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Paper 15
Date: January 27, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

3SHAPE A/S and 3SHAPE INC.,
Petitioner,

v.

ALIGN TECHNOLOGY, INC.,
Patent Owner.

IPR2021-01240
Patent 10,709,527 B1

Before HYUN J. JUNG, NEIL T. POWELL, and
JAMES J. MAYBERRY, *Administrative Patent Judges*.

POWELL, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. BACKGROUND

3Shape A/S and 3Shape Inc. (collectively, "Petitioner") filed a Petition for *inter partes* review of claims 1–9, 11–20, and 22 of U.S. Patent No. 10,709,527 B1 (Ex. 1001, "the '527 patent"). Paper 3 ("Pet."). Align Technology, Inc. ("Patent Owner") filed a Preliminary Response. Paper 10 ("Prelim. Resp.").

An *inter partes* review may not be instituted "unless . . . the information presented in the petition . . . shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a) (2018). Having considered the arguments and the associated evidence, for the reasons described below, we institute *inter partes* review of all the challenged claims on all the grounds set forth in the Petition.

B. RELATED MATTERS

The Petition states that that "[t]he following judicial or administrative proceedings would affect, or be affected, by a decision in this proceeding":

- *Align Technology, Inc. v. 3Shape A/S*, 6:20-cv-00979-ADA (W.D. Tex.) (complaint filed October 19, 2020) ("WDTX Action");
- *3Shape A/S v. Align Technology, Inc.*, 1:20-cv-01492-LPS (D. Del.) (complaint filed November 2, 2020);
- *Align Technology, Inc. v. 3Shape A/S*, 1:18-cv-01949-LPS (D. Del.) (complaint filed December 11, 2018);
- SN 16/922,630 filed July 7, 2020 now U.S. Patent No. 10,964,425;
- SN 16/433,885 filed June 6, 2019 now U.S. Patent No. 10,568,722;
- SN 16/164,092 filed October 18, 2018 now U.S. Patent No. 10,405,951;

- SN 15/388,580 filed December 22, 2016 now U.S. Patent No. 10,143,541;
- SN 14/882,312 filed October 13, 2015 now U.S. Patent No. 9,549,794;
- SN 14/324,784 filed July 7, 2014 now U.S. Patent No. 9,186,228;
- SN 13/716,008 filed December 14, 2012 now U.S. Patent No. 8,805,563;
- SN 13/227,435 filed September 7, 2011 now U.S. Patent No. 8,359,115;
- SN 12/654,762 filed December 31, 2009 now U.S. Patent No. 8,041,439;
- SN 12/222,287 filed August 6, 2008 now U.S. Patent No. 7,734,368;
- SN 11/349,124 filed February 8, 2006 now U.S. Patent No. 7,555,403;
- SN 17/247,815 filed December 23, 2020; and
- U.S. Provisional Application No. 60/699,499 filed July 15, 2005.

Pet. 2–3.

C. THE '527 PATENT

The '527 patent relates to computer-aided methods used in dentistry. Ex. 1001, 1:41–42. The '527 patent notes that "[t]here are many procedures associated with the oral cavity in which a precise three-dimensional representation of the cavity is very useful to the dental practitioner." *Id.* at 1:46–48. "For example, in prosthodontics, a computer model of a patient's teeth may be manipulated to provide machining data to manufacture a physical model of the intra oral cavity, and/or to design and manufacture a coping and/or a prosthesis." *Id.* at 1:56–60.

Designing and manufacturing a prosthesis involves a parameter called "the finish line, or transition boundary between the prosthesis and the dental preparation." *Id.* at 1:61–64. According to the '527 patent, acquiring the

finish line's coordinates with a computer model provides certain advantages over using a plaster cast. *Id.* at 1:65–2:3. The '527 patent further notes,

> [h]owever, it is often the case that when scanning the intra oral cavity to obtain 3D data of the preparation and finish line on which the virtual model is based, part of the finish line, and possibly also the shoulder and other parts of the preparation, may be obscured by soft tissues such as the gum that, no longer being pushed by the dental surfaces that have been removed, deform to cover at least a part of the finish line on the prepared dental site.
>
> Additionally or alternatively, part or all of the finish line may be obscured by other agents, including, for example, accumulation of one or more of saliva, blood, lubricant used with a dental drill, debris resulting from working the, dental site, and so on.

Id. at 2:4–16. Figure 1 of the '527 patent is reproduced below.

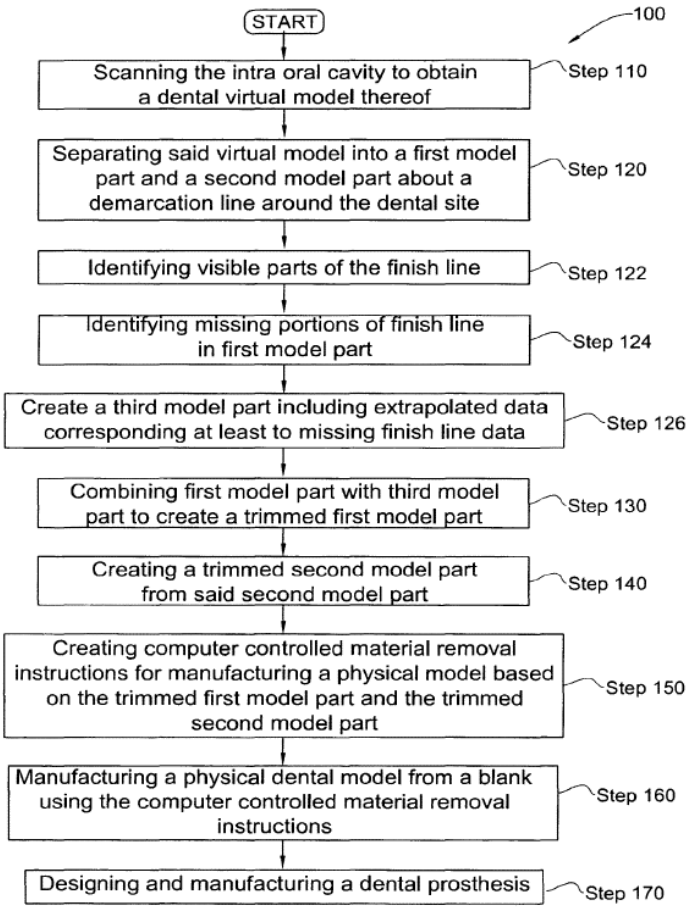

FIG. 1

Figure 1 shows "[a] computer-based method for manipulating a virtual dental model, particularly useful for defining a finish line." *Id.* at 6:47–48.

The method begins with step 110, which entails "acquiring an accurate 3D representation . . . of the intraoral cavity." *Id.* at 6:50–53. To do this, a dental practitioner may use an optical scanner, such as "a probe for determining three dimensional structure by confocal focusing of an array of light beams." *Id.* at 7:41–44, 7:62–66. An example of a resulting virtual 3D model appears in Figure 4, which is reproduced below.

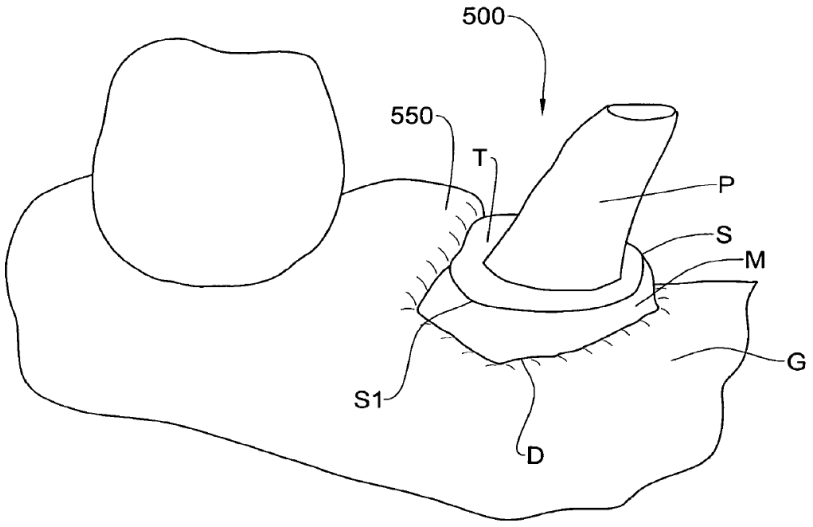

FIG. 4

Figure 4 shows first virtual model 500, which includes preparation P and other material 550. *Id.* at 6:54–56, 7:10–17.

Preparation P includes a central anchoring stump, a shoulder T, and a finish line S. *Id.* at 7:13–17. Shoulder T joins the central anchoring stump to finish line S. *Id.* Finish line S "circumscribes the stump and separates the preparation from the emerging profile M, which in turn extends to the gum line G." *Id.* at 7:14–17. Finish line S may be at least partially obscured by various things, "including, but not limited to, deformed soft tissues,

accumulation of one or more of saliva, blood, lubricant used with a dental drill, debris resulting from working the dental site, and so on." *Id.* at 3:39–43, 7:34–40. In the '527 patent, "[a] dental site relates to a location in the intra oral cavity comprising one or more teeth of interest. One or more such teeth may include a preparation" for placing a prosthesis. *Id.* at 5:28–30.

In the method shown in Figure 1, following step 110, step 120 involves using a computer to manipulate virtual model 500 by separating it into multiple parts. *Id.* at 9:4–8. An example of the results of this step is shown in Figure 5, which is reproduced below.

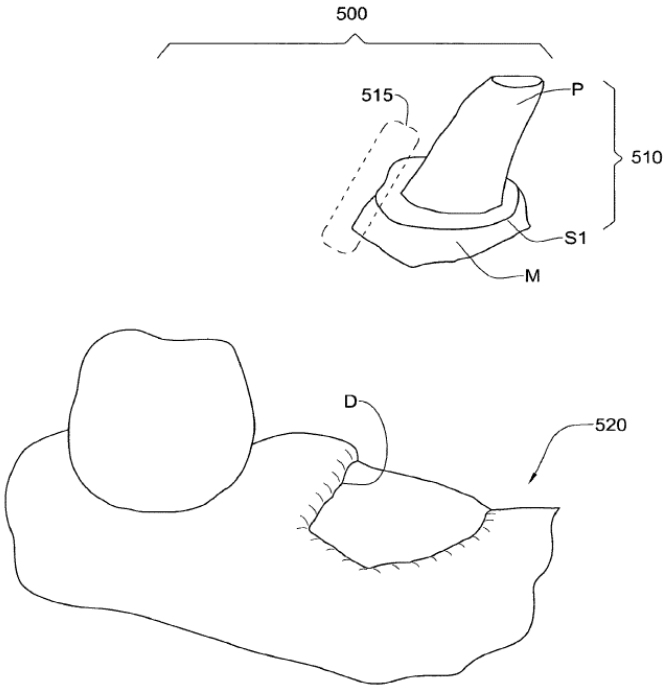

FIG. 5

Figure 5 shows virtual model 500 with first part 510 separated from second part 520. *Id.* at 9:4–8.

In this example, first part 510 constitutes a dental site, and second part 520 is "typically the remainder of the model 500, and including at least the data representing the soft tissues and possibly foreign matter such as

retraction wires, etc, that surround the first part 510." *Id.* at 9:4–12. The separation "step isolates the surface data corresponding to the parts of the emerging profile M, the portion S1 of finish line S and preparation P that are not obscured by soft tissue or foreign objects including, for example, saliva, blood, lubrication fluid, debris and so on." *Id.* at 9:12–16. A user may perform step 120 manually with a computer. *Id.* at 9:18–35. Alternatively, virtual model 500 may be separated into first part 510 and second part 520 in an automated manner. *Id.* at 9:36–49.

After separation of first part 510 and second part 520, step 122 involves finding and marking unobscured parts of finish line S. *Id.* at 9:50–10:2. This may be performed manually or in an automated manner. *Id.* at 9:56–62.

Subsequently, step 124 involves identifying regions of first part 510 that lack a finish line. *Id.* at 10:3–5. This may be done manually or in an automated manner. *Id.* at 10:5–14.

"[O]nce the missing portions, herein generally designated as 515, are identified and optionally marked in a suitable [manner] with reference to the first model part 510, the next step 126 is to create 3-dimensional representations of the missing portions 515, i.e., a third model part," which can be done in various ways. *Id.* at 10:15–19. The '527 patent discusses

one exemplary approach in connection with Figures 6 and 7. Figure 6 is reproduced below.

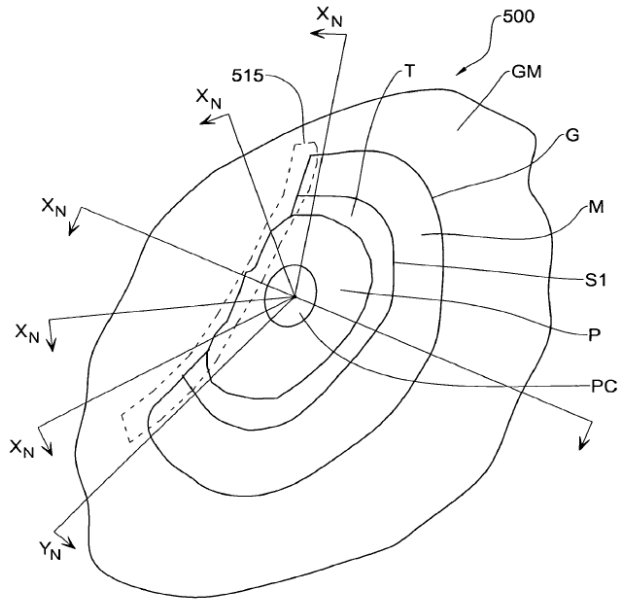

FIG. 6

Figure 6 "illustrates in plain view the first model part of [Figure] 5 including a plurality of planes normal to this view." *Id.* at 6:35–36. Figure 7 is reproduced below.

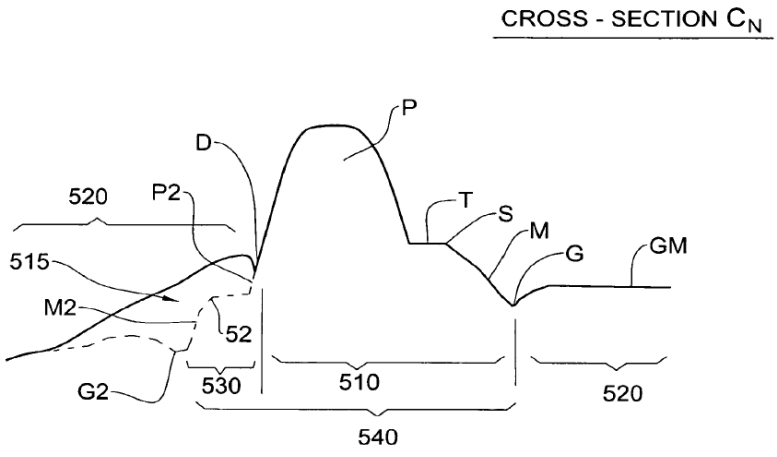

FIG. 7

Figure 7 "illustrates a typical cross-section of the virtual first model part obtained along one of the planes in [Figure] 6." *Id.* at 6:37–38.

> Regarding Figures 6 and 7, the '527 patent explains that
>
> virtual model 500 is sliced about a plurality of working planes X_N to provide a corresponding plurality of cross-sections CN of the model 500. These cross-sectional planes XN are typically orthogonal to the occlusal plane, and preferably pass approximately through the center portion PC of the preparation P. The plurality of planes may span an arc as viewed from above the dental site ([Figure] 6) such as to include the full missing portion 515 and extend at least a little beyond the same to include at least two cross-sectional profiles that fully include emerging profile M data, finish line S data, preparation P data, gum line G data, plus gum GM data.
>
> A typical cross-section CN is illustrated in FIG. 7, and shows the profile of the model 500, including first model part 510, second model part 520, and demarcation line D.

Id. at 10:22–37.

The '527 patent then explains one exemplary approach for generating the third model part, disclosing that

> [b]ased on the user's experience and skill, the user can extrapolate where he or she considers that at least one or more of the missing finish line $S2_N$ data, missing emerging profile data M2, missing preparation data P2, and missing gum line data G2 data may be in relation to this cross-section. These missing data can then be input to the computer in which the manipulations are being carried out, for example by "clicking" with a mouse or by means of a tablet, or by any other computer aided means, at locations on the displayed cross-section where the extrapolations are to be made.

Id. at 10:38–48. Subsequently, "[w]hen this operation has been repeated for all the cross-sections, a 3-dimensional virtual third model part 530 corresponding to the extrapolated data may be created by the computer by properly integrating the created data." *Id.* at 10:65–11:1. The '527 patent

also discloses certain alternatives for this process. *Id.* at 11:4–32. For example, "step 126 may be performed in a fully automated or semi automated manner, and suitable algorithms and/or rules such as geometrical rules may be formulated for this purpose." *Id.* at 11:24–27.

Following step 126, step 130 involves combining third model part 530 with first model part 510. *Id.* at 11:33–34. This produces "completed trimmed virtual first model part 540 of the dental site, including a fully defined finish line S and preferably also a complete emerging profile M." *Id.* at 11:33–37.

Then, step 140 includes converting second model part 520 to a trimmed second model part 570, so that "trimmed first model part 540 'fits' in the same position as before with respect to the second model part 520." *Id.* at 11:38–47. This is illustrated in Figure 8, which is reproduced below.

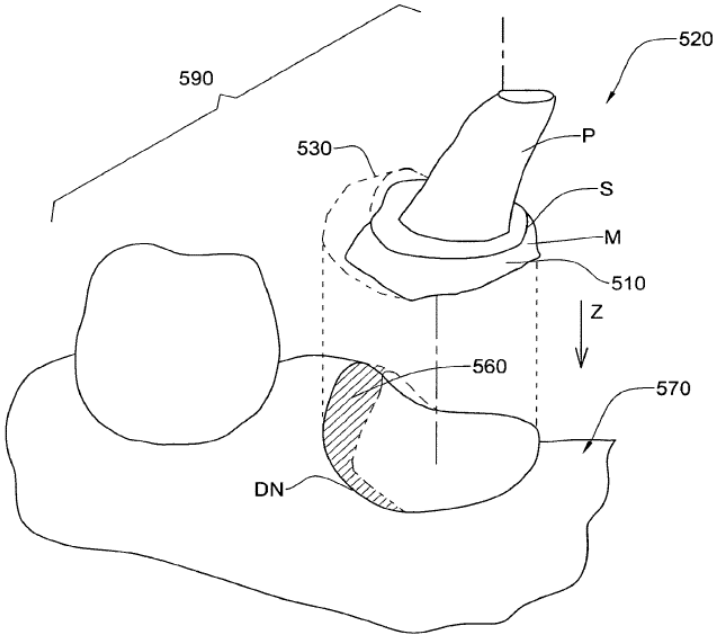

FIG. 8

Figure 8 shows how "trimmed second model part 570 . . . joins, at a new demarcation line DN (at least along direction Z), the trimmed first model

part 540 to form a new virtual model 590 in which the finish line S, emerging profile P, gum line G and preparation P are now fully defined." *Id.* at 11:48–53.

The '527 patent adds that "[t]he method of the invention may be further extended to the manufacture of a physical dental model that may be used in the design and/or manufacture of a prosthesis, for example a crown or bridge prosthesis." *Id.* at 11:56–59. Steps 150, 160, and 170 may accomplish this. *Id.* at 11:56–13:47.

D. ILLUSTRATIVE CLAIM

Of the challenged claims, claims 1 and 12 are independent. Each of claims 2–9, 11, 13–20, and 22 depends, directly or indirectly, from one of claims 1 and 12. Claim 1 is illustrative and is reproduced below with certain reformatting:[1]

> 1. [Preamble] A method for scanning obstructed intraoral structures of a patient, the method comprising:
>
> [1.1] providing a hand-held intraoral scanner, wherein the hand-held intraoral scanner is configured to focus light onto an intraoral structure;
>
> [1.2] scanning, using the hand-held intraoral scanner, the intraoral structure of the patient to generate first 3D data of a surface of the intraoral structure of the patient;
>
> [1.3] generating a 3D virtual model of the intraoral structure of the patient based on the first 3D data;
>
> [1.4] determining a missing portion of the 3D virtual model that are missing a portion of the intraoral structure of the patient;

[1] We have added the same numbers used by the Petition to identify each of claim 1's limitations.

[1.5] generating second 3D data representing the intraoral structure of the missing portion of the 3D virtual model;

[1.6] combining the second 3D data with the 3D virtual model such that the 3D virtual model includes a representation of the intraoral structure in place of the missing portion.

Ex. 1001, 13:60–14:11.

E. ASSERTED GROUNDS OF UNPATENTABILITY

Petitioner challenges the patentability of claims 1–9, 11–20, and 22 of the '527 patent on the following grounds (Pet. 6):

Claims Challenged	35 U.S.C. §	References
1, 4–9, 11, 12, 15–20, 22	103	Rubbert[2], Weyrich[3]
2, 3, 13, 14	103	Rubbert, Weyrich, Babayoff[4]
1–9, 11–20, 22	103	Durbin[5], Weyrich, Babayoff

In support of its challenges, Petitioner also relies on the Declaration of John Phillip Mellor, Ph.D. Ex. 1002. Patent Owner relies on the Declaration of Simon Heinzle, Ph.D. Ex. 2003.

[2] Rubbert et al., Published U.S. Patent Application No. 2002/0180760 A1, published Dec. 5, 2002 (Ex. 1005, "Rubbert").

[3] T. Weyrich et al., *Post-processing of Scanned 3D Surface Data* (Eurographics Association 2004) (Ex. 1007, "Weyrich").

[4] Noam Babayoff et al., Published International Patent Application No. WO 00/08415, published Feb. 17, 2000 (Ex. 1008, "Babayoff").

[5] Duane Milford Durbin et al., Published U.S. Patent Application No. 2002/0064759 A1, published May 30, 2002 (Ex. 1006, "Durbin").

II. ANALYSIS

A. DISCRETION TO DENY UNDER 35 U.S.C. § 325(d)[6]

35 U.S.C. § 325(d) states, in relevant part: "In determining whether to institute or order a proceeding under this chapter, chapter 30, or chapter 31, the Director may take into account whether, and reject the petition or request because, the same or substantially the same prior art or arguments previously were presented to the Office." The Board uses a two-part framework for evaluating arguments under § 325(d):

> (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and
>
> (2) if either condition of first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.

Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential). "[T]he *Becton, Dickinson* factors provide useful insight into how to apply the framework under 35 U.S.C. § 325(d)." *Id.* at 9 (footnote omitted). The non-exclusive *Becton, Dickinson* factors are:

> (a) the similarities and material differences between the asserted art and the prior art involved during examination;

[6] Although Patent Owner takes issue with Petitioner for arguing that "Patent Owner has routinely dismissed, or attempted to dismiss, patents from its various litigations even at later stages" (Pet. 77), Patent Owner does not argue that we should exercise discretion to deny under § 314(a) based on *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 5–6 (PTAB Mar. 20, 2020) (precedential). Prelim. Resp. 53–54.

> (b) the cumulative nature of the asserted art and the prior art evaluated during examination;
>
> (c) the extent to which the asserted art was evaluated during examination, including whether the prior art was the basis for rejection;
>
> (d) the extent of the overlap between the arguments made during examination and the manner in which Petitioner relies on the prior art or Patent Owner distinguishes the prior art;
>
> (e) whether Petitioner has pointed out sufficiently how the Examiner erred in its evaluation of the asserted prior art; and
>
> (f) the extent to which additional evidence and facts presented in the Petition warrant reconsideration of the prior art or arguments.

Becton, Dickinson & Co. v. B. Braun Melsungen AG, IPR2017-01586, Paper 8 at 17–18 (PTAB Dec. 15, 2017) (precedential as to § III.C.5, first paragraph). *Becton, Dickinson* factors (a), (b), and (d) relate to the first part of the *Advanced Bionics* framework (whether the same or substantially the same art or arguments previously were presented to the Office), and *Becton, Dickinson* factors (c), (e), and (f) relate to the second part of that framework (previous Office error). *Advanced Bionics*, IPR2019-01469, Paper 6 at 9–11.

Petitioner argues that the "Petition does not raise Section 325(d) concerns." Pet. 79. Petitioner notes that, during the prosecution history of the '527 patent, an information disclosure statement cited a continuation of Rubbert, specifically Published U.S. Patent Application No. 2006/0281041 A1 (hereafter "Rubbert '041"). *Id.* Petitioner also notes that the Notice of Allowance for the '527 patent discussed Rubbert '041. *Id.* at 79–80 (quoting Ex. 1004, 20). Addressing the Notice of Allowance, Petitioner argues that "[t]he [Office's] analysis merely cited a brief portion of the abstract of

Rubbert '041 and parroted several limitations of claim 1 of the '527 Patent. Neither a substantive analysis nor rejection based upon Rubbert '041 was provided." *Id.* at 80. Petitioner also argues that the Office did not evaluate Weyrich, Babayoff, and Durbin during prosecution history of the '527 patent. *Id.* at 79.

Patent Owner argues that Petitioner does not address adequately the *Advanced Bionics* test or the discussion of Rubbert '041 in the Notice of Allowance. Prelim. Resp. 16–17. Patent Owner takes the position that Rubbert '041 contains the same disclosure as Rubbert, cited by Petitioner in this proceeding. *See id.* at 16 ("The same Rubbert disclosure cited as the primary reference in the Petition was considered by the office during prosecution."). Citing the Notice of Allowance, Patent Owner contends that "the Examiner specifically found that the claims were allowable because Rubbert failed to disclose limitations 1.3-1.6." *Id.* Patent Owner adds that "[t]he Petition relies on Rubber to teach these very same limitations. For example, Petitioner relies on Rubbert—and no other reference—to disclose limitation 1.3 in Ground I." *Id.* Patent Owner also argues that Durbin is cumulative to Rubbert. *Id.* at 42–43.

Beginning with the first part of the *Advanced Bionics* framework, we consider whether *Becton Dickinson* factors (a), (b), and (d) indicate that "the same or substantially the same art previously was presented to the Office" or that "the same or substantially the same arguments previously were presented to the Office." As Petitioner notes, the Office did not consider Weyrich, Babayoff, or Durbin during the prosecution history of the '527 patent. *E.g.*, Ex. 1001, code (56). Additionally, the Office did not consider Rubbert. *E.g.*, *id.*

As the parties note, however, the Office considered Rubbert '041. *E.g., id.*; Ex. 1004, 20. For purposes of this analysis, we accept Patent Owner's undisputed position that Petitioner's first prior art reference, Rubbert, contains substantially the same disclosure as Rubbert '041. *See* Prelim Resp. 16. The Notice of Allowance's discussion of Rubbert '041 states that

> [t]he allowability of the claims 1-22, resides, at least in part, in that closest prior art of Shyu (US 5,180,333) discloses Rubbert et al. (US 2006/0281041) discloses The individual, virtual three-dimensional tooth objects are created by comparing the virtual model of the dentition to virtual, three-dimensional template teeth that are stored in memory in a process described in detail herein. The template teeth can include roots as well as crowns. The template teeth can be stored objects acquired from some external source or alternatively developed from a database of patient scans, see abstract; however, the prior art does not disclose or suggest, alone or in combination, generating a 3D virtual model of the intraoral structure of the patient based on the first 3D data; determining a missing portion of the 3D virtual model that are missing a portion of the intraoral structure of the patient; generating second 30 data representing the intraoral structure of the missing portion of the 3D virtual model; combining the second 3D data with the 30 virtual model such that the 30 virtual model includes a representation of the intraoral structure in place of the missing portion; in combination with the other elements and features of the claimed invention.

Ex. 1004, 20. Patent Owner apparently understands this passage to mean that Rubbert '041's disclosure lacks each and every one of limitations 1.3–1.6 of challenged claim 1. *See* Prelim. Resp. 16. We do not agree. Patent Owner overlooks the passage's closing words: "in combination with the other elements and features of the claimed invention." Ex. 1004, 20. By closing with this language, the Notice of Allowance finds that Rubbert '041 does not disclose the claimed invention as a whole, i.e., all of the claim

limitations together. Thus, contrary to Patent Owner's suggestion, the prosecution history of the '527 patent does not demonstrate that the Office has already found that Rubbert '041 (or, by extension, Rubbert) fails to disclose limitation 1.3, 1.4, 1.5, 1.6, or any other individual limitation of claim 1.

Against this backdrop, we find *Becton* factors (a), (b), and (d) indicate that Petitioner's cited prior art and arguments are not the same or substantially the same as those previously presented to the Office. For example, with respect to independent claim 1, we find Petitioner's combination of Rubbert and Weyrich differs materially from and is not cumulative to Rubbert '041 because, as discussed below in Section II.D, Petitioner shows sufficiently that, in combination, Rubbert and Weyrich render obvious claim 1 as a whole. Additionally, we find that Petitioner's arguments that claim 1 would have been obvious over the combination of Rubbert and Weyrich and also over the combination of Durbin, Weyrich, and Babayoff do not overlap with arguments previously presented to the office.

Given that *Becton* factors (a), (b), and (d) indicate that the same or substantially the same prior art or arguments were not presented previously to the Office, we need not consider the second part of the *Advanced Bionic* framework, and we decline to exercise our discretion under 35 U.S.C. § 325(d) to deny institution.

B. Level of Ordinary Skill in the Art

Petitioner contends that

> [a] person of ordinary skill in the art ("POSITA") as of the effective filing date of the '527 Patent would have had at least a bachelor's degree in electrical engineering, computer

> engineering, or computer science (or equivalent course work) and two to three years of work experience in 3D imaging and modeling of physical structures. EX1002, ¶¶35-39. Alternatively, a POSITA could have a master's degree in electrical engineering, computer engineering, or computer science (or equivalent course work) with a focus in 3D imaging and modeling of physical structures. *Id.*

Pet. 9–10. At this stage, Patent Owner does not dispute Petitioner's definition of a person of ordinary skill in the art. *See generally* Prelim. Resp.

We find Petitioner's proposed definition reasonable and consistent with the prior art before us. *See In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (determining that the Board of Patent Appeals and Interferences did not err in concluding that the level of ordinary skill in the art was best determined by the references of record). Accordingly, we apply the level of skill set forth above.

C. CLAIM INTERPRETATION

We apply the same claim construction standard used in district courts, namely that articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b) (2020). In applying that standard, claim terms generally are given their ordinary and customary meaning as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips*, 415 F.3d at 1312–13. "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic*

Sofamor Danek, Inc., 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

The Petition notes that "[i]n the WDTX Action, parties associated with Petitioner and Patent Owner have proposed certain constructions." Pet. 10. The Petition includes a table summarizing the parties' proposed claim constructions for claim limitations 1.4, 1.5, 12.2c, and 12.2d from the related district court proceeding in the Western District of Texas. *Id.* at 10–11. With respect to the challenges in the Petition, "Petitioner does not believe any express claim constructions are necessary." *Id.* at 11. Petitioner contends that "[t]he prior art demonstrates invalidity using either Petitioner or Patent Owner's proposed constructions." *Id.*

Patent Owner argues that, if we institute *inter partes* review, the parties' proposed constructions for claim limitations 1.4, 1.5, 12.2c, and 12.2d could affect whether Petitioner demonstrates unpatentability of "at least a few of the challenged claims." Prelim. Resp. 12–13.

1. *Claim Limitations 1.4 and 12.2c*

Claim limitation 1.4 recites "determining a missing portion of the 3D virtual model that are missing a portion of the intraoral structure of the patient." Ex. 1001, 14:3–5. Similarly, claim limitation 12.2c recites "determine a missing portion of the 3D virtual model that are missing a portion of the intraoral structure of the patient." *Id.* at 14:54–56. The parties' proposed constructions for these terms in the related district court proceeding in the Western District of Texas are reproduced below.

Term	3Shape's Proposed Construction	Align's Proposed Construction
"determining [determine] a missing portion of the 3D virtual model that are missing a portion of the intraoral structure of the patient" *Claims:* • '527 Patent: claims 1, 12	determining [determine] a missing dental structure in the 3D virtual model	determining a portion of the 3D virtual model that is missing a portion of any target part of the intraoral cavity of the patient

Ex. 1011, 15.

The Preliminary Response sheds additional light on Patent Owner's understanding of these claim limitations. Specifically, the Preliminary Response explains that "the claims and specification describe the task of identifying a missing portion of a model, where the missing portion corresponds to a target dental structure present in the patient's intraoral cavity but missing from the model due to an obstruction in the scan." Prelim. Resp. 13. Patent Owner further argues that the disclosure of Petitioner's prior art does not meet such a construction.

As explained below in Section II.D.3.a.(3), we find Petitioner has demonstrated a reasonable likelihood of establishing that the prior art teaches or suggests identifying a missing portion of a model that results from an obstruction in the scan. Thus, even under Patent Owner's proposed construction, Petitioner's arguments and evidence are sufficient for purposes of instituting an *inter partes* review, obviating a need to construe expressly these claim limitations at this stage.

2. *Claim Limitations 1.5 and 12.2d*

Claim limitation 1.5 recites, among other things, "generating second 3D data." Ex. 1001, 14:6–8. Similarly, claim limitation 12.2d recites "generate second 3D data." *Id.* at 14:57–59. The parties' proposed constructions for these terms in the related district court proceeding in the Western District of Texas are reproduced below.

Term	3Shape's Proposed Construction	Align's Proposed Construction
"generating [generate] second 3D data" *Claims:* • '527 Patent: claims 1, 12	generating second 3D data in any manner, including scanning or based on the 3D virtual model	generat[ing] second data representing the intraoral structure of the missing portion of the 3D virtual model by extrapolating the 3D virtual model or interpolating between points in the 3D virtual model

Ex. 1011, 15.

The Preliminary Response sheds additional light on Patent Owner's understanding of the meaning of these claim limitations. Specifically, the Preliminary Response argues that limitations 1.5 and 12.2c distinguish the claims from Petitioner's cited prior art because "[n]one of the cited prior art discloses the concept of generating additional data to represent a structure missing from dental model *without* acquiring such data from external sources like additional scans." Prelim. Resp. 14. The Preliminary Response also notes that "a human operator's judgment" constitutes an "external source." *Id.* at 29. Thus, Patent Owner suggests that the claims exclude any reliance on a human's judgment in generating the second 3D data.

At this stage, we do not agree with this position. The language of limitations 1.5 and 12.2c does not appear to address whether a human's judgment could contribute to generation of the second 3D data. And the Specification of the '527 patent discloses relying at least partially on a human's judgment when generating data to replace a missing portion of a 3D virtual model. For example, the '527 patent discloses that

> Based on the user's experience and skill, the user can extrapolate where he or she considers that at least one or more of the missing finish line $S2_N$ data, missing emerging profile data M2, missing preparation data P2, and missing gum line data G2 data may be in relation to this cross-section. These missing data can then be input to the computer in which the manipulations are being carried out, for example by "clicking" with a mouse or by means of a tablet, or by any other computer aided means, at locations

> on the displayed cross-section where the extrapolations are to be made. Such extrapolations may be made by the user, utilizing experience and judgment as to where the missing profile may be.

Ex. 1001, 10:38–50.

As explained below in Section II.D.3.a.(4), we find Petitioner has demonstrated a reasonable likelihood of establishing that the prior art teaches or suggests the generate or generating recitations. Petitioner's arguments and evidence are sufficient for purposes of instituting an *inter partes* review, and Patent Owner's arguments based on its construction do not provide a reason for denying institution.

D. GROUND 1 – ALLEGED OBVIOUSNESS OVER RUBBERT AND WEYRICH

1. *Overview of Rubbert*

Rubbert "relates to a computerized method of creating individual, virtual, three-dimensional tooth models from three-dimensional information of a patient's dentition and a template object." Ex. 1005 ¶ 3. The models allow "treatment planning for a patient suffering from a malocclusion." *Id.* Traditionally, orthodontics involves treating such a malocclusion with brackets and an archwire to shift the teeth in a desired manner. *Id.* ¶ 4. According to Rubbert, an orthodontist normally installs the brackets and wire on a patient "and hopes for the best," but "treatment time could be significantly reduced if proper planning was done." *Id.* ¶ 6.

Rubbert discloses that prior art systems allowed "scanning the dentition to thereby obtain more precise information about the dentition." *Id.* ¶ 7. Rubbert notes that one such system provided scanned data that did "not distinguish between teeth and other objects captured by the scanner," whereas "[o]rthodontists conceptualize teeth as individual tooth objects that

can be moved independently." *Id.* ¶ 10. Rubbert's "invention solves this problem by providing methods and apparatus for separating individual teeth from other structures in a three-dimensional virtual model." *Id.* ¶ 11. Additionally,

> The individual teeth are three-dimensional virtual tooth objects that can be moved or positioned independently from each other. Moreover, the individual tooth objects can be displayed on a computer workstation in context with virtual, three-dimensional orthodontic appliances, such as brackets, archwires, retainers, and transparent removable aligning devices. The individual virtual tooth objects are thus a highly useful tool in orthodontic treatment planning, monitoring and diagnosis.

Id.

Rubbert discloses its "invention is useful for creating individual, virtual three-dimensional tooth models from virtually any source of three-dimensional information of a patient's dentition." *Id.* ¶ 12. "For example, the invention will work with CAT scan or laser scanning as the scanning system. The 3-D data can also be obtained from a hand-held optical scanner . . . ." *Id.* Rubbert explains that "[a] complete three-dimensional model of the patient's dentition can be generated from the scanning system of the present invention." *Id.* ¶ 203.

After certain processing is performed, a "virtual three-dimensional model of the entire jaw is presented to the orthodontist." *Id.* ¶ 288. To facilitate the orthodontist's treatment planning, "it is highly desirable . . . to process the three dimensional model . . . by separating the teeth from the gums and other anatomical structure, and presenting just the crowns of the teeth to the orthodontist." *Id.* ¶ 290. "This allows virtual individual teeth objects to be moved independently in three dimensions on the computer." *Id.*

Enabling this, Rubbert discloses a process of producing "an individual tooth model from a scanned tooth." *Id.* ¶ 293. The process uses the scanned tooth and a template tooth, which "is a three-dimensional tooth object having a single set of points defining the boundaries of the tooth." *Id.* ¶ 294. The process involves placing the template tooth in approximately the same position as the scanned tooth object. *Id.* Additionally, "[t]he template tooth can be scaled larger or smaller or positioned arbitrarily by the user, in order to get a close a position as possible to the point cloud of the dentition." *Id.* The process also involves drawing vectors from locations on the template tooth to point cloud of the scanned tooth. *Id.* ¶ 295. "[P]oints of the surfaces intersected by all the vectors are combined as newly generated triangle surfaces and therefore form one consistent surface." *Id.* Subsequently, "missing parts of the tooth are completed from the template tooth," which produces an object that is used in place of the template tooth in another iteration of the process. *Id.* Eventually, the process produces and displays for the user "an individual three-dimensional virtual tooth object." *Id.* ¶ 296.

Rubbert notes that

> [a] lack of data will always occur in the spaces between teeth since the scanner cannot usually capture images of the gaps between teeth effectively. A lack of data can also occur due to improper scanning. The lack of data can be cured to a certain extent by the modeling algorithm of **FIG. 58,** with the lack of data supplied by the template tooth, e.g., in the gaps between teeth, and adapting this template tooth to the scanned dentition as described above.

Id. ¶ 307. Rubbert elaborates that "[m]issing data or gaps from the tooth scan can also be filled from the template tooth using a simple interpolation

procedure, such as shown in [Figure] 65." *Id.* ¶ 308. Figure 65 is reproduced below.

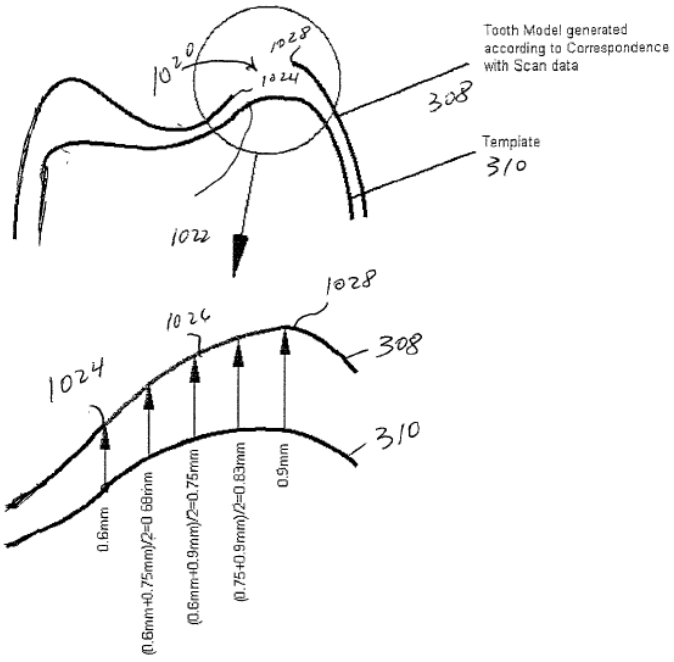

Fig. 65

Figure 65 shows tooth 308 with gap 1020, as well as a template tooth, which includes "surface 1022 that corresponds to [gap 1020]." *Id.* Using the template tooth and performing certain mathematical operations, Rubbert's process completes the surface of tooth 308. *Id.*

2. *Overview of Weyrich*

Noting that various application fields used 3D shape acquisition to create digital 3D surface data, Weyrich

> address[es] a variety of scanning artifacts that are created by common optical scanners and provides a comprehensive set of user-guided tools to process corrupted data sets. These include an eraser tool, low-pass [fi]lters for noise removal, a set of outlier detection methods, and various up-sampling and hole-[fi]lling tools.

Ex. 1007, Abstract. The tools disclosed by Weyrich include, among others, an eraser that "simply removes all selected points." *Id.* at 88. Another tool is the "*MLS spray can tool*," for "fill[ing] small holes in the geometry." *Id.* at 91. Operation of the spray can tool is illustrated in Figure 12, which is reproduced below.

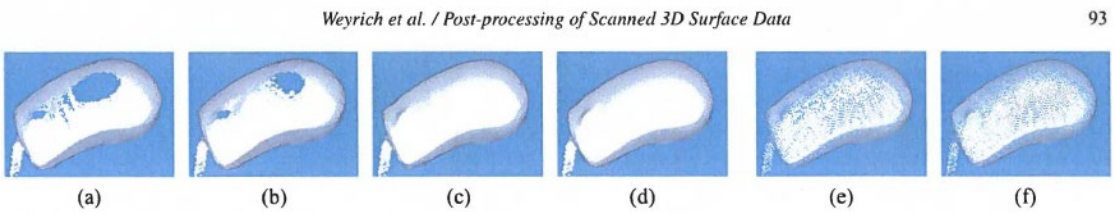

Figure 12: *Manual hole lling using the MLS spray can tool.* (a) *A poor scan of a computer mouse, containing a hole in the surface.* (b,c) *Gradually lling the hole using the MLS spray can.* (d) *Point relaxation improves the point distribution.* (e,f) *Versions of (c) and (d) with reduced splat radii to reveal the point distribution.*

Figure 12 shows the progression of a process of using the spray can tool to for "[m]annual hole [fi]lling" with "[a] poor scan of a computer mouse." *Id.* at 93.

Weyrich also discloses automatic hole filling using a volumetric diffusion process. *Id.* at 91. Weyrich illustrates the use of this technology in Figure 17, among other figures. Figure 17 is reproduced below.

Figure 17: *Robustness of the volumetric diffusion tool.* Left: *The furred object surface produces severe noise and outliers.* Center: *After the outlier removal, only little object points are left.* Right: *The volumetric diffusion tool still reconstructs a water-tight model.*

Figure 17 shows how "the hole filling tool is . . . capable of producing a water-tight model" of a scan of a furry reindeer, which "shows severe noise and a lot of outliers." *Id.* at 92.

3. *Discussion*

The Petition argues that Rubbert discloses intraoral scanning that produces teeth models potentially having gaps or holes, and Weyrich discloses techniques for addressing such errors. Pet. 11–12, 14–16. The Petition argues that a person of ordinary skill in the art would have had motivation to combine Weyrich's teachings with Rubbert, as well as a reasonable expectation of success in doing so. *Id.* at 15–21. The Petition then maps disclosures of Rubbert and Weyrich to the challenged claims. *Id.* at 24–50.

Patent Owner alleges numerous flaws in Petitioner's position that claims 1, 4–9, 11, 12, 15–20, and 22 would have been obvious over Rubbert and Weyrich. Patent Owner argues that Petitioner does not demonstrate that a person of ordinary skill in the art would have had motivation to combine Rubbert's and Weyrich's teachings, or a reasonable expectation of successfully doing so. Prelim. Resp. 2, 17–27. Patent Owner also argues that Rubbert and Weyrich do not teach certain limitations of the challenged claims. *Id.* at 2, 27–41.

Weighing the parties' arguments and evidence, we find Petitioner has demonstrated a reasonable likelihood of establishing obviousness of at least independent claim 1 over Rubbert and Weyrich. We turn now to detailed discussions of the disputes raised by the parties' arguments at this stage.

a) Independent Claim 1

(1) Whether a Person of Ordinary Skill in the Art Would Have Had a Reason to Combine Rubbert's and Weyrich's Teachings

Petitioner contends that a person of ordinary skill in the art would have been motivated to combine Weyrich's teachings with Rubbert's. Pet. 15. Petitioner explains that Rubbert discloses that teeth models generated from scan data can include holes or gaps. *Id.* Petitioner adds that Rubbert teaches filling these holes or gaps "from the template tooth using a simple interpolation procedure." *Id.* at 16 (quoting Ex. 1005 ¶ 308).

Petitioner argues that a person of ordinary skill in the art would have known that it would have been obvious to consult other references related to correcting errors related to missing data. *Id.* Petitioner asserts that a person of ordinary skill in the art would have recognized that Weyrich discloses tools applicable to errors in Rubbert's tooth model 308. *Id.* at 17. Petitioner argues that Weyrich discloses using "an eraser tool, a 'spray can' tool, and an automatic hole-filling tool" to address "scanning artifacts," which include "noise, outliers, holes, or ghost geometry." *Id.* (quoting Ex. 1007, Abstract, 91).

Regarding motivation to combine Weyrich's teachings with Rubbert's, Petitioner argues, among other things, that

> [a person of ordinary skill in the art] would have been motivated to introduce Weyrich's techniques into Rubbert's modeling process to provide the user a comprehensive set of tools to correct errors or holes in the 3D scan data. EX1002, ¶69. A [person of ordinary skill in the art] would have recognized that the combination of Rubbert and Weyrich is beneficial, *e.g.*, because it would have provided the user a more robust user interface with more tools to correct errors in scan data, such as holes. *Id.*

Id. at 18.

Petitioner adds that Weyrich discloses certain advantageous characteristics of its tools. For example, Petitioner argues that

> Weyrich itself explains that its tools, such as the "spray can" hole closing and automatic hole filling, "support an efficient scan cleaning process" and provide: (i) predictability; (ii) controllability; and (iii) intuitive handling. EX1007, 87. Weyrich also explains that the techniques proved to be "versatile and well-adaptable," and that most operations were "robust against sampling artifacts [*e.g.*, noise or holes] and do not impose any topological constraints on the data." *Id.*, 94. Weyrich describes that the techniques also provide an "efficient visual feedback loop." *Id.*, Abstract.

Id. at 18–19.

Petitioner also argues that the combination of the references' teachings would have produced predictable results, noting similarities between the technologies used by the references. *Id.* at 17–18. For example, Petitioner argues that Rubbert uses "a 'scanned point cloud'" and "Weyrich's techniques operate on the same data structure (a 3D point cloud), generated from the same type of device (an optical scanner), and address the same problems (*e.g.*, noise or holes in the model) as described in Rubbert." *Id.*

Patent Owner argues that "Weyrich may not be combined with [Rubbert] . . . to arrive at the claimed invention." Prelim. Resp. 17. Patent Owner argues that a person of ordinary skill in the art would have dismissed other considerations in favor of accuracy to ensure creation of a quality prosthesis. *Id.* Additionally, Patent Owner argues that Rubbert "does not purport to guess at what the scanned teeth actually look like based on any data in the existing model." *Id.* at 19. Instead, Patent Owner asserts,

Rubbert uses "data from another source," specifically "template tooth data to fill in the gaps." *Id.*

Patent Owner argues that Weyrich mostly relates to "*digital* use" of models for "large objects for which there is extremely limited or poor data," not to "constructing a functional physical duplicate of the original object." *Id.* at 19–20. Patent Owner notes that Weyrich only "mentions the medical field once in passing" and "does not mention the dentistry field anywhere in the paper." *Id.* at 20–21. Patent Owner argues that

> the purpose of dental scanning . . . is to build a physical duplicate of the scanned object that can function in a patient's body and interact with other teeth in the same way as the original. There is no indication that Weyrich's computer tools are appropriate for or even capable of such an application.

Id. at 21. Asserting that the prior art "is silent with respect to using [the volumetric diffusion technology underlying Weyrich's automatic hole-filling tool] in the medical or dentistry fields," Patent Owner concludes that "none of the cited references . . . identifies any shortcomings or advantages that would have suggested to a [person of ordinary skill in the art] any benefit from combining them." *Id.*

Patent Owner also argues that "Weyrich does not address the problems described in the '527 patent." *Id.* at 26. Specifically, Patent Owner argues that Weyrich's spray-can tool and computer-automated hole filling tool do not address the problem "that 3D models of a patient's oral structure may include gaps or holes due to obstructions 'by other agents, including, for example, accumulation of one or more of saliva, blood, lubricant used with a dental drill, [and] debris resulting from working the, dental *[sic]* site.'" *Id.* at 26–27.

Patent Owner contends that "Petitioner relies on the specification of the '527 patent for the motivation to combine Rubbert . . . with Weyrich." *Id.* at 21. Patent Owner argues that "[i]t is impermissible as a matter of law to use the teachings of the challenged patent itself as motivation to combine the prior art." *Id.* at 22.

Weighing the parties' arguments and evidence, we find Petitioner's demonstrate a reasonable likelihood of establishing that a person of ordinary skill in the art would have had motivation to combine Rubbert's and Weyrich's teachings. Contrary to Patent Owner's argument, Petitioner presents evidence of advantages associated with Weyrich's tools. *E.g.*, Prelim. Resp. 21. For example, as Petitioner notes, Weyrich explicitly teaches that it created its tools with a number of advantageous characteristics, including "[p]redictability," "[c]ontrollability," and "[i]ntuitive [h]andling." Ex. 1007, 87; Pet. 18. As Petitioner also notes, Weyrich further discloses that its tools "proved to be versatile and well-adaptable," providing "robust" operations. Ex. 1007, 94; Pet. 18–19. Patent Owner does not argue Weyrich's tools lack these characteristics. Considering Petitioner's evidence of advantages associated with Weyrich's tools, we find Petitioner has demonstrated a reasonable likelihood of establishing that a person of ordinary skill in the art would have had reason to combine them with Rubbert's teachings, such as to "provide the user a comprehensive set of tools to correct errors or holes in the 3D scan data," as well as "provide[] the user a more robust user interface with more tools to correct errors in scan data, such as holes." Pet. 18.

Patent Owner's arguments and evidence may demonstrate some limiting characteristics of Weyrich's tools for at least some purposes. Yet,

at this stage, they do not persuasively rebut Petitioner's showing of a reasonable likelihood of prevailing. For example, Patent Owner focuses on arguing that Weyrich's tools would not prove adequate for purposes of making a physical prosthesis. Prelim. Resp. 18–21. Even if accurate, this argument fails to recognize that Rubbert does not limit its use of 3D virtual modeling to production of a physical prosthesis. For example, Rubbert discloses using its 3D virtual model for "treatment planning." Ex. 1005 ¶ 3–5, 332–341. This includes, for instance, using the 3D virtual model "for simulating the movement and positioning of teeth relative to each other in planning treatment for the patient." *Id.* ¶ 339. Additionally, like Rubbert, the challenged claims do not require using the 3D virtual model for producing a physical prosthesis. *E.g.* Ex. 1001, 13:60–14:11.

Also, Petitioner argues that it would have been obvious to modify Rubbert's disclosure to have Weyrich's tools *in combination* with the tools Rubbert already includes. Pet. 18, 20 ("A [person of ordinary skill in the art] also would have understood the benefits of retaining the ability to use template teeth while adding Weyrich's additional user interface tools to provide greater user flexibility in resolving errors in the scan data."). To the extent Weyrich's tools did not have apparent application for physical prostheses, they may well have had apparent application for other tasks within the scope of Rubbert's disclosure.

Moreover, evidence of disadvantages associated with Weyrich's tools does not preclude a conclusion that it would have been obvious to combine Weyrich's tools with Rubbert's. "The fact that the motivating benefit comes at the expense of another benefit, however, should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another.

Instead, the benefits, both lost and gained, should be weighed against one another." *Winner Int'l Royalty Corp. v.* Wang, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000). Here, the parties' evidence of advantages and disadvantages raises fact-intensive questions best-suited for resolution on a fuller record developed during trial.

Additionally, we find unavailing Patent Owner's argument that Weyrich does not address the same problem as the '527 patent. Prelim. Resp. 26–27. In evaluating Petitioner's obviousness assertions, we must consider more than whether the cited references address the same problem as the '527 patent. Indeed, we must "consider a range of real-world facts to determine 'whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.'" *Intercont'l Great Brands LLC v. Kellogg N. Am. Co.*, 869 F.3d 1336, 1344 (Fed. Cir. 2017) (quoting *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 418 (2007)). Here, Petitioner's arguments and evidence demonstrate a reasonable likelihood of establishing that a person of ordinary skill in the art had an apparent reason to combine the references' teachings, even if they do not address expressly the same problem as the '527 patent.

Furthermore, although the portion of the Petition addressing motivation cites to the '527 patent, we do not find that fatal to Petitioner's challenge. Pet. 19; *see also* Prelim. Resp. 21 ("Petitioner relies on the specification of the '527 patent for the motivation to combine Rubbert and Babayoff with Weyrich, citing the '527 patent specification's teaching that any known technique can be used to implement the extrapolation and interpolation needed to generate the second 3D data."). Excluding the Petition's citation of the '527 patent in connection with motivation, the

Petition's other arguments and evidence suffice to demonstrate a reasonable likelihood of establishing motivation.

(2) Whether a Person of Ordinary Skill in the Art Would Have Had a Reasonable Expectation of Success

Petitioner contends that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Rubbert's and Weyrich's teachings. Pet. 20–21. Petitioner argues, for example, that "[a person of ordinary skill in the art] would have known that Weyrich's tools (such as the eraser, spray can, or automatic hole filling) were generally well-known and easily implemented into Rubbert's virtual modeling system." *Id.* at 20.

Patent Owner argues that a person of ordinary skill in the art would not have expected success in combining Weyrich's teachings with Rubbert's. Prelim. Resp. 23–25. Patent Owner argues that Weyrich's photos demonstrate its tools provide a level of accuracy and precision insufficient for "the patented dental system." *Id.* at 23–24. For example, Patent Owner asserts that Weyrich's techniques do not provide the level of precision required by the invention "since the objective of the method shown in [Weyrich's] Figure 18 is to close geometric forms, not achieve proper occlusion through a prosthetic recreation of an irregular object as claimed." *Id.* at 24 (footnote omitted).

When weighing the parties' arguments and evidence, we note that

> [t]he reasonable expectation of success requirement refers to the likelihood of success in combining references to meet the limitations of the claimed invention. "[F]ailure to consider the appropriate scope of the . . . patent's *claimed invention* in evaluating the reasonable expectation of success . . . constitutes a legal error that [is] review[ed] without deference."

Intelligent Bio-systems, Inc. v. Illumina Cambridge, Ltd., 821 F.3d 1359, 1367 (Fed. Cir. 2016) (quoting *Allergan, Inc. v. Apotex Inc.*, 754 F.3d 952, 966 (Fed. Cir 2014)).

With respect to at least claim 1 of the '527 patent, we find Petitioner sufficiently shows that a person of ordinary skill in the art would have had a reasonable expectation of successfully adding Weyrich's tools to Rubbert's system and manipulating data in the manner required by the claim. For purposes of institution, Petitioner's evidence shows sufficiently that adding Weyrich's tools to Rubbert's system would have been straightforward and predictable for a person of ordinary skill in the art. For example, Petitioner provides evidence that Weyrich's "tools make extensive use of basic techniques . . . which are well-known in [the] point graphics community" (Ex. 1007, 86), that "[a person of ordinary skill in the art] would have known that Weyrich's tools (such as the eraser, spray can, or automatic hole filling) were generally well-known and easily implemented into Rubbert's virtual modeling system" (Ex. 1002 ¶ 72), and that the combination would have been predictable (*id.*).

Patent Owner does not persuasively dispute Petitioner's evidence that it would have been straightforward for a person of ordinary skill in the art to add Weyrich's tools to Rubbert's system. Instead, Patent Owner emphasizes that "small mounds or protrusions" that Weyrich's tools allegedly would produce "would be disastrous" because "[a]ny errant protrusion from a dental prosthetic would prevent proper occlusion of the patient's teeth." Prelim. Resp. 24. This argument is unavailing because it is not commensurate in scope with the claims, which do not require producing a physical prosthesis. *E.g.*, Ex. 1001, 13:60–14:11.

(3) Claim Limitation 1.4

Claim limitation 1.4 recites "determining a missing portion of the 3D virtual model that are missing a portion of the intraoral structure of the patient." Addressing this limitation, Petitioner cites both Rubbert and Weyrich. Pet. 30–33. For example, Petitioner cites Rubbert's disclosure that "missing parts of the tooth are completed from the template tooth." Ex. 1005 ¶ 295; Pet. 30. Petitioner also cites Rubbert's disclosure that "[m]issing data or gaps from the tooth scan can also be filled from the template tooth using a simple interpolation procedure, such as shown in [Figure] 65." Ex. 1005 ¶ 308; Pet. 30. Petitioner argues that "Weyrich also discloses determining a missing portion of a 3D virtual model." Pet. 32.

As noted in Section II.C.1 above, Patent Owner takes the position that the proper construction of limitation 1.4 requires a missing portion in the 3D virtual model due to an obstruction in the scan. Prelim. Resp. 13. Also in the claim construction portion of the Preliminary Response, Patent Owner suggests that Rubbert and Weyrich do not disclose limitation 1.4 because "the prior art does not disclose the concept of a model missing a target portion of a dental structure due to the inclusion of an obstruction." *Id.*

Weighing the parties' arguments and evidence, we find Petitioner has shown sufficiently that the combination of Rubbert and Weyrich teaches or suggests claim limitation 1.4. We reach this result even under Patent Owner's construction of limitation 1.4 as requiring a missing portion of the 3D virtual model due to an obstruction in the scan.

In particular, we find that Petitioner has demonstrated a reasonable likelihood of establishing that at least Rubbert teaches or suggests

determining a missing portion of a 3D virtual model that results from an obstruction in the scan. Dr. Mellor testifies that

> Rubbert explains a lack of data arises when scanning due to constraints in the oral cavity, such as the area between adjacent teeth. EX1005, ¶[0307]; *see also id.* ¶[0300](describing gums and other teeth obstructing a single tooth). Accordingly, I believe that a [person of ordinary skill in the art] would have understood Rubbert discloses a method for scanning obstructed intraoral structures of a patient.

Ex. 1002 ¶ 79. Dr. Mellor also testifies that

> [a]s explained above with respect to the preamble of claim 1, I believe Rubbert discloses that the virtual model includes missing portions due to 3D data of obscuring material. EX1005, ¶[0305] (discussing extraneous anatomical structures obscuring the tooth model). Rubbert also explains "the scanner cannot usually capture images of the gaps between teeth effectively," which I believe a POSITA would understand to mean the tooth edges obscure the narrow gaps between the teeth. EX1005, ¶[0307].

Id. ¶ 116.[7] This evidence tends to demonstrate that Rubbert teaches or suggests determining a missing portion of a 3D virtual model resulting from an obstruction in the scan.

At this stage, Patent Owner does not persuasively rebut this evidence. Patent Owner argues that "[t]he intraoral structure or a portion thereof may be missing in the 3D virtual model *due to* obscuring material, such as saliva, blood, lubrication fluid, debris." Prelim. Resp. 39. Then, Patent Owner

[7] The Petition cites paragraphs 79 and 116 of Dr. Mellor's testimony in connection with claim 1's preamble and claim 11, respectively, not in connection with limitation 1.4. Pet. 25, 46. It appears this happened because claim 1's preamble recites "obstructed intraoral structures" and claim 11 recites "obscuring material," whereas limitation 1.4 does not say anything about an obstruction. Ex. 1001, 13:60–61, 14:3–5, 14:39–40.

argues that "Rubbert describes anatomical structures as soft tissue, bone, or gum," which Patent Owner contends "are not 'obscuring material.'" *Id.*

The Specification of the '527 patent conflicts with Patent Owner's suggestion that "obscuring material" cannot be "soft tissue, bone, or gum." For example, the '527 patent discloses that

> it is often the case that when scanning the intraoral cavity to obtain 3D data of the preparation and finish line on which the virtual model is based, part of the finish line, and possibly also the shoulder and other parts of the preparation, may be *obscured* by *soft tissues* such as the *gum* that, no longer being pushed by the dental surfaces that have been removed, deform to cover at least a part of the finish line on the prepared dental site.

Ex. 1001, 2:4–11 (emphasis added).

(4) Claim Limitation 1.5

Claim limitation 1.5 recites "generating second 3D data representing the intraoral structure of the missing portion of the 3D virtual model." Ex. 1001, 14:6–8. Petitioner argues that "[t]he combined disclosures of Rubbert and Weyrich render this limitation obvious." Pet. 33. Petitioner asserts that Weyrich's "spray can" tool and its automatic hole-filling algorithm each teach producing data that represents a missing part of a 3D virtual model. *Id.* at 33–35. Addressing limitation 1.5's recitation of an "intraoral structure," Petitioner contends that "Weyrich's error-correction tools render obvious generating second 3D data representing the structure of the missing portion of the 3D virtual model and adding that feature to Rubbert's system (which models 'intraoral' structures) would have been obvious." *Id.* at 35.

Patent Owner argues that Rubbert and Weyrich do not teach limitation 1.5, asserting that

> [t]he '527 patent generates second 3D data based on extrapolated or interpolated data taken from the existing 3D model. EX1001, 10:65-11:3 ("When this operation has been repeated for all the cross-sections, a 3-dimensional virtual third model part 530 corresponding to the extrapolated data may be created by the computer by properly integrating the created data, and the user may view the results together with or separately from the first model part 510."). The patent is clear that the second 3D data is generated by *creating* it from internal information, not by acquiring it from an external source as required by Rubbert or Weyrich's spray can tool. For that reason, the claimed second 3D data represents the intraoral structure of the missing portion of the model. Weyrich's tools, on the other hand, compensate for sparse data in a portion of the model that may be of poor quality, but not missing entirely.

Prelim. Resp. 27–28.

Weighing the parties' arguments and evidence, we find Petitioner's arguments and evidence are sufficient at this stage of the proceeding. For example, contrary to Patent Owner's argument, the record evidence does tend to show that Weyrich's tools address portions of a model that are "missing entirely." Petitioner cites Weyrich's Figure 12, which shows "[m]anual hole [fi]lling using the MLS spray can tool." Ex. 1007, 93; Pet. 33–34. Additionally, Petitioner cites Weyrich's disclosure of "Automatic Hole Filling" using volumetric diffusion. Ex. 1007, 91; Pet. 34. The cited portions of Weyrich disclose addressing portions of models with a "hole[s]," which appear to be entirely missing portions of the model. *E.g.*, Ex. 1007, 93, Figs. 12, 17, 18.

Additionally, we find unavailing Patent Owner's argument that "the second 3D data is generated by *creating* it from internal information, not by acquiring it from an external source as required by Rubbert or Weyrich's spray can tool." Prelim. Resp. 28. As noted above in Section II.C.2, Patent

Owner's position that the patent excludes reliance on an "external source" like "a human operator's judgment" conflicts with the '527 patent's disclosure of relying on user for "extrapolations" of "missing data." Ex. 1001, 10:38–50. Moreover, even if the '527 patent did exclude reliance on an external source, Patent Owner does not allege that Weyrich's automatic hole-filling tool relies on an external source.

(5) Claim Limitation 1.6

Claim limitation 1.6 recites "combining the second 3D data with the 3D virtual model such that the 3D virtual model includes a representation of the intraoral structure in place of the missing portion." Ex. 1001, 14:9–11. Petitioner argues that "[t]he combined disclosures of Rubbert and Weyrich render obvious combining the second 3D data with the 3D virtual model such that the 3D virtual model includes a representation of the intraoral structure in place of the missing portion." Pet. 36. Petitioner asserts that Rubbert discloses filling gaps in intraoral structures and Weyrich discloses "generating second 3D data, *e.g.*, using the spray can tool or automatic hole filling, to fill in holes or areas with sparse data." *Id.* Petitioner further argues that "Weyrich's generated data is then combined with the 3D virtual model to fill in holes or sparse areas of the model." *Id.* Petitioner reasons that the combination of Weyrich's hole-filling approaches and Rubbert's modeling of intraoral structures renders obvious limitation 1.6.

Patent Owner argues that Petitioner erroneously mixes and matches characteristics of Weyrich's different tools. Prelim. Resp. 28.

Patent Owner argues that "Weyrich's spray can tool does not teach combining the second 3D data with the 3D virtual model. *Id.* at 29. Patent Owner contends that "[t]he spray can is merely another tool for inputting

data from an external source (a human operator's judgement) rather than the claimed generating data using computer projections of existing information." *Id.* Patent Owner also argues that a person of ordinary skill in the art would not have considered Weyrich's spray can tool for use with a virtual dental model. *Id.* at 29–30.

Patent Owner further argues that the volumetric diffusion process of Weyrich's automatic hole filling tool "does not teach combining the second 3D data with the existing 3D model." *Id.* at 30. Arguing that "the patent claims require the generation of additional data points," Patent Owner contends that the volumetric diffusion process only moves existing data points. *Id.*

Patent Owner also argues that Petitioner erroneously mixes and matches characteristics of Weyrich's different tools. Prelim. Resp. 28. According to Patent Owner, Petitioner "improperly picks and chooses attributes from different embodiments and tools disclosed in Weyrich that do not form a single embodiment as recited in the claims." *Id.* at 30–31.

We find Petitioner has demonstrated a reasonable likelihood of establishing that limitation 1.6 would have been obvious over Rubbert and Weyrich. Petitioner cites viable evidence that Weyrich's process with the spray can tool involves generating data and combining that data with a 3D virtual model. *E.g.*, Ex. 1002 ¶ 93; Pet. 33. Petitioner also cites viable evidence that Weyrich's process of automatic hole-filling with volumetric diffusion involves generating data and combining that data with a 3D virtual model. *E.g.*, Ex. 1002 ¶ 95; Pet. 35.

We find unavailing Patent Owner's argument that Weyrich's spray can tool relies on a human user's input. Prelim. Resp. 29. As explained

above in Section II.C.2, the '527 patent's disclosure conflicts with Patent Owner's position that the claimed invention excludes reliance on input from a user. *See*, Ex. 1001, 10:35–50. Weighing the parties' arguments and evidence, we find Petitioner demonstrates sufficiently, for purposes of instituting an *inter partes* review, that the combination of Weyrich's spray can tool with Rubbert's disclosure would have rendered limitation 1.6 obvious.

We also find unavailing Patent Owner's argument that a person of ordinary skill in the art would not have considered using Weyrich's spray can tool for dental applications. Prelim. 29–30. This argument relates to whether a person of ordinary skill in the art would have had reason to combine the references' teaching and/or a reasonable expectation of success. As explained in Sections II.D.3.a.1 and II.D.3.a.2 above, Petitioner has shown sufficiently that a person of ordinary skill in the art would have had motivation and a reasonable expectation of success for combining the references' teachings.

Regarding Weyrich's automatic hole-filling technique using volumetric diffusion, Petitioner cites evidence that the disclosed process creates new data points. *E.g.*, Ex. 1002 ¶ 95; Pet. 35. Although, Patent Owner argues to the contrary (Prelim. Resp. 30–31), we find at this stage that Petitioner has demonstrated a reasonable likelihood of prevailing. We find it best to resolve this fact-intensive issue based on a fuller record developed during trial.

Petitioner has demonstrated a reasonable likelihood of prevailing with respect to claim limitation 1.6 based at least on Weyrich's spray can tool combined with Rubbert's teachings. Thus, contrary to Patent Owner's

suggestion, it does not appear that Petitioner's position necessarily rests on mixing and matching Weyrich's embodiments, let alone doing so improperly.

(6) Summary—Alleged Obviousness of Claim 1 over Rubbert and Weyrich

Having considered the parties' arguments and evidence, we find Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claim 1 would have been obvious over Rubbert and Weyrich.

b) Independent Claim 12

Petitioner argues that "[t]he only difference between independent claims 1 and 12 is that claim 12 defines a system with a hand-held scanner and a computer having instructions that, when executed, cause the system to perform the method recitations of claim 1." Pet. 47. Petitioner argues that Rubbert discloses a hand-held scanner. *Id.* at 47–48. Petitioner also argues that "[t]he limitations of claim 12 that the computer is caused to perform are identical to claim 1, and so the discussion above demonstrates why the combined disclosures of Rubbert and Weyrich render elements 12.1 and 12.2a-12.2e obvious." *Id.* at 50. Therefore, Petitioner contends that Rubbert and Weyrich render claim 12 obvious.

Patent Owner argues that Petitioner "fails to show a reasonable likelihood that claim[] 12 . . . [is] likely unpatentable for the same reasons" that Patent Owner alleges Petitioner fails to show a reasonable likelihood of prevailing on its assertion that claim 1 would have been obvious over Rubbert and Weyrich. Prelim. Resp. 41.

In view of the parties' arguments and evidence with respect to the challenge of claim 1 as obvious over Rubbert and Weyrich, and having considered Petitioner's arguments and evidence regarding the challenge of

claim 12 as allegedly obvious over Rubbert and Weyrich, we find Petitioner has demonstrated a reasonable likelihood of establishing obviousness of claim 12 over Rubbert and Weyrich.

c) Dependent Claims 4–9, 11, 15–20, and 22

The parties' arguments and evidence regarding dependent claims 4–9, 11, 15–20, and 22 raise numerous fact-intensive questions that are best-suited for resolution on a fuller record. Pet. 38–47, 50; Prelim. Resp. 31–42. Given this, and given Petitioner's demonstration of a reasonable likelihood of demonstrating obviousness of independent claims 1 and 12, we find it warranted to institute *inter partes* review with respect to all claims challenged in Ground 1. *See SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1354, 1359–60 (2018); 37 C.F.R. § 42.108(a) ("When instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim.").

E. GROUND 2 – ALLEGED OBVIOUSNESS RUBBERT, WEYRICH, AND BABAYOFF

Relying on arguments and evidence cited in Ground 1, Petitioner, in Ground 2, argues that it would have been obvious to combine Babayoff's teachings with those of Rubbert and Weyrich, citing Babayoff's teachings to address certain limitations in challenged dependent claims 2, 3, 13, and 14. Pet. 15, 21–24, 37–38, 50. Patent Owner does not dispute the merits of Ground 2 separately from Ground 1. Prelim. Resp. 15–42. Based on our above-discussed review of Ground 1, and having considered the Petitioner's arguments and evidence in Ground 2, we find it warranted to institute review of Ground 2 with respect to claims 2, 3, 13, and 14.

F. GROUND 3 – ALLEGED OBVIOUSNESS DURBIN, WEYRICH, AND BABAYOFF

In Ground 3, Petitioner argues that claims 1–9, 11–20, and 22 would have been obvious over Durbin, Weyrich, and Babayoff. Pet. 50–75. Building on its position that the Office's prior consideration of Rubbert '041 weighs in favor of a § 325(d) discretionary denial, Patent Owner argues that Durbin is cumulative to Rubbert, further compelling a denial under § 325(d). Prelim. Resp. 43–45. As discussed above in Section II.A, we disagree with Patent Owner's argument that the Office's prior consideration of a reference related to Rubbert weighs in favor of a § 325(d) denial. Considering the parties' arguments and evidence for Ground 3 in concert with the arguments and evidence for Grounds 1 and 2, we find it warranted to institute review of Ground 3 with respect to claims 1–9, 11–20, and 22.

III. CONCLUSION

For the foregoing reasons, we institute an *inter partes* review of all challenged claims under all grounds set forth in the Petition.

Our determination at this stage of the proceeding is based on the evidentiary record currently before us. This decision to institute trial is not a final decision as to patentability of any claim for which *inter partes* review has been instituted. Our final decision will be based on the full record developed during trial.

IV. ORDER

For the reasons given, it is:

ORDERED that an *inter partes* review is instituted on all challenged claims under all challenged grounds; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(a), *inter partes* review of the '527 patent is hereby instituted commencing on the

entry date of this Decision, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial.

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