pseudo-Label : The Simple and Efficient Semi-Supervised Learning Method for Deep Neural Networks,” <i>ResearchGate</i> (https://www.researchgate.net/profile/Dong-Hyun-Lee/publication/280581078_Pseudo-Label_The_Simple_and_Efficient_Semi-Supervised_Learning_Method_for_Deep_Neural_Networks/links/55bc4ada08ae092e9660b776/Pseudo-Label-The-Simple-and-

	Efficient-Semi-Supervised-Learning-Method-for-Deep-Neural-Networks.pdf) (Aug. 1, 2015)
1044	Patrini et al., “Making Deep Neural Networks Robust to Label Noise: a Loss Correction Approach,” <i>arXiv.org</i> (https://arxiv.org/pdf/1609.03683v2) (Mar. 22, 2017)
1045-46	Intentionally Left Blank
1047	Schnitman et al., “Inducing Semantic Segmentation from an Example,” <i>Computer Vision—ACCV 2006</i> (2006)
1048	Reply Declaration of Dr. Hassan Foroosh
1049	Intentionally Left Blank
1050	Order Granting Final Judgment Pursuant to Joint Stipulation, Dental Monitoring SAS v. Align Technology, Inc., Case No. 3-22-cv-07335 (N.D. Cal., Aug. 8, 2024)
1051	Deposition Transcript of Dr. John Mongan (Aug. 28, 2024)
1052	Deposition Transcript of Dr. Budi Kusnoto (Sep. 6, 2024)

CERTIFICATE OF SERVICE

The undersigned certifies that the foregoing Petitioner's Reply to Patent Owner's Response and Exhibits 1031-1033, 1037-1038, 1043-1044, 1047-1048, and 1050-1052 were served on October 4, 2024, at the following electronic service addresses:

Charlotte Jacobsen
Josh Krevitt
Jaysen S. Chung
Andrew Blythe
Allyson E. Parks
Gibson, Dunn & Crutcher LLP
cjacobsen@gibsondunn.com
JKrevitt@gibsondunn.com
JSChung@gibsondunn.com
ABlythe@gibsondunn.com
AParks@gibsondunn.com

Dated: October 4, 2024

/ Matthew A. Argenti /
Matthew A. Argenti, Lead Counsel
Reg. No. 61,836