

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. IPR2023-01369

U.S. Patent No. 10,755,409

PATENT OWNER'S SUR-REPLY

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PATENT OWNER'S UPDATED EXHIBIT LIST

Exhibit Number	Description
2001	Declaration of Joshua A. Krevitt in Support of Patent Owner's Motion for <i>Pro Hac Vice</i> Admission
2002	Declaration of John Mongan, dated December 7, 2023
2003	Curriculum Vitae of John T. Mongan, MD, PhD
2004	Redline of Carrier against the Carrier Provisional
2005	GeForce GTX TITAN X Specifications
2006	Andri et al., <i>YodaNN: An Architecture for Ultralow Power Binary-Weight CNN Acceleration</i>
2007	Shrestha and Dang, <i>Deep Learning-Based Real-Time Auto Classification of Smartphone Measured Bridge Vibration Data</i>
2008	<i>Dental Monitoring SAS v. Align Technology, Inc.</i> , Case No. 22-cv-07335, Dkt. No. 59, Order Denying Second Motion to Dismiss (N.D. Cal., July 19, 2023)
2009	<i>Dental Monitoring SAS v. Align Technology, Inc.</i> , Case No. 22-cv-07335, Defendant's Patent Local Rule 3-3 and 3-4 Initial Invalidity Contentions and Disclosures (N.D. Cal., Sept. 11, 2023)
2010	<i>Dental Monitoring SAS v. Align Technology, Inc.</i> , Case No. 22-cv-07335, Dkt. No. 86, Align's Notice of Pending Inter Partes Review Petition (N.D. Cal., Oct. 5, 2023)
2011	<i>Dental Monitoring SAS v. Align Technology, Inc.</i> , Case No. 22-cv-07335, Dkt. No. 92, Order Re Updated Patent Showdown Deadlines (N.D. Cal., Oct. 26, 2023)
2012	<i>Dental Monitoring SAS v. Align Technology, Inc.</i> , Case No. 22-cv-07335, Dkt. No. 56, Patent Showdown Scheduling Order (N.D. Cal., July 14, 2023)

Exhibit Number	Description
2013	<i>Docket Navigator Report on Time to Trial in cases before Judge Alsup (Excluding Outliers)</i>
2014	[Reserved]
2015	[Reserved]
2016	[Reserved]
2017	[Reserved]
2018	[Reserved]
2019	[Reserved]
2020	The PASCAL VOC 2012 Segmentation dataset (July 13, 2017 version available at https://web.archive.org/web/20170713000522/http://host.robots.ox.ac.uk/pascal/VOC/voc2012/#data)
2021	[Reserved]
2022	[Reserved]
2023	[Reserved]
2024	[Reserved]
2025	[Reserved]
2026	[Reserved]
2027	[Reserved]
2028	Expert Declaration of Dr. John T. Mongan, M.D., Ph.D., in support of Dental Monitoring's Patent Owner's Response
2029	Updated Curriculum Vitae of John T. Mongan, M.D., Ph.D.

Exhibit Number	Description
2030	Expert Declaration of Dr. Budi Kusnoto, D.D.S., M.S., in support of Dental Monitoring's Patent Owner's Response
2031	Curriculum Vitae of Budi Kusnoto, D.D.S., M.S.
2032	American Association of Orthodontists, <i>2023 Economics of Orthodontics Analysis Reporting on 2022 Practice & Patient Statistics: Member Report</i> (Aug. 28, 2023)
2033	American Board of Orthodontists, <i>Ideal Photographs and Radiographs</i>
2034	Institute of Medical Illustrators, <i>IMI National Guidelines: Orthodontic Photography</i> (Feb. 2008).
2035	Canon, <i>Canon Dental Photography Guide</i> (2015)
2036	Excerpts from Transcript of Deposition of Dr. Maureen A. Valley in IPR2019-00132 (Dec. 18, 2019)
2037	Excerpts from Declaration of Dr. Maureen A. Valley in <i>Dental Monitoring SAS v. Align Technology, Inc.</i> , 3:22-cv-07335-WHA (Dkt. 104-5)
2038	R. Kaplan, <i>Standardization for Serial Intraoral Photography</i> , The C.V. Mosby Co. 431 (1979)
2039	J. Liu et al., <i>Machine Learning in Orthodontics: Challenges and Perspectives</i> , 30(10) Adv. Clin. Exp. Med. 1065 (2021)
2040	S. Samawi, <i>Clinical Digital Photography in Orthodontics: Professional Photographic Records in Daily Practice</i> , 18 Jordan Dental J. 20 (2012)
2041	O. Russakovsky et al. <i>ImageNet Large Scale Visual Recognition Challenge</i> , https://arxiv.org/pdf/1409.0575
2042	S. Xie & Z. Tu, <i>Holistically-Nested Edge Detection</i> , https://arxiv.org/pdf/1504.06375

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2043	M. Owen, <i>How iPhone Speeds Have Grown in the Last 5 Years</i> , Apple Insider (Sept. 26, 2022), https://appleinsider.com/articles/22/09/26/how-iphone-speeds-have-grown-in-the-last-5-years
2044	Apple, <i>iOS 11 is Available Tomorrow</i> , Apple Newsroom (Sept. 18, 2017)
2045	B. Lang, <i>NVIDIA's Next-Gen Titan X Has 11 TFLOPS Performance, 12GB of Memory, and Costs 1 Arm and 1 Leg, Road TOVR</i> (July 21, 2016)
2046	I. Ahmad, <i>Digital Dental Photography, Part 2: Purposes and Uses</i> , 206(9) British Dental J. 459 (May 2009)
2047	S. Finlay, <i>Photographic Analysis and Diagnosis: Step One</i> , 2(3) <i>Inside Dentistry</i> (Oct. 2009)
2048 ¹	Deposition Transcript of Dr. Hassan Foroosh, Ph.D., in IPR2023-01369 (May 17, 2024)
2049	Apple, <i>Deploying Transformers on the Apple Neural Engine</i> , Machine Learning Research (June 2022 version available at https://machinelearning.apple.com/research/neural-engine-transformers) (served not filed)
2050	Apple, <i>iPhone 8 and iPhone 8 Plus: A new generation of iPhone</i> , Newsroom (Sept. 12, 2017 version available at https://www.apple.com/newsroom/2017/09/iphone-8-and-iphone-8-plus-a-new-generation-of-iphone/) (served not filed)
2051	Supplemental Declaration of Dr. John Mongan (served not filed)

¹ Patent Owner has filed a signed copy of this transcript as EX1049.

Exhibit Number	Description
2052	Supplemental Declaration of Dr. Budi Kusnoto (served not filed)
2053	Deposition Transcript of Dr. Maureen Valley, D.M.D., M.P.H., M.S. in IPR2023-01369 (September 16, 2024)
2054	Deposition Transcript of Dr. Hassan Foroosh, Ph.D., in IPR2023-01369 (September 19, 2024)

I. Introduction

Patent Owner's Response demonstrated that Petitioner's proposed "deep learning device"—Maninis's COB neural network—is inoperable for the combination proposed in the Petition. Petitioner does not contest Patent Owner's explanation of Maninis's disclosure or that the COB neural network is incapable of producing the "semantic contours" required by Petitioner's combination. Petitioner also does not dispute that the COB neural network could not perform Carrier's overlay analysis sufficiently quickly when run on a mobile phone as proposed. Each is fatal to Petitioner's ground because a POSA would have no motivation to use or reasonable expectation of success with a combination unfit for its intended purpose.

In Reply, Petitioner proposes multiple improper alterations to its proposed combination, including: using other neural networks in combination with COB to enable detection of semantic contours (§IV.C); moving those neural networks from the acquisition device to a remote server or restructuring them entirely to work on a mobile phone (§§V.B.1.-2.); swapping the allegedly "state of the art" contours that result from Maninis's COB neural network for rough, intermediate data to save time (§V.B.3.); and abandoning reliance on Carrier's overlay technique entirely to avoid the need for near-instantaneous analysis (§V.B.4.). Petitioner offers merely conclusory testimony in support of each, failing to provide a motivation to combine

or a reasonable expectation of success and in many cases directly undermining those advanced in the Petition. The Board should reject these new arguments offered only in Reply.

Petitioner's Reply is equally inadequate when addressing the lack of motivation to combine Carrier's alignment techniques with Salah. Despite now offering testimony from a dental expert, Petitioner still fails to account for the fundamental differences between the "orthodontic standard" imaging in Carrier and the 3D-modeling process in Salah. There is no benefit to Salah in replacing its alignment technique with that of Carrier, and indeed, Salah expressly dismisses the very combination Petitioner proposes.

Independently, Petitioner fails to meaningfully contest that its proposed combination lacks the "image attribute value" required by claim 7. Petitioner's attorney argument does not overcome Dr. Mongan's un rebutted explanation of the patent's distinction between "detailed" and "global" analyses and the corresponding distinction between the "tooth attribute" labels required by claim 3 and the "image attribute" labels required by claim 7. Petitioner's misguided attempt to align its sole proposed combination with two distinct approaches inevitably fails.

II. Level of Skill in the Art

Petitioner seeks to dismiss its expert's shortcomings by noting that the parties' POSA definitions are "not materially different." Reply, 1. But as Patent Owner's Response explained, the sole declarant supporting the Petition—Dr. Foroosh—is not a POSA under *either* party's proposal. POR, 4-6. The parties agree a POSA is a member of an interdisciplinary team including dental expertise where "appropriate." Reply, 1-2. There is also no dispute that Salah and Carrier address problems in the field of dentistry, making it "appropriate" to rely on dental expertise when addressing them. POR, 5; EX1048, ¶3; *infra*, §§3.A, 5.A. The Petition thus lacked the testimony necessary to make a prima facie case, which requires a "full appreciation" of a reference's disclosure.² *In re Wesslau*, 353 F.2d 238 (CCPA 1965). Dr. Foroosh's lack of relevant expertise contributed directly to the hindsight apparent throughout Petitioner's analysis. POR, 43-45; *Infra*, §5.A; *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

Petitioner now offers the testimony of a dental expert, Dr. Valley, in reply. But Dr. Valley's testimony only confirms the dental nature of the ground references, including by explaining disclosures that Dr. Foroosh did not understand

² Dr. Foroosh's one-time "experience with dental image analysis" does not give him the necessary dental expertise. Reply, 1-2; POR, 6.

when forming his opinions. EX1035, ¶¶34, 41-44; EX2053, 38:18-39:6, 64:5-67:19; EX2048, 130:8-11, 143:22-145:10, 149:19-22. Petitioner cannot fix its prima facie case in reply. *Virtek Vision Int’l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882, 888 (Fed. Cir. 2024). The Board should disregard Petitioner’s untimely attempt to backfill.

III. Petitioner Has Not Shown Carrier and Maninis are Prior Art

A. Carrier

The Federal Circuit in *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1381 (Fed. Cir. 2015), confirmed that “[a] reference patent is only entitled to claim the benefit of the filing date of its provisional application if the disclosure of the provisional application provides support for the claims in the reference patent in compliance with § 112.” While addressing pre-AIA law, the AIA did not change any of the language in §§ 102, 119, or 120 on which the Federal Circuit based its analysis. *Compare id.* (“entitled to claim the benefit”) *with* 35 U.S.C. § 102(d)(2) (same); *compare Dynamic Drinkware*, 800 F.3d at 1378 (addressing “invention” language in pre-AIA 35 U.S.C. § 119) *with* 35 U.S.C. § 119 (same language). Petitioner admitted that *Dynamic Drinkware* applies in the Petition. Petition, 8-10. While Petitioner now relies on *Penumbra*, the reasoning and statutory interpretation in *Dynamic Drinkware* still controls. POR, 24-25.

Petitioner fails to identify written description in the Carrier Provisional for Carrier's claim limitations requiring that the patient is guided to take pictures of their own teeth with their own mobile device. POR, 24-25. The Carrier Provisional purports to offer new tools for "doctors and dental technicians" to improve the practice of capturing dental images according to "orthodontic standards"—a practice carried out in-office by dental professionals. EX2030, ¶¶54-55; EX1006, [0004]-[0006]. Nowhere does the Carrier Provisional propose to alter this practice such that patients take photos of their own teeth, and indeed, the disclosure is inconsistent with patients doing so. EX2030, ¶¶56-59. Thus, a POSA would not understand the Carrier Provisional to disclose *guiding the patient* to image their own teeth. *Id.*, ¶¶72-75; EX2028, ¶¶104-09.

In Reply, Petitioner's experts rely on a single phrase in which "user" allegedly implies "patient," which Petitioner extrapolates to "users" throughout the remaining disclosure. Reply, 4-5; EX1035, ¶¶27-35; EX1048, ¶¶18-22. But Dr. Valley could not dispute that it would be difficult—if not *impossible*—for a patient to capture all of the "standard" orthodontic views required by Carrier, including profile pictures or those pointed inside the patient's open mouth. EX1035, ¶33; EX2053, 91:19-93:15, 98:18-101:4; EX1006, Figs. 4C-4D, 5C; EX1005, Figs 4C-4D, 5C. A single correlation of "patient" with "user" cannot overcome the overwhelming evidence that the Carrier Provisional does not contemplate a patient

imaging their own teeth. *Regents of the Univ. of Minnesota v. Gilead Scis., Inc.*, 61 F.4th 1350, 1355 (Fed. Cir. 2023) (“The purpose of the written description requirement is to prevent an applicant from later asserting that he invented that which he did not.”).

B. Maninis

Petitioner has the burden to show Maninis is prior art. *E.g., Louisiana Pac. Group v. Huber Engineered Woods LLC*, IPR2020-00600, Paper 14 (P.T.A.B. Aug. 20, 2020). Petitioner cites only speculation and anecdote. POR, 35-37. None of its arguments in reply prove publication.

First, Petitioner disputes that the discussion of arXiv.org’s alleged policies in an archived webpage are speculative hearsay. Reply, 6. But a webpage with no custodian to authenticate or explain it is by no means “extensive uncontroverted evidence of business practice.” *Cf. Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1568 (Fed. Cir. 1988). Petitioner has no evidence from anyone with knowledge whether, and if so, how these alleged policies were applied to Maninis. Many questions with respect to Maninis’s publication remain unanswered. For example, Petitioner acknowledges publication was not automatic; Dr. Foroosh testified that Maninis would have been subject to “review” before publication, but the duration of such review is unknown. EX2048, 231:17-232-15.

Second, Petitioner faults Patent Owner for not addressing a snapshot of the arXiv.org search page (EX1025), but Patent Owner already did so in substance: the “download link” therein is the same as that on the Maninis authors’ website and would have pointed to the earlier version of Maninis on which Petitioner does not rely. POR, 36 (addressing EX1024). Petitioner does not dispute that this link would have pointed to another publication. *Id.*; EX2048, 235:5-236:8.

Third, Dr. Foroosh’s anecdotal experience as an occasional submitter to arXiv.org is equally speculative and insufficient. Reply, 6. Unlike the Japanese patent attorney in *Cooler Masters Co. v. Aavid Thermalloy LLC*, IPR2019-00337, Paper 49 at 30, Dr. Foroosh has no expert knowledge regarding the practices of arXiv.org. EX2048, 231:14-234:24. Dr. Foroosh’s interpretation of “metadata,” which is not of record in this proceeding, is likewise pure speculation. Reply, 6; EX1002, ¶66.

IV. Petitioner Cannot Avoid the Consequences of Its Inoperable Combination

A. The Inoperability of Maninis COB Is Dispositive

Patent Owner’s Response demonstrated that Petitioner’s reliance on Maninis’s COB neural network as the “deep learning device trained by means of a learning base” dooms its obviousness ground. POR, 37-42. In Petitioner’s proposed combination, the deep learning device analyzes images to perform

Carrier's "overlay" and "tooth counting" techniques for image alignment. *Id.* To do so, the deep learning device must produce "semantic contours," identifying the boundaries of a patient's teeth and the tooth associated with those boundaries by tooth number. *Id.* Accordingly, Petitioner proposes to train the deep learning device on a learning base of historical images with pixelwise labels identifying teeth by tooth number. *Id.* But the COB neural network on which Petitioner relies is neither capable of generating semantic contours nor being trained on them, making the proposed combination inoperable. *Id.*; EX2028, ¶¶131-41, 168-72. A POSA would thus not have been motivated to combine Maninis with Salah and Carrier as Petitioner proposes with a reasonable expectation of success. POR, 39-42.

In Reply, Petitioner does not dispute Patent Owner's explanation of the COB neural network and does not contest its inoperability for training on or producing semantic contours. Reply, 7-10; EX1048, ¶¶24-28. The Petition fails as to every challenged claim on this basis alone.

B. Petitioner Cannot Reasonably Dispute Reliance on COB

Petitioner now argues that it does not rely exclusively on the COB neural network in the Petition. Reply, 7-10. Not so.

In the Petition, Petitioner points exclusively to Maninis's description of the COB neural network, including the illustration of its "deep learning architecture"

in Figure 2, as satisfying the “deep learning device” limitation. Petition, 29-30; EX1002, ¶¶105-07.³ That neural network architecture produces only generic contours. EX2028, ¶¶132-35. Petitioner does not suggest—nor could it—that the COB neural network architecture encompasses the distinct neural networks discussed only later in Maninis as capable of generating semantic results. EX2028, ¶¶136-39.

Likewise, in the Petition, Petitioner relies exclusively on Maninis’s description of training the COB neural network as satisfying the “trained by means of a learning base” limitation. Petition, 30-31 (citing EX1007, 3, 5-6); EX1002, ¶108 (same). Petitioner does not suggest that the other neural networks mentioned in Maninis could be trained to generate semantic results using the same learning base on which the COB neural network is trained to generate generic contours—they could not. EX2028, ¶140.

Petitioner’s alleged motivation to combine and expectation of success also depend on the COB neural network as the “deep learning device.” Petitioner relies on Maninis’s description of COB as an “improvement[]” over the state of the art

³ “VGGNet and ResNet” referenced in this section of the Petition relate to the “Base CNN,” a component of the COB neural network in Figure 2—not separate neural networks. EX1007, 2, Fig. 2; EX1037, 147:13-149:24.

and the speed of COB as a desirable characteristic leading to an expectation of success with Carrier's overlay technique. Petition, 23, 31, 69; EX1002, ¶¶85, 108, 228; EX2028, ¶141. Petitioner also relies on Maninis's description of COB as "flexible" and "modular." Petition, 23; EX1007, Figs. 1-2; EX1037, 116:3-117:6, 147:16-149:24. "Based on" this "flexibility and prospect to improve performance," Petitioner argues "a POSA would have been motivated to analyze images using ... Maninis." Petition, 23, 24, 29.

Having identified no other structure beyond the COB neural network as satisfying Step 1(b'), nor any reason a POSA would have been motivated to select another neural network and expect success, Petitioner cannot reasonably dispute its sole reliance on the COB neural network.⁴ POR, 37-39.

Petitioner now argues that it did not misunderstand Maninis but rather intended to rely on a "combined system" to produce semantic contours of which the COB neural network is somehow only a "component" or "element," pointing to its citations to sections of Maninis that mention other neural networks. *E.g.*, Reply, 7-10; EX1048, ¶¶25-27. Petitioner's new-found understanding of Maninis

⁴ Petitioner's focus on Dr. Mongan's use (for clarity) of the phrase "COB *neural network*" is a red herring—COB is undeniably a neural network. Reply, 7-8; EX1037, 108:4-112:17.

cannot be reconciled with the prior record in which Petitioner clearly attributes Maninis's semantic results to the COB neural network alone. For example, Petitioner relies on the speed of COB reported in Maninis, mistakenly claiming it applied to "classifying" or "categorizing even challenging images." Petition, 23, 69; EX1002, ¶108. Dr. Foroosh similarly testified that the COB neural network produces "a contour of a cat, ... *labeled as a cat.*" EX2048, 211:20-212:15.⁵ Tellingly, Dr. Foroosh does not address his earlier cross-examination testimony or dispute Patent Owner's characterization of it. EX1048, ¶¶24-28. Petitioner's attorney argument cannot explain away Petitioner's clear misunderstanding of Maninis.⁶ Reply, 9-10; POR, 40.

Petitioner does not now dispute that the COB neural network must be run *in parallel* with another neural network that can produce semantic contours. EX2028, ¶136. However, the Petition never described the necessary "coupling" or how any "system" of neural networks, either in the alternative or in combination, satisfies the claim limitations, including which is the "deep learning device," how it is "trained" and by means of what "learning base," and which performs what

⁵ All emphases herein are added unless otherwise indicated.

⁶ Dr. Mongan confirmed that the contours depicted in the bottom right frame of Maninis Figure 10 were not "detected as" sheep. Reply, 10; EX1037, 130:1-136:21.

“analysis” to obtain which “results” required by the claims. POR, 42. That failure is significant because a neural network’s training determines its functionality, and COB and the other neural networks mentioned in Maninis cannot be trained on the same learning base and cannot perform the same tasks. *E.g.*, EX2048, 201:20-205:10; EX2028, ¶170.

C. Petitioner’s New Grounds Are Improper

Petitioner’s new reliance on different neural networks from Maninis as satisfying core limitations of claim 1 goes beyond the scope of proper reply and should be disregarded. 37 C.F.R. §42.23(b); *Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1367–68 (Fed. Cir. 2015) (upholding “Board’s rejection of Ariosa’s reliance, in its Reply submissions, on previously unidentified portions of a prior-art reference to make a meaningfully distinct contention.”).

Regardless, as explained in Patent Owner’s Response and further below, Petitioner’s ground fails even if other neural networks are used in combination with COB. POR, 41-42.

V. Petitioner Fails to Show the Challenged Claims are Unpatentable

A. Petitioner Identifies No Motivation to Combine Carrier with Salah

In Petitioner’s original combination, Carrier’s two alignment techniques—the “overlay” and “tooth counting” methods—are incorporated into the method

disclosed in Salah. POR, 37-38. Petitioner’s only motivation was that Carrier and Salah are in the “same field of endeavor,” “provide complementary teachings,” and “[i]n combination ... would each perform substantially the same function as they provide alone,” namely, image “alignment.” POR, 45-46; Petition, 21; EX1002, ¶¶81-82; EX2048, 62:18-66:3. This is insufficient. *Sisvel Int’l S.A. v. Sierra Wireless, Inc.*, 82 F.4th 1355, 1364 (Fed. Cir. 2023) (“[A]ssertions that the references were analogous art, ... without more, is an insufficient articulation for motivation to combine.”); *Virtek*, 97 F.4th at 887 (motivation insufficient where expert did not “articulate[] any reason to substitute one for another or any advantages that would flow from doing so”); EX2048, 64:20-66:3, 226:22-229:13. It is also inaccurate: Carrier’s techniques do not provide critical functionality offered by Salah’s “registration marks,” namely, enabling fast and efficient determination of acquisition conditions in the subsequent analysis. POR, 46-47. Carrier’s alignment techniques are thus either redundant with or a detrimental replacement to those in Salah. *Id.*, 48-49.

In Reply, Petitioner does not contest that Salah’s “registration marks” serve an important purpose that Carrier’s techniques do not address. That alone is reason to find a lack of motivation to combine. *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1331–32 (Fed. Cir. 2019) (“[T]he benefits, *both lost and gained*, should be weighed against one another.”) (emphasis in original). Petitioner instead

suggests that Carrier’s tooth-measuring techniques are “superior[]” to and more “reliable” than Salah’s registration marks. Reply, 12-13; EX1035, ¶¶43-44; *c.f.*, EX2048, 157:16-158:18. Petitioner’s efforts to now position Carrier’s techniques as an improvement over Salah’s approach, rather than “[s]imilar to” or providing “the same function” as them, represents a new motivation and should be rejected. Petition, 19-21; *Virtek*, 97 F.4th at 888.

In any event, the question is not whether Carrier’s techniques are advantageous for Carrier; the question is whether any such advantage applies to Salah. Petitioner points to Carrier’s alignment as ensuring “**high-quality** dentition images” but ignores that Carrier’s “orthodontic standard[]” photos—something Dr. Foroosh admittedly did not understand (EX2048, 130:4-11, 153:21-156:23)—are used for an entirely different purpose than Salah’s “**simple** image[s] of the teeth.” Reply, 11; POR, 18. Unlike Carrier, Salah’s images are not visually analyzed by a dental professional—their information is paired with an existing 3D model of the patient’s teeth using a process that can account for misalignment **after** the image has been taken. POR, 17, 20-24; EX2028, ¶¶87-98; EX2030, ¶¶43-44, 60-64; EX1035, 53:10-55:2.

Salah not only obviates the need for Carrier’s alleged accuracy, Salah touts its avoidance of such efforts as advantageous. POR, 48. Salah recognizes that “the accuracy of positioning the retractor [having the registration marks] in relation to

the teeth is limited” but notes that its “image processing does not require very precise positioning of the acquisition apparatus at the time the images are acquired.” EX1008, 31:10-17. This is “a considerable advantage” that removes any need to use alignment indicators “the positioning of which [are] perfectly defined in relation to the teeth.” EX1008, 31:18-25; *c.f.*, EX1035, ¶44. Accordingly, Salah expressly discourages Carrier’s use of teeth for alignment accuracy. EX1008, 31:26-27; *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1069 (Fed. Cir. 2018). Because Carrier’s techniques take away functionality in Salah, require more processing, and offer nothing of value in return, a POSA would have no reason to incorporate them in Salah. POR, 45-49.

B. Petitioner Cannot Alter Its Ground to Make Maninis Compatible with Salah and Carrier

Salah and Carrier both teach that the computer program used for their respective alignment techniques is run on a processor of the acquisition device—here, a mobile phone. POR, 19, 23. Petitioner does not dispute this, nor that in its Petition, it made no proposal to depart from Salah and Carrier’s local analysis. Rather, Petitioner argued that “a POSA would have been motivated to *adapt Salah and Carrier’s image acquisition device* to employ a deep learning architecture as taught by Maninis.” Petition, 23. But a mobile device in July 2017 undeniably could not run Maninis’s COB neural network (alone or in combination with other

neural networks) to perform Carrier's overlay technique, which requires near instantaneous analysis to function for its intended purpose. POR, 51-54; EX2028, ¶¶191-96. Dr. Foroosh suggests that a POSA would simply ignore the uncontested resource constraints of state-of-the-art mobile phones because a POSA would predict future technological developments, but that only highlights the hindsight infecting Petitioner's ground. EX1048, ¶46.

Petitioner further proposes four fundamental alterations to the combination in the Petition to try to provide the near instantaneous analysis required by Petitioner's ground. Each proposed change to the instituted ground is improper reply argument and should be rejected.

1. Reconfiguring the Neural Networks in Maninis

Petitioner proposes that a POSA could re-configure the structure of the neural networks in Maninis to use fewer computing resources, pointing to three new publications cited nowhere in the Petition (or Maninis). Reply, 16-17; EX1048, ¶¶43-44; EX1039-41. Petitioner does not explain which of this unrelated research a POSA would apply or how. Nor does Dr. Foroosh identify the magnitude of alleged improvement, speculating only that a POSA could "reduce any delay to an acceptable level." EX1048, ¶44. This vague and conclusory testimony should be given no weight. *TQ Delta, LLC v. CISCO Sys., Inc.*, 942 F.3d 1352, 1359-61 (Fed. Cir. 2019).

The new publications themselves provide no more clarity. Two describe research in which neural networks were respectively “sparsified” or “quantized” to make them more efficient with a “tradeoff” of decreased accuracy. EX1039, 810; EX1040, 5. Decreased accuracy is the exact opposite of Maninis’s alleged benefit. Petition, 23-24, 60, 69. Petitioner offers no evidence that these research papers reflect established techniques that a POSA could apply to Maninis. Nor does Petitioner address that these techniques run on a CPU rather than the GPU used in Maninis, frustrating any direct application. EX1039; EX1040; EX2054, 24:2-26:21, 27:10-28:9; EX1007, 5. One publication does not even refer to mobile applications—it was tested on an Intel CPU for desktop computers. EX1039, 812. The third publication, EX1041, concerns an entirely new and distinct neural network architecture called “MobileNets,” not a technique to modify existing networks. EX1041, 2. Dr. Foroosh offers no explanation whether or how its teachings apply here either.

Petitioner’s proposal to change the neural network architecture in Maninis is a complete abandonment of the instituted ground and is patently improper. *Wasica Fin. GmbH v. Cont’l Auto. Sys., Inc.*, 853 F.3d 1272, 1286-87 (Fed. Cir. 2017) (rejecting new reply argument that “looked to a different passage” of ground reference than that cited in Petition and proposed further modification “as taught in other references”). The Federal Circuit has previously affirmed the Board’s

rejection of a similar reply, where petitioner pointed to new expert testimony and exhibits in response to an argument that the embodiment relied on in the Petition was not “suitabl[e]” for the proposed combination. *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1366 (Fed. Cir. 2016). The Board should likewise reject Petitioner’s proposal to modify Maninis.

2. Removing Analysis from the Acquisition Device

Petitioner also now proposes for the first time that Salah and Carrier could be modified further to run Maninis’s alignment analysis on a remote device rather than on the acquisition device as indicated in the Petition. Reply, 15-16; EX1048, ¶¶40-42. But Petitioner’s assertions of speed and efficiency are conclusory and unsupported; Dr. Foroosh fails to cite a single example of a remote neural network analysis in the prior art. EX1048, ¶42. His reliance on COB’s speed for generic contours also ignores Petitioner’s need for an additional neural network, as well as connection latency, which Dr. Foroosh does not even attempt to quantify. *E.g.*, EX1002, ¶228. Petitioner has also failed to offer any motivation to modify Salah and Carrier in this way. The Board should reject this second improper modification as well. *See Wells Fargo Bank, N.A. v. United Servs. Auto. Ass’n*, No. IPR2019-01082, 2020 WL 6937381, at *10-16 (P.T.A.B. Nov. 24, 2020) (refusing to consider reply proposal to perform image processing step on mobile phone instead

of a remote server where Petitioner failed to identify such an embodiment in the Petition).

3. Using “Side Outputs” Instead of Finished Contours

Petitioner also proposes to speed up the analysis by pulling data from the middle of the COB neural network to use as a substitute for its final contours. Reply, 18; EX1048, ¶¶49, 60. This new idea fails for numerous reasons: it jettisons COB’s contour accuracy that Petitioner cited as an alleged motivation to combine; it is unclear how such a partial “analysis” would map to the claim limitations; and it is entirely speculative how much, if any, time would actually be saved. The Board should not consider this proposal either. *See Intelligent Bio-Systems*, 821 F.3d at 1366 (upholding Board’s refusal to consider reply arguments “changing the unpatentability rationale from express reliance on [one embodiment of a ground reference], to asserting that [embodiment] would have been obvious to modify”).

4. Using *Only* the “Tooth Counting” Technique

In yet another effort to escape the need for rapid image processing, Petitioner proposes abandoning Carrier’s overlays entirely in favor of “tooth counting,” despite heavy reliance on those overlays throughout the Petition and Dr. Foroosh’s insistence that the instituted ground uses both techniques simultaneously. Reply, 20; EX1048, ¶48; Petition, 23-24; EX1002, ¶86; EX2048, 53:4-17.

In doing so, Petitioner attempts to paint “tooth counting” as a “quality” analysis distinct from the “alignment” achieved by the overlays. Reply, 20-21; EX1048, ¶¶30, 58. But the Petition unequivocally identified *alignment* as the alleged purpose of both techniques. Petitioner argued that “[a] POSA would have had reason to use Carrier’s technique for assessing *alignment of teeth*,” noting that “Carrier teaches detecting whether all required teeth are visible and whether the imaged teeth are within a threshold distance of the overlay” “[t]o assess *alignment*.” Petition, 19-21; EX2048, 53:18-54:10. Petitioner also relied on the allegedly “complementary” teaching of Salah and Carrier as both disclosing “*assessing alignment* and using the assessment to guide users.” Petition, 21. Petitioner based its expectation of success on the same, arguing that “[t]he resulting combination would use each reference’s teachings to perform substantially the same function as they provide alone, with Carrier’s techniques *for assessing alignment* used to determine the feedback to users when guiding them to acquire dental images.” Petition, 21.

Carrier itself demonstrates that the identification of “all required teeth” is part of its alignment technique, as Dr. Foroosh originally agreed. EX1002, ¶80; EX1006, [0032], [0060]; EX1005, [0068], [0105]. Carrier concerns standard orthodontic imagery, which seeks to capture specific “views,” and thus does not require identifying and checking teeth off a predetermined list. EX2030, ¶¶31-44,

76-82. Instead, edges of a patient's teeth are compared to the overlay, and if alignment is sufficient, all required teeth are present. EX2028, ¶209; EX1006, [0060]-[0061]; EX1005, [0105]-[0106]. All experts agree, confirming alignment with the overlay also confirms the presence of the required teeth. EX2048, 52:2-11, 143:10-14; EX2053, 125:2-127:12; EX2028, ¶209; EX2030, ¶64.

Petitioner's late attempt to alter its ground should be rejected. *Apple Inc. v. Zentian Ltd.*, No. IPR2023-00036, 2024 WL 2946125, at *12 (P.T.A.B. June 11, 2024) ("We do not permit Petitioner to propose a mapping of the prior art in the Petition and then completely change that mapping after Patent Owner argues the initial mapping was flawed.").

C. Petitioner Cannot Dismiss the Costs of Implementation

Petitioner does not deny that there was no suitable prior art learning base to train the claimed deep learning device. POR, 55-57. Petitioner also does not dispute that creating a learning base adds time, cost, and complexity. *Id.*; EX2054, 23:17-24:1 (10,000 images without "augmentation"). Here, these downsides far outweigh any motivation Petitioner offers for its combination. *Supra*, §5.A; *Henny*, 938 F.3d 1324, 1331-32.

In Reply, Petitioner simply asserts that "economic arguments cannot rebut the petition's showing of obviousness, as they raise no issue of technological feasibility." Reply, 18-19 (citing *Orthopedic Equip. Co. v. United States*, 702 F.2d

1005, 1013 (Fed. Cir. 1983)). *Orthopedic* provides no *per se* prohibition on considering costs. To the contrary, it is perfectly appropriate to weigh the economic costs of a proposed combination against its possible benefits. *E.g., Andersen Corp. v. Pella Corp.*, 300 F. App'x 893, 898 (Fed. Cir. 2008) (“It is not unreasonable to suggest that a significant difference in cost could discourage” a combination); *In re Schweickert*, 676 F. App'x 988, 995 (Fed. Cir. 2017) (vacating obviousness ruling where combination “would do little more than add unwanted cost and complexity”).

The undisputed costs and complexity of generating a brand-new learning base weigh strongly against any proposed motivation to combine. Indeed, the only expert with relevant experience, Dr. Kusnoto, estimated that these costs could reach \$1.5 million over two years based on his direct involvement with similar projects. EX2030, ¶¶46-49. Dr. Kusnoto's deposition testimony cited by Petitioner to calculate a \$200,000 cost is based on only what Dr. Kusnoto could remember at deposition about one project. EX1038, 86:16-90:23. But even \$200,000 would swallow the scant benefits of that combination. POR, 57.

D. Petitioner Fails to Show “Real Time” Analysis Is Obvious (Claim 14)

Claim 14 requires that the image is “analyzed and checked in real time.”⁷ In the Petition, Petitioner points only to Carrier’s near-instantaneous overlay technique for alignment *during* image acquisition as satisfying this limitation. Petition, 68-69. For its expectation of success incorporating Mannis, Petitioner cites only the “800 ms” calculation time that Mannis reports for the COB neural network. *Id.*, 69; EX1007, 9, Table 3. But COB alone is incapable of “categorizing” images as required by the instituted ground or operating at that speed when combined with Salah and Carrier’s acquisition device. *Supra*, §IV.B. Petitioner thus fails to prove claim 14 is unpatentable.

In Reply, Petitioner once again changes its argument, now pointing to a discussion of Carrier and Salah that includes providing feedback *after* an image has already been captured. Reply, 26. Petitioner’s latest suggestion that the “analysis” and “check” could occur after image capture is incompatible with the use of Carrier’s alignment techniques and thus incompatible with the instituted ground.

⁷ Petitioner does not dispute Patent Owner’s construction of “real time” as “immediately.” Reply, 3; POR, 66.

E.g., EX2048, 134:13-136:6, 138:24-142:8, 162:18-163:9, 165:4-167:4.

Petitioner's argument should be rejected.

E. Attorney Argument Cannot Save Petitioner's Failure to Identify "Image Attribute" in the Learning Base (Claim 7)

Claim 7 requires a learning base comprising more than 1000 historical images comprising an image attribute value, and training a deep learning device by means of that learning base. Petitioner identified two alleged "image attributes": (1) "pixelwise" semantic annotations of the tooth number of each visible tooth; and (2) "the distance between the edges of the tooth and the overlay." Petition, 50-51; EX1002, ¶181. Petitioner does not contest that the latter argument fails. POR, 63. Petitioner's case thus hinges on whether pixelwise semantic annotations are "image attribute values"—they are not.

The '409 Patent differentiates between the "detailed analysis" method that trains the deep learning device on historical images labeled with "tooth attributes" and the "global" analysis method using historical images labeled with "image attributes." EX2028, ¶¶52-64, 219. Training according to the "global" method "[a]dvantageously ... makes it possible to directly obtain a value for an image attribute, without having to determine values for a tooth attribute." *Id.*; EX1001, 26:27-34. The parties agree that an "image attribute value" must be a value of an attribute that "relates to the *whole image* and *not to part of the image*." Petition,

15-16; POR, 61-63. A value indicating the tooth number depicted in a single pixel (“pixelwise” annotation) does not describe the whole image. EX2028, ¶¶224-225. Because Petitioner’s combination uses only pixelwise labeling, Petitioner fails to identify the required “image attribute” value.

In Reply, Petitioner argues that pixelwise annotations of tooth numbers, *if considered collectively* as a “list of tooth attribute values,” would form “an image attribute value.” Reply, 23-24. But Petitioner’s thought exercise ignores the functional distinction between tooth and image attributes, which are referred to as “labels” in this context. EX2028, ¶¶221-22; EX2048, 97:6-98:11. Indeed, Dr. Foroosh confirmed the difference between a “pixel-wise label,” which “describes for each region what object is there” (*e.g.*, these *pixels* are an image of a cat, other *pixels* are an image of a dog), and “image attributes,” which “would just be a label to the entire image overall” (*e.g.*, this is an image of a cat and a dog). EX2048, 98:12-103:20. Whether a label applies to a single pixel or the whole image matters: different neural networks are trained on these different types of labels, and they perform distinct analyses. EX2028, ¶¶223-28.

Whether tooth numbers are a “tooth attribute” or an “image attribute” depends on whether they relate to “part of the image” or “the image as a whole.” *E.g.*, EX1001, 3:23-29. This difference is illustrated in the following demonstrative example with a 900-pixel “historical image” depicting tooth numbers 6 and 7:

Example “Historical Image”

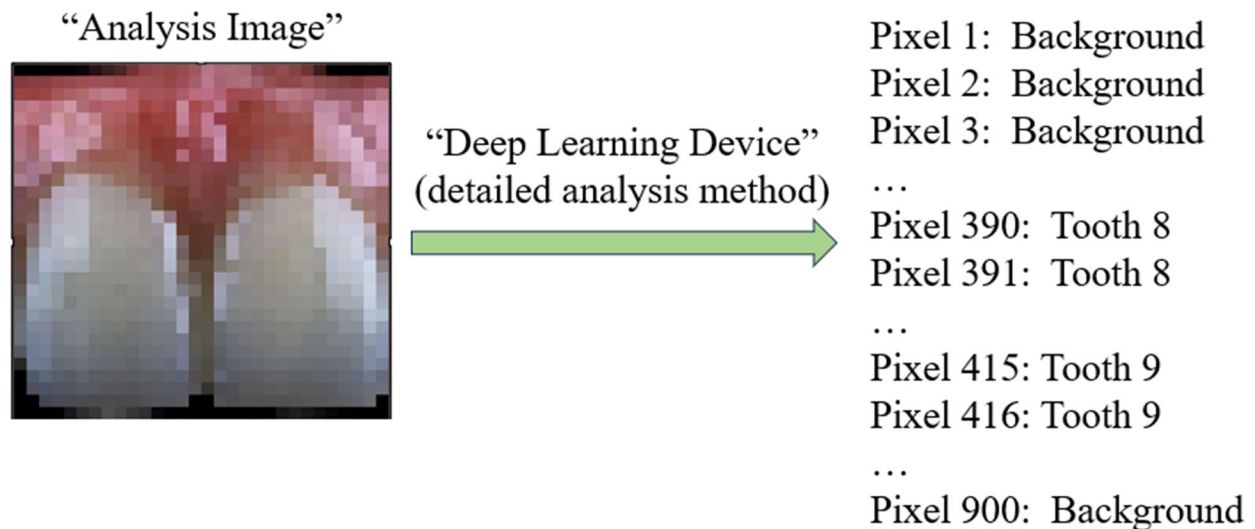


30 X 30 Pixel Image
(900 pixels)

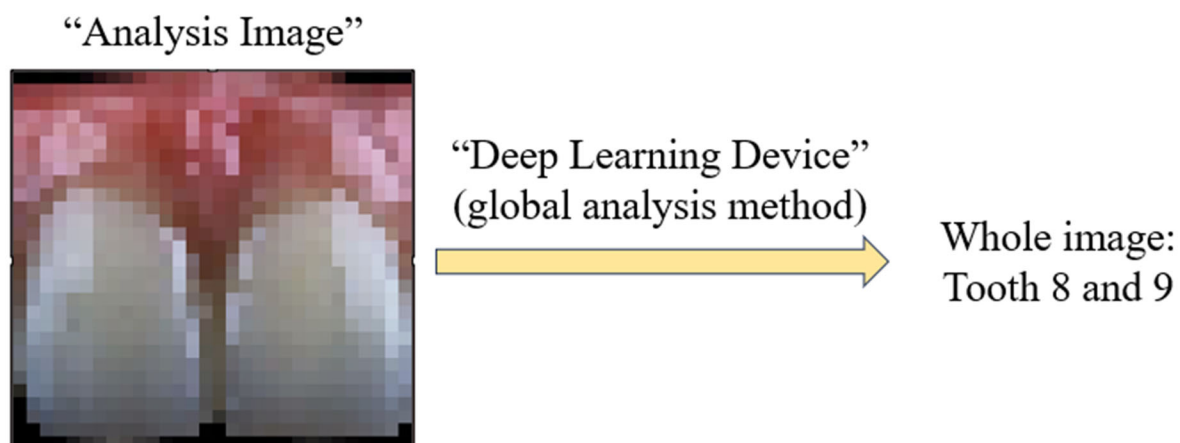
Petitioner’s proposed combination applies pixelwise annotations as shown below on the left, which are distinct from an “image attribute value” that could be applied to this same historical image, shown below on the right (EX2028, ¶¶224-28):

Pixelwise Semantic Annotations (“Detailed Image Analysis”)	Image Attribute Value Label (“Global Image Analysis”)
(from left to right, top to bottom): Pixel 1: Background Pixel 2: Background Pixel 3: Background ... Pixel 121: Tooth 6 Pixel 122: Tooth 6 ... Pixel 359: Tooth 7 Pixel 360: Tooth 7 Pixel 361: Tooth 6 ... Pixel 900: Background	Whole Image: Tooth 6 and 7

A neural network trained using Petitioner’s pixelwise semantic annotations would produce pixelwise semantic annotations (*e.g.*, “semantic contours”) when analyzing an “analysis image,” as in the below example depicting tooth numbers 8 and 9 (*Id.*, ¶¶136-38):



By contrast, a neural network trained using “image attribute values” would arrive directly at an image attribute value from its analysis (EX1001, 26:27-34):



Just because an “image attribute” can be “determined as a function of” a “tooth attribute,” does not make them interchangeable. EX1001, 26:16-17; EX2028, ¶231. As illustrated above, there is a substantive difference between training on attributes that “relate to” regions of pixels (or “tooth zones”) and attributes that “relate to” the whole image.

Petitioner’s assertion that the same learning base can satisfy both claim 3 (detailed analysis method) and 7 (global analysis method) erases the ‘409 Patent’s distinction between detailed and global analyses. Petitioner’s proposed combination lacks claim 7’s required learning base of historical images that comprise “image attribute values.” Petitioner also undisputedly fails to identify any deep learning device even capable of training on such a learning base. EX2028, ¶223. Petitioner’s ground thus fails as to claim 7.

VI. Conclusion

Patent Owner respectfully submits that the Board should find all the challenged claims are patentable over the ground raised in the Petition.

Date: October 1, 2024

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Certificate of Word Count

The undersigned hereby certifies that the portions of the above-captioned **DENTAL MONITORING SAS'S PATENT OWNER'S SUR-REPLY** has 5,598 words in compliance with the 5,600-word limit set forth in 37 C.F.R. § 42.24. This word count was prepared using Microsoft® Word for Microsoft 365 MSO.

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Certificate of Service

Pursuant to 37 C.F.R. §§ 42.6(e), the undersigned certifies that on October 1, 2024, a complete copy of **DENTAL MONITORING SAS'S PATENT OWNER'S SUR-REPLY** was served via electronic mail on the following counsel of record for Petitioner at the email addresses: mrosato@wsgr.com, margenti@wsgr.com, and pmedley@wsgr.com, as indicated in the Petition for electronic service to the following Petitioner counsel:

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