

Filed on behalf of Patent Owner

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DENTAL IMAGING TECHNOLOGIES CORPORATION
Petitioner

v.

3SHAPE A/S
Patent Owner

Case No. IPR2024-00849
Patent 10,695,151

PATENT OWNER'S PRELIMINARY RESPONSE

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I. INTRODUCTION

Patent Owner, 3Shape A/S (“3Shape” or “Patent Owner”), submits this Patent Owner’s Preliminary Response to the Petition for *Inter Partes* Review (“Petition” or “Pet.”) filed by DENTAL IMAGING TECHNOLOGIES CORPORATION (“DITC” or “Petitioner”) against U.S. Patent No. 10,695,151 (EX1001, “the ’151 Patent”). This paper is timely filed pursuant to 37 C.F.R. §42.207(b) and the Notice of Filing Date Accorded to Petition and Time for Filing Patent Owner Preliminary Response (Paper 5).

II. STATEMENT OF THE PRECISE RELIEF REQUESTED

Patent Owner requests that the Board deny institution of the Petition with respect to all challenged claims and all asserted grounds. A full statement of the reasons for the relief requested is set forth in Sections III-VI below.

III. THE ’151 PATENT

The ’151 Patent discloses a method, a user interface and a system for use in determining shade of a patient’s tooth, wherein a digital 3D representation including shape data and texture data for the tooth is obtained. EX1001, Abstract. A tooth shade value for at least one point on the tooth is determined based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values. *Id.* EX2017, ¶33.

Claims 1, 13 and 14 of the '151 Patent are challenged in this IPR. All other challenged claims directly or indirectly depend from Claims 1, 13 or 14. Each of the independent claims is reproduced below.

1. A method for determining shade of a patient's tooth, wherein the method comprises:

obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth; and

determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values,

wherein the method comprises deriving a certainty score expressing the certainty of the determined tooth shade value.

13. A method for determining shade of a patient's tooth, wherein the method comprises:

obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth; and

determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values,

wherein the method comprises creating a shade profile for the tooth from shade values determined one or more points on the tooth, wherein the tooth shade profile comprises a one or more tooth shade regions on the tooth surface where an average tooth shade is derived for each region from tooth shade values determined for a number of points within the region.

14. A method for determining shade of a patient's tooth, wherein the method comprises:

obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth; and

determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values,

wherein obtaining the digital 3D representation of the tooth comprises recording a series of sub-scans of the tooth, where at least one of said sub-scans comprises both texture information and geometry information for said tooth, and generating the digital 3D representation of the tooth from the recorded series of sub-scans.

Petitioner fails to demonstrate unpatentability of the challenged claims for at least the reasons set forth below.

IV. CLAIM CONSTRUCTION

The standard for claim construction in *inter partes* review is the “ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. §42.100(b). Petitioner states “[f]or purposes of this proceeding only, Petitioner submits constructions for only the following term; all other claim terms should be given their plain and ordinary meaning.” Pet. at 11.

Petitioner applies the claim construction for the term “deriving a certainty score” recited in Claim 1 as adopted by the District Court in the parallel litigation. The District Court construed this term to mean “determining an accuracy value based on the tooth shade value, the texture data, and/or texture information.” EX1003 at 3.

The decision on whether to institute trial is not dependent on the constructions that the parties offered in the parallel litigation. Nevertheless, Petitioner fails to demonstrate a reasonable likelihood of success under any construction whether it be its asserted constructions here or its asserted constructions in the district court.

V. ARGUMENT

Institution should be denied because Petitioner has failed to establish a reasonable likelihood that the Petitioner would prevail with respect to any ground or any challenged claim.

The Director may not authorize an *inter partes* review to be instituted unless the Director determines that the information presented in the petition filed under 35 U.S.C. §311 and any response filed under 35 U.S.C. §313 show that there is a reasonable likelihood that the Petitioner would prevail with respect to at least one of the claims challenged in the petition. 35 U.S.C. §314(a); 37 C.F.R. §42.108(c).

The Petition sets forth six grounds of alleged unpatentability. Pet. at 3-4.

In Ground 1, Petitioner alleges that Claims 1, 12, 14, and 15 are unpatentable under 35 U.S.C. §102 as anticipated by Korten.

In Ground 2, Petitioner alleges that Claims 1, 2, 4, 5, 9, and 12-16 are unpatentable under 35 U.S.C. §103 as obvious based on Korten and Lehmann II.

In Ground 3, Petitioner alleges that Claims 10, 16, and 17 are unpatentable under 35 U.S.C. §103 as obvious based on Korten, Lehmann II, and Babayoff.

In Ground 4, Petitioner alleges that Claims 1, 2, 9, 12, and 14-16 are unpatentable under 35 U.S.C. §103 as obvious based on Korten and Lehmann I.

In Ground 5, Petitioner alleges that Claim 13 is unpatentable under 35 U.S.C. §103 as obvious based on Korten and Pye.

In Ground 6, Petitioner alleges that Claims 10, 16 and 17 are unpatentable under 35 U.S.C. §103 as obvious based on Korten and Babayoff.

To establish anticipation of a claimed invention under 35 U.S.C. §102, Petitioner must identify where in a single reference each and every element of the

claimed invention is disclosed in in the prior art. “A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). “The identical invention must be shown in as complete detail as is contained in the ... claim.” *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989).

To establish obviousness of a claimed invention under 35 U.S.C. §103(a), Petitioner must establish that “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person of ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007) (citing *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966)). A patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was known, independently, in the prior art. *See KSR*, 550 U.S. at 418.

Further, the appropriate inquiry into obviousness requires that “one must have a motivation to combine accompanied by a reasonable expectation of achieving what is claimed in the patent-at-issue.” *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367 (Fed. Cir. 2016). Thus, the requirement for a

motivation to combine references is separate from the requirement for a person of ordinary skill in the art to have a reasonable expectation of success in combining the cited references to meet the limitations of the claimed invention. *Id.* See also *In re Merck & Co., Inc.*, 800 F.2d 1091 (Fed. Cir. 1986).

“[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006); see also *KSR*, 550 U.S. at 418.

The Petition does not adequately explain where each of the challenged claims are found in Korten alone or in the combination of Korten and the asserted secondary references. Further, the Petition does not provide articulated reasoning based on rational underpinnings for why one of ordinary skill in the art would have modified the asserted art to arrive at the claimed invention.

Petitioner fails to demonstrate a reasonable likelihood of success with respect to all challenged claims and all grounds presented in the Petition. The deficiencies of the Petition as they relate to independent Claims 1, 13 and 14 are discussed below. Each of the deficiencies of the independent claims are equally applicable to each of the challenged dependent claims.

A. Petitioner fails to demonstrate a reasonable likelihood of success that Petitioner would prevail with respect to at least one of the claims challenged in Ground 1

Petitioner asserts under Ground 1 that Claims 1, 12, 14, and 15 are anticipated by Korten. Pet. at 23-30. Petitioner fails to establish a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in Ground 1. Korten does not disclose each of the features of independent Claims 1 and 14. Thus, none of Claims 1, 12, 14 or 15 are anticipated by Korten. EX2017, ¶36.

1. Korten does not disclose [Claim 1b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values”

Petitioner asserts that Korten discloses “matching at least the first color with a standard color from a standard color scheme.” Pet. at 25. Petitioner further asserts that Korten describes that “[s]uch a standard color scheme may for example correspond to the widely used VITAPANTM Classical tooth color scheme.” *Id.* at 25-26. However, Petitioner fails to explain how Korten discloses determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation. EX2017, ¶¶37-38.

As stated in the '151 Patent, “[d]etermining [] the tooth shade value from a digital 3D representation comprising both shape data expressing the shape of the

tooth and texture data expressing a texture profile of the tooth provides the advantage that [the] shade and geometry information are directly linked.” EX1001, 2:46-50. By determining the tooth shade value from data in the 3D digital representation, one gains numerous additional advantages. For example, determining the tooth shade value from data in the 3D representation allows the user to rely on multiple subscans of the same or different points or locations of the tooth. “Deriving the texture data based on texture information from two or more sub-scan[s] can provide a more accurate measurement of the texture data” *Id.*, 4:33-35. “The texture information [derived from] one sub-scan for a particular region of the tooth may be unreliable, e.g. due to the angle between the surface in this region and the scanner when this particular sub-scan was recorded.” *Id.*, 4:35-39. “The combination of texture information from several sub-scans can provide more reliable color.” *Id.*, 4:39-40. EX2017, ¶¶39-40.

“This approach has the advantage that the derived texture data of the digital 3D representation are not as sensitive to errors in the texture information of a single scan.” EX1001, 4:59-61. “Such errors can be caused by several factors. *Id.*, 4:62. “One factor is the angle between the optical path of the probe light at the tooth surface and the tooth surface itself.” *Id.*, 4:62-64. “When utilizing e.g. the focus scanning technique, the texture data for a point on the tooth is preferably derived from a number of sub-scans where at least some of the sub-scans are recorded at

different orientations of the scanner relative to the teeth.” *Id.*, 4:64-5:1. “The sections of the sub-scans relating to this point are hence acquired at different angles relative to the tooth surface in this point.” *Id.*, 5:1-4. This cannot be accomplished when one independently measures the color of a point on a tooth, compares that measured color with a tooth shade guide and thereafter correlates the tooth shade with a point in the 3D representation. EX2017, ¶¶40-41.

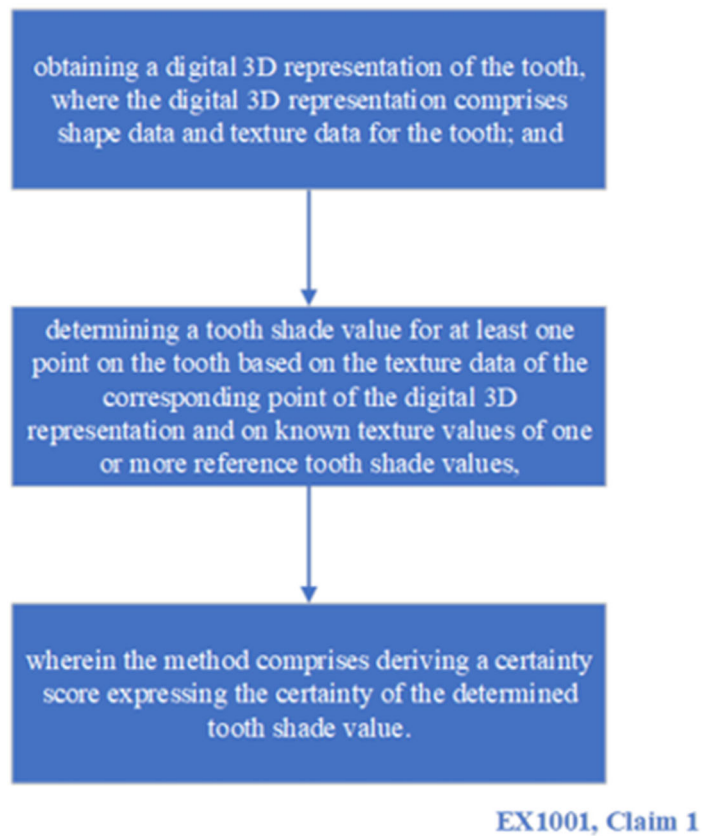
Korten makes no mention of determining a tooth shade value based on any data in a 3D representation. There is no disclosure of using texture data in a 3D representation for determining a tooth shade. There is no mention of using color data in a 3D representation for determining a tooth shade value. EX2017, ¶42.

The ’151 Patent describes and claims a method for determining a shade value of a point on a patient’s tooth. A step in the process is obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises both shape data and texture data for the tooth. EX1001, 2:5-15. Patent Owner understands that the ’151 Patent states that texture information comprises at least one of tooth color or surface roughness. EX1001, 2:37-38. Whether the texture data includes properties other than color is not relevant. What is relevant is that Claim 1 requires one to obtain a 3D representation having both shape and texture data (comprising at least one of color or surface roughness). EX2017, ¶43. Another step in the process is determining a tooth shade value for at least one point on the tooth based on the

texture data (comprising at least one of color and surface roughness) of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values. EX1001, 2:5-15. The 3D representation having both shape and texture data is obtained (not independently as in Korten) with an intra-oral scanner that obtains sub-scans of the scanned teeth from a plurality of 2D images. EX1001, 11:9-13. The generated digital 3D representation comprises shape data expressing the shape of the tooth and texture data (comprising at least one of color or surface roughness). EX1001, 11:57-59. The '151 Patent describes and claims first obtaining a digital 3D representation having texture (comprising at least one of color and surface roughness) and then determining tooth shade values based on data in the digital 3D representation. EX1001, 2:46-50, Claim 1. EX2017, ¶44.

A diagram of the method claimed in the '151 Patent is provided below.

Figure 1



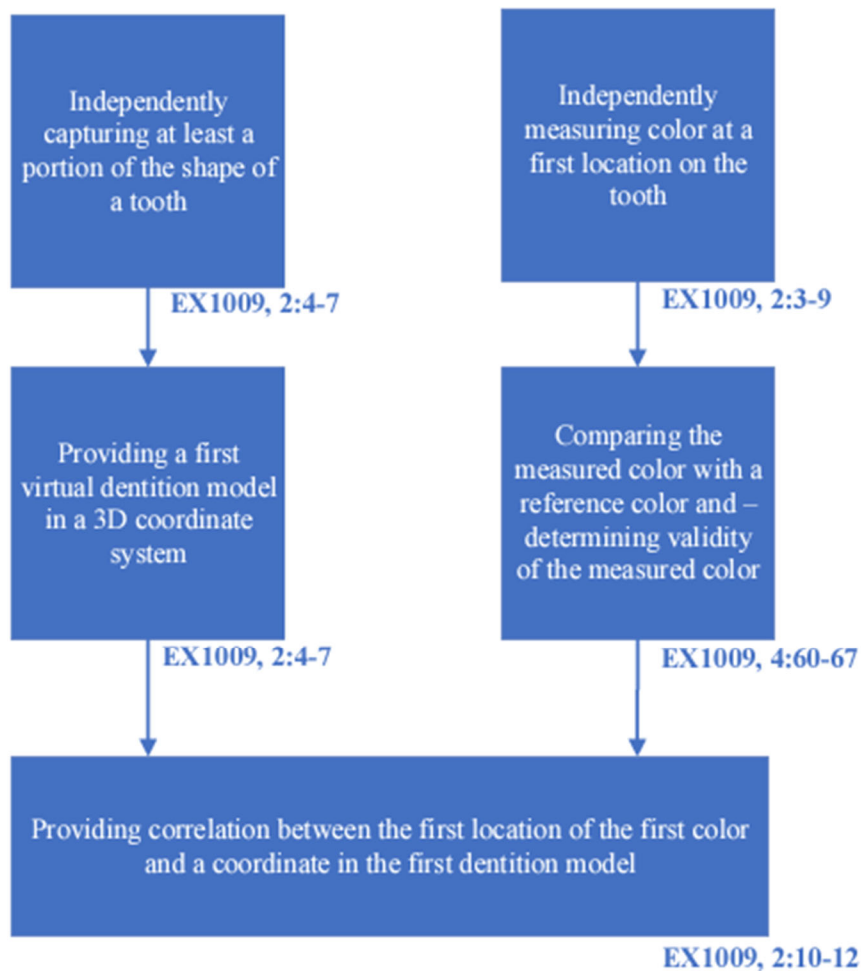
EX2017, ¶45.

Petitioner fails to describe how Korten discloses first obtaining a 3D representation including shape and color data (or any other texture data), and then determining a tooth shade value based on the color data of the corresponding point of the digital 3D representation. Petitioner makes no mention of providing tooth shade based on the data of a point on a 3D representation. Instead, Korten discloses comparing a directly measured tooth color with reference tooth shade values. *See, e.g.,* EX1009, 5:28-41. EX2017, ¶46.

Petitioner asserts that “Korten discloses that color data is captured on a point-by-point basis such that each captured XYZ location on the surface of the tooth will have color data that corresponds to that point on the tooth.” Pet. at 26. According to Petitioner, Korten’s reference to “the first color” corresponds to the color obtained for a location on the tooth. Pet. at 26. Petitioner explicitly states that this “relationship is even more explicit in the relevant disclosure in Korten because the reference to the ‘first color’ corresponds to the color obtained for the first location, or point, on the patient’s tooth” Pet. at 26. However, obtaining color of a point on the tooth is not the same as providing tooth shade based on texture data of the corresponding point of a 3D digital representation having both shape data and texture data (comprising at least color or surface roughness). EX2017, ¶47.

A diagram of the method claimed in Korten is provided below to clearly illustrate the distinct differences between the ‘151 Patent and Korten.

Figure 2



EX2017, ¶48.

As shown above in Figure 2, Korten obtains a dentition model without color. Korten measures color on a tooth and before placing the color into the dentition model compares the measured tooth color with a reference color. Thereafter, Korten correlates color with a coordinate in its dentition model. EX2017, ¶49.

As shown above in Figure 1, Claim 1 of the '151 Patent requires first creating a 3D representation including at least color or surface roughness. It then uses data

from the 3D representation containing at least color or surface roughness and known values of one or more reference tooth shade values to determine tooth shade. In contrast, and as shown in Figure 2, Korten obtains a dentition model without color. EX2017, ¶50.

Korten provides no disclosure of using color data from a 3D representation to determine a shade value. Korten discloses comparing color with a reference shade before there is a correlation of the color and location of the dentition model. EX2017, ¶51.

Korten operates in this manner because it obtains the shape of a tooth using a first optical sensor while independently measuring the color at a location on the tooth using a second optical sensor (which Korten contemplates as preferably being part of a spectrometer). *See, e.g.*, Ex. 1009 at 2:64-4:40; 8:45-10:18; FIGs. 2-4. In particular, Korten specifically describes the separate optical arrangement that is used to independently obtain the shape of the tooth from measuring color. *See id.* This allows Korten to compare the measured color with a reference color without any need to reference the 3D model. *See id.* EX2017, ¶52.

2. Korten does not disclose [Claim 1c]: “wherein the method comprises deriving a certainty score expressing the certainty of the determined tooth shade value.”

Petitioner asserts that Patent Owner has argued that the term “deriving a certainty score” means “determining an accuracy value based on the tooth shade

value, the texture data, and/or texture information.” Pet. at 27. In fact, this is the construction applied by the District Court. EX1003 at 3. However, Petitioner fails to provide any explanation as to how Korten describes determining a certainty score or accuracy value of a tooth shade value. Instead, Petitioner states that “a POSITA would understand that the technology in Korten calculates a ‘certainty score’ under this construction because it measures how accurately the standard color data for each standard tooth shade value matches the color data from the patient’s tooth.” Pet. at 27. There are no underlying facts in support of the assertion that a POSITA would understand that the technology in Korten calculates a “certainty score.” The Director has been clear that institution should be denied when the expert declaration presents conclusory assertions without underlying factual support and repeats verbatim the petitioner’s argument. *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 (PTAB Aug. 24, 2022), Paper 12 (PTAB Feb. 10, 2023).

Petitioner asserts that “Korten discloses that the color data from the location on the patient’s tooth may be compared to the standard color data from a standard color data scheme to find a matching standard color. Pet. at 26. Petitioner further asserts that Korten describes that it is desirable to provide “precise color measuring,” and that the technology it describes is directed towards “minimizing errors in color measurement.” *Id.* According to Petitioner, a POSITA would understand the disclosure in Korten regarding “matching at least the first color with a standard

color” to be referring to finding a standard color that closely matches the first color. *Id.* at 26-27. However, Petitioner fails to explain how any of these statements amount to deriving a certainty score expressing the certainty or accuracy of the determined tooth shade value as opposed to the measured tooth color. EX2017, ¶53.

As explained above, the tooth shade value of Claim 1 is obtained from data in the 3D representation containing shape and texture data (comprising at least one of color or surface roughness). In contrast, Korten does not disclose obtaining a tooth shade value based on data in a 3D representation containing both shape and color data—it discloses comparing a tooth color with a reference color. EX2017, ¶54.

Korten explicitly states that “the method further comprises the step of comparing the measured first color with a reference color, and—depending on the degree of similarity or the match between the measured first color and the reference color—determining the validity of the measured first color.” EX1009, 4:60-64. That is, Korten discloses determining similarity between a measured tooth color and a reference color. But, that is not what Claim 1 requires. Claim 1 requires (1) determining a tooth shade value based on data of a corresponding point of the 3D representation and on known texture values of one or more reference tooth shade values and then (2) deriving a certainty score expressing the certainty of the determined tooth shade value. See Figure 1 above. The tooth shade value is based on data in the 3D representation instead of from a tooth directly as disclosed in

Korten. The certainty score in Claim 1 is of the tooth shade value of the 3D representation not the validity of the color measured from the tooth as in Korten. Again, Korten does not disclose obtaining a tooth shade value based on data in a 3D representation containing both shape and color data. EX2017, ¶¶55-56.

Korten's color matching of a tooth color with a reference color does not involve obtaining a certainty score of a tooth shade value that is based on data in a digital 3D representation. Korten discloses comparing color with a reference shade before there is a correlation of the color and location of the dentition model. EX2017, ¶57.

The '151 Patent describes using the certainty score to determine whether the "determined tooth shade value" in the 3D representation is acceptable. EX1001, 6:52-56. This may be based on the comparison of the derived certainty score and the range of acceptable certainty score values, e.g., where it is decided that the determined tooth shade value is acceptable if the certainty score is within the range of acceptable values. *Id.* In some embodiments, if large variations are found in the texture information in the vicinity of the parts corresponding to the point for a substantial fraction of the sub-scans, the texture data derived therefrom may be unreliable and the tooth shade value derived for this point is accordingly not very reliable. EX1001, 7:9-13. In other embodiments, the certainty measure relates to

how close the texture data is to the known texture value of the determined tooth shade value. EX1001, 7:14-20. EX2017, ¶58.

Petitioner asserts that the system in Korten would need to compare the color data of the first color with each of the standard colors to find the closest match. Pet. at 27. Petitioner further asserts that Korten discloses “comparing the measured first color with a reference color, and—depending on the degree of similarity or the match between the measured first color and the reference color—determining the validity of the measured first color.” Pet. at 27. According to Petitioner, Korten further discloses that “[a] mismatch between the measured first color and the reference color may trigger a further method step of issuing an error signal,” and that the limits for finding an acceptable mismatch “may be adjustable.” Pet. at 27. However, Korten’s color matching of a tooth color with a reference color does not involve obtaining a certainty score of a tooth shade value that is based on data in a digital 3D representation. Korten describes independently obtaining shape and color and then correlating the color into an XYZ coordinate system. Again, Korten operates in this manner because it obtains the shape of a tooth using a first optical sensor while independently measuring the color at a location on the tooth using a second optical sensor (which Korten contemplates as preferably being part of a spectrometer). *See, e.g.*, EX1009 at 2:64-4:40; 8:45-10:18; FIGs. 2-4. In particular, Korten specifically describes the separate optical arrangement that is used to independently obtain the

shape of the tooth from measuring color. *See id.* This allows Korten to compare color with a reference shade before there is a correlation of the color and location of the dentition model. EX1009, 4:62-64. EX2017, ¶¶59-63.

Petitioner and Dr. Foroosh further assert that Korten discloses “comparing the measured first color with a reference color, and—depending on the degree of similarity or the match between the measured first color and the reference color—determining the validity of the measured first color.” *See* Pet. at 27; EX1009, 4:60–5:6; EX1015, ¶115. However, as stated above, measuring the validity of the measured first color of a tooth is not the same as “deriving a certainty score expressing the certainty of the determined tooth shade value.” The measured first color in Korten is the color measurement of the tooth, whereas the determined tooth shade value in Claim 1 is based on data of a corresponding point on a digital 3D representation containing both shape and texture data (comprising at least one of color and surface roughness). *See* Claim 1. Korten does not describe using data from a 3D representation to determine either tooth shade or a certainty score. EX2017, ¶64.

3. **Korten does not disclose [Claim 14b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values”**

Petitioner asserts that Korten discloses Element 14b. Pet. at 28. Petitioner fails to satisfy its burden with respect to challenged Claim 14. For the same reasons Korten does not disclose or suggest [Claim 1b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values” Korten does not disclose or suggest the limitations of Claim 14b. *See* §V.A.1. EX2017, ¶65.

4. **Korten does not disclose [Claim 14c]: “wherein obtaining the digital 3D representation of the tooth comprises recording a series of sub-scans of the tooth, where at least one of said sub-scans comprises both texture information and geometry information for said tooth, and generating the digital 3D representation of the tooth from the recorded series of sub-scans.”**

Petitioner asserts that Korten discloses Element 14c. Pet. at 28. Petitioner is mistaken. The Petition does not point to any disclosure in Korten of this feature of Claim 14. As already recognized on pages 26-28 of the ID that issued in related IPR2023-01315 (EX2019), this is a weakness in the arguments of the Petition. Simply put, Petitioner’s assertions fail to describe how Korten discloses “recording a series of sub-scans ... where at least one of said subscans comprises both texture

information [comprising at least one of color or surface roughness] and geometry information for said tooth, and generating [a] digital 3D representation of the tooth from the recorded series of sub-scans,” as recited in Claim 14. EX2017, ¶66.

Korten discloses capturing data from a patient’s dentition with the steps of capturing the shape of a tooth and independently measuring a color at a location on the tooth using separate sensors. EX1009, Abstract; *see also* Figure 2 above. There is no disclosure of a sub-scan containing both shape and color because Korten obtains shape and color independently. Korten discloses capturing shape through the use of a scanner that “captures continuous 3D video images.” EX1009, at 4:2436. Separately, Korten captures color using an optical sensor preferably a spectrometer which measures color at a point on the surface of a tooth. *Id.*, at 2:3142. The method and system “allows for capturing shape and for measuring the color in independent steps” and thereafter “providing a correlation between the captured shape and the location at which the color is measured. *Id.*, at 1:9-12. That is, “independent from capturing the shape,” Korten measures color at a point on the tooth. *Id.*, at 2:8-9. Thereafter, Korten provides “a correlation” between the color and “a coordinate in the dentition model.” *Id.*, at 2:10-12. Petitioner fails to demonstrate that Korten discloses a sub-scan comprising both texture (comprising at least color or surface roughness) information and geometry information for a tooth or generating the

digital 3D representation of the tooth from a recorded series of subscans. EX2017, ¶¶67-69.

The '151 Patent discloses a system for determining shade of a patient's tooth comprising a scanner capable of recording a digital 3D representation of the tooth where the digital representation comprises shape data and texture data (at least color or surface roughness) for the tooth. EX1001, 10:60-64. The 3D representation can be generated from the recorded sub-scans. *Id.*, at 11:38-40. The sub-scans of the scanned teeth are reconstructed from a plurality of acquired 2D images. *Id.*; EX1001, 15:30-33 (“For instance a focus scanner can record series of 2D color images for the generation of sub-scans.”); 15:59-61 (“the individual sub-scans of the tooth are derived from a sequence of 2D images”). The generated digital 3D representation formed by such a procedure comprises shape data expressing the shape of the tooth. The texture information of the sub-scans can be used in various ways to provide that the generated digital 3D representation also comprises texture data (comprising at least one of color or surface roughness) expressing a texture profile of the tooth. *Id.*, 11:57-59. EX2017, ¶70.

Petitioner asserts that Korten discloses “measuring a second color at a second location on the same tooth or a further tooth in the patient's dentition, the second location being different from the first location.” Pet. at 29. But measuring color at a second point on a tooth or a further tooth is not a sub-scan let alone a sub-scan

containing both texture information (comprising at least color or surface roughness) and geometry information. EX2017, ¶71.

Petitioner asserts that the “the first optical sensor may capture ‘the shape of that further tooth and based thereon updating the first virtual dentition model by the shape of the further tooth.’” Pet. at 29. But Korten’s first optical sensor only captures shape. It does not capture color. Further, providing a dentition model of a second tooth is not a sub-scan of a single tooth as required by Claim 14. Further, updating the first dentition model is not generating a digital 3D representation of the tooth from a recorded series of sub-scans. There is no mention of recording, Korten only states “updating.” There is also no scan that provides color information used in generating a digital 3D representation. Korten discloses measuring color with a spectrometer at a point of a tooth and after the 3D dentition is prepared correlating the point of color to the 3D dentition. EX2017, ¶72.

Petitioner further argues that Korten discloses that “[t]he measured colors may be mapped relative to the first virtual dentition model at coordinates which correspond to the location at the dentition.” Pet. at 29. However, mapping color to the virtual dentition is not a sub-scan containing texture information (comprising at least color or surface roughness) and geometry information. There is no sub-scan containing both color and geometry. The recorded sub-scans in Claim 14 are not the

3D representation itself. Instead, the recorded sub-scans are used to generate the 3D representation. EX2017, ¶73.

Petitioner asserts that “[t]he capture of the first location corresponds to the first sub-scan in this claim limitation, and the capture of shape and color data associated with the second location correspond to the second sub-scan.” Pet. at 29. According to Petitioner, “[b]y incorporating the shape and color data from the second subscan into the location coordinates determined for the first scan, the disclosed system in Korten generates the 3D representation using this series of subscans.” *Id.* However, none of the scans described by Korten include capture of texture information (comprising at least color or surface roughness) and geometry information in a single sub-scan. Korten explicitly discloses capturing color and shape independently. EX1009, Abstract, 1:9-12, 2:1-12. Further, while Petitioner describes “updating” the first virtual model, it does not explain where in Korten it describes recording a series of sub-scans and generating a digital 3D representation of a tooth from the recorded series of sub-scans. As indicated above, Korten explicitly discloses obtaining shape with a first sensor and independently obtaining color with a second sensor. Thereafter, there is provided a correlation between the location of the color and a coordinate in the captured shape. EX1009, 2:10-13. EX2017, ¶¶74-75.

In the ID of related IPR2022-01315 at page 29, the panel states that “the parties should develop whether limitation 14[c] requires the at least one subscan to collect shape and color data simultaneously.” In fact, Claim 14 does not require collection of the shape and color data at the same instance within the sub-scanning period, but it does require a subscan to have collected shape and color data through the sub-scanning process and within the sub-scanning period. That is, it is the sub-scan process that collects both color and shape, not separate and independent data collection processes as in Korten. Korten discloses scanning for shape. Korten does not collect color within that scanning process. Instead, Korten discloses measuring color on a point of the tooth and then correlating that data with the shape data. EX2017, ¶¶76-77.

Petitioner fails to satisfy its burden with respect to the challenged dependent claims for at least the reasons discussed above with respect to Claims 1 and 14. Thus, for the reason stated above, Petitioner fails to satisfy its burden with respect to Ground 1.

B. Petitioner fails to demonstrate a reasonable likelihood of success that Petitioner would prevail with respect to at least one of the claims challenged in Ground 2

Petitioner asserts that Claims 1, 2, 4, 5, 9, and 12-16 would have been obvious over Korten in view of Lehmann II. Pet. at 30. However, Petitioner fails to establish a reasonable likelihood that Petitioner would prevail with respect to at least one of

the claims challenged in Ground 2. Neither Korten nor Lehmann II independently or combined disclose each of the features of independent Claims 1, 13 and 14. Further, a POSITA would not have been motivated to combine Korten with Lehmann II as Petitioner suggests. Thus, none of Claims 1, 2, 4, 5, 9, or 12-16 would have been obvious over the combination. EX2017, ¶78.

1. Claims 1, 2, 4, 5, 9 and 12-16 would not have been rendered obvious by the combination of Korten and Lehmann II

Petitioner asserts that Claims 1, 2, 4, 5, 9, and 12-16 would have been obvious over Korten in view of Lehmann II. Pet. at 30. Neither Korten nor Lehmann II alone or in combination disclose each of the features of independent Claim 1. Further, a POSITA would not have been motivated to combine Korten with Lehmann II as Petitioner suggests. Thus, none of Claims 1, 2, 4, 5, 9, or 12-16 would have been obvious. EX2017, ¶79.

a. Lehman II does not disclose [Claim 1b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade value”

Petitioner asserts that Lehmann II discloses this limitation. Pet. at 30. Petitioner is mistaken. Petitioner fails to explain how Lehmann II determines a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of a 3D digital representation. EX2017, ¶80.

Petitioner first quotes Lehmann II as saying that “[t]he identification of tooth shade(s) is generally made by comparing the determined tooth color to a plurality of electronically stored tooth shades.” Pet. at 30. According to Petitioner, the system in Lehmann II “associates one or more of the plurality of tooth shades with at least one standardized shade” by comparing “the chromaticities and RGB representations” of the tooth color and the reference teeth. *Id.* Petitioner further asserts that Lehmann II discloses that “[t]he color information of the patient’s tooth may be compared to the plurality of tooth shade guides on a pixel-by-pixel basis.” *Id.* However, Lehmann II discloses the use of a digital camera connected to a tooth shade analyzer subsystem. EX1011, Title, ¶[0027]. “A shade analyzer sub-system is in electrical communication with the intraoral camera, and preferably has (i) a color processing section for determining the color of the patient’s tooth from the color information of the image; (ii) storage memory for storing shade information representative of a plurality of tooth shades (i.e., each of the tooth shades corresponds to a different tooth color), (iii) a color correlation section for comparing the color of the patient’s tooth to the plurality of tooth shades and for identifying a tooth shade with a color corresponding to the color of the patient’s tooth” EX1011, ¶[0042]. Like Korten, Lehmann II makes no reference to determining a tooth shade value based on the texture (comprising at least one of color or surface roughness) data of the corresponding point of a digital 3D representation. In fact, Lehmann II makes no

reference to a digital 3D representation containing shape and texture data at all. EX2017, ¶¶81-82.

- b. Lehmann II does not disclose [Claim 1c]: “wherein the method comprises deriving a certainty score expressing the certainty of the determined tooth shade value.”**

Petitioner asserts that Lehmann II discloses this limitation. Pet. at 31. Petitioner is mistaken. Petitioner fails to explain how Lehmann II discloses deriving a certainty score expressing the certainty of the determined tooth shade value. EX2017, ¶83.

Petitioner asserts that Lehmann II relates to technology “for determining a patient’s tooth shade.” Pet. at 31. Petitioner further asserts that, “[t]he identification of tooth shade(s) is generally made by comparing the determined tooth color to a plurality of electronically stored tooth shades.” Pet. at 31. According to Petitioner, “a comparison of the RGB values is made between the tooth image data 52 and the several shades to find a best fit or match.” Pet. at 31. Once again, Petitioner fails to explain how any of these statements amount to deriving a certainty score or accuracy value expressing the certainty of the determined tooth shade value. Lehmann II does not disclose obtaining a certainty score or accuracy value of the tooth shade based on data on the texture of a digital 3D representation containing shape and texture data. Comparing colors or finding the best match is simply not the same as obtaining

a certainty score or accuracy value let alone the expression of the certainty of the determined tooth shade value as recited in Claim 1. EX2017, ¶¶84-85.

Petitioner asserts that a POSITA would understand that finding the “best fit or match” necessarily involves determining accuracy values based on (i) the texture data (*e.g.*, color data) of the reference tooth shades and (ii) the texture data (*e.g.*, the color data) of the point on the patient’s tooth because the “best fit or match” will correspond to the most accurate value. Pet. at 31. Petitioner cites to Dr. Foroosh (EX1015, ¶139) in support of this assertion. However, Dr. Foroosh merely repeats what is stated in the Petition. Neither Petitioner nor Dr. Foroosh describe how Lehmann II discloses reference to a shade value or a certainty score of the shade value based on data in a 3D representation containing shape and color data. Again, Lehmann II makes no reference to a digital 3D representation at all. EX2017, ¶86.

c. A POSITA would not have been motivated to combine accuracy features in Lehmann II with the system disclosed in Korten with a reasonable expectation of success

Petitioner asserts that a POSITA would be motivated to include the “best fit” technology from Lehmann II into the shape and color measuring system from Korten. Pet. at 31; EX2017, ¶87. Petitioner is mistaken. As recognized in the ID of related IPR2023-01315 at pages 30-31, Petitioner’s contentions concerning motivation to combine Korten and Lehmann II seem to focus on a motivation for using Lehmann’s teachings of the subject matter of limitation 1[c], and does not address Petitioner’s

reliance on Lehmann II for the subject matter of limitation 1[b], which recites the step of “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values.”

Petitioner first asserts that both references disclose overlapping technology related to providing image, color, and tooth shade information. Pet. at 31. Petitioner next asserts that although Lehmann II is directed towards the analysis of 2D images, whereas Korten is directed towards rendering and displaying 3D models, this difference is immaterial as it relates to determining the certainty score of the selected tooth shade value. *Id.* at 31-32. Petitioner cites to Dr. Foroosh (EX1015, ¶141) in support of this assertion. However, once again, Dr. Foroosh merely repeats the petition without any underlying facts supporting the assertion. *Id.* EX2017, ¶88.

Further, the technology described in Korten is not overlapping with the technology described in Lehmann II as it relates to providing image, color, and tooth shade information. Korten describes using a spectrometer with a multiplicity of different color filters for measuring color. EX1009, 2:31-55. Lehmann II discloses the use of a camera to capture tooth shade, and then compares the image to reference images. EX1011, ¶[0063]. Petitioner makes no attempt to explain how to combine these very different technologies. EX2017, ¶89.

Petitioner was further well-aware of the issues associated the combination of 2D images and 3D models as was previously argued in the POPR and addressed in the institution decision in IPR2023-00400. In that matter, like here, Petitioner and its expert failed to explain how a POSITA could have successfully combined the 2D imaging systems and shade guides with a 3D imaging system in to arrive at the claimed step of determining a shade value. *See* EX1016, pp. 32-34. Here, similar to the failures of the Petitioner in IPR2023-00400 in providing motivation to combine and expectation of success, Petitioner's assertions lack merit. Korten discloses adding color for a point in the independently obtained 3D representation. Lehmann II discloses the use of a solid state camera to capture tooth shade, and then compares the image (as opposed to a point) to reference images. EX1011, ¶[0063]. EX2017, ¶90. Integrating color data for a point into a 3D representation is very different from associating an image with a 3D representation as required from the combination of Korten and Lehmann II. Imagine mapping a point to a 3D model as described in Korten to mapping an image (which requires extensive registration) to a 3D model as described in Lehmann II. There is no explanation in the petition as to how to integrate Lehmann II's 2D image containing color into Korten's 3D representation containing no color. EX2017, ¶91. Lehmann II discloses the use of images, not points as disclosed in Korten.

- There is no explanation how a POSITA would have implemented the devices described in Lehmann II in the Korten system such that the 2D color image in Lehmann II would be appropriately registered into the 3D representation of Korten.
- There is no explanation how one might associate a Z-coordinate of Korten with the 2D color data of the color image acquired by the Lehmann II camera.
- There is no explanation of how a POSITA would have Korten's processor align the 2D color image areas obtained by the Lehmann II camera with the 3D entity previously created by Korten, and then provide color values to the entity at the appropriately registered X-Y-Z points.
- There is no explanation of how one would associate an existing shade guide useful with a particular camera with the data gathered by Korten's imaging system.

EX2017, ¶92.

Petitioner is also well aware of the problems associated with using a spectrometer from IPR2023-00400. In the prior IPR, Patent Owner asserted that Petitioner has failed to address in the Petition the difficulties in using spectrophotometers to obtain color data of a tooth. EX1016, pp. 34-35. “[T]he data

obtained using the spectrophotometric approach . . . has been found difficult to implement in practice.” *See* U.S. Patent No. 8,208,704, issued on June 26, 2012, to Wong and Milch (“Wong”) (EX2020, 3:54-58). *Id.* “The use of a light scanning component for measuring different spectral components, generally employing a grating or filter wheel, tends to make the spectrophotometric system fairly bulky and complex.” *Id.*, 3:58-61. “This makes it difficult to measure teeth toward the back of the mouth.” *Id.* “Attempts to alleviate this problem have not shown great success.” *Id.* at 3:61-64. “To obtain a color mapping of an entire tooth surface requires numerous separate measurements with this approach.” *Id.*, 4:4-6. “The image capture process is time-consuming and does not provide consistent results.” *Id.*, 4:6-8. “Color mappings can be inaccurate using such an approach, since there can be considerable sensitivity to illumination and image capture angles and probe orientation during the imaging process.” *Id.*, 4:8-12; EX2017, ¶93. Petitioner was well aware of these issues having cited IPR2023-00400 yet chose not to substantively address the issues.

Petitioner is also well-aware of the problems with associating 2D color with 3D representations from IPR2023-00400. *See* EX1016, pp. 35-36. Babayoff recognized that “[a]ssociating color information with three-dimensional objects is not straightforward, particularly when the position information is obtained by using a three dimensional scanning method, while the color information is obtained by

using a two dimensional scanning method.” EX2021, 2:12-16; *see also* EX2022, 1:31-35. “The problem of conformally mapping the two-dimensional color information onto the three-dimensional surface model is difficult and it is common for mismatching of the color with three-dimensional points to occur.” EX2021, 2:16-20. “Essentially, where two-dimensional color detectors are used for obtaining the color information, it is difficult to accurately associate color information from the detectors with the correct points on the three-dimensional surface model, particularly where relative movement between the object and the device occurs between the acquisition of the three-dimensional topological data and acquisition of the two-dimensional image data.” EX2021, 2:20-27; EX2017, ¶94. Petitioner was well aware of these issues having cited IPR2023-00400 yet chose not to substantively address the issues.

2. Claim 13 would not have been rendered obvious by the combination of Korten and Lehmann II

Petition asserts that Claim 13 would have been obvious based on Korten in view of Lehmann II. Pet. at 36-41. Petitioner is mistaken for at least the following reasons.

Neither Korten nor Lehmann II discloses each of the features of Claim 13. Further, Petitioner is incorrect that a POSITA would have had the motivation to combine Korten with Lehmann II to arrive at the claimed invention with a reasonable expectation of success. EX2017, ¶95.

- a. **Korten does not disclose [Claim 13b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values”**

Petitioner asserts that Korten discloses this feature of Claim 13. Pet. at 36.

Petitioner is mistaken. *See supra* §V.A.1.; *see also* EX2017, ¶96.

- b. **Korten does not disclose [Claim 13c]: “wherein the method comprises creating a shade profile for the tooth from shade values determined one or more points on the tooth”**

Petitioner asserts that Korten discloses this feature of Claim 13. Pet. at 36.

Petitioner is mistaken for at least the same reasons Korten does not disclose Element 13b. *See supra* §V.A.1.; *see also* EX2017, ¶97.

- c. **A POSITA would not have been motivated to combine the tooth-shade-determining and averaging feature for regions of a patient’s tooth disclosed in Lehmann II with the system disclosed in Korten**

Petitioner asserts that Claim 13 would have been obvious based on Korten in view of Lehmann II. Pet. at 39-41. Petitioner is mistaken. A POSITA would not have been motivated to combine the tooth-shade-determining and averaging feature for regions of a patient’s tooth disclosed in Lehmann II with the system disclosed in Korten. *See supra* §V.B.1.c.; *see also* EX2017, ¶98.

3. Claims 14-16 would not have been rendered obvious by the combination of Korten and Lehmann II

Petitioner asserts that Claims 14-16 would have been obvious based on Korten in view of Lehmann II. Pet. at 41-43. Petitioner is mistaken for at least the following reasons. Neither Korten nor Lehmann II discloses each of the features of Claim 14. Further, Petitioner is incorrect that a POSITA would have the motivation to combine Korten with Lehmann II to arrive at the claimed invention with a reasonable expectation of success. Thus, none of Claims 14-16 would have been obvious in view of the combination. EX2017, ¶99.

- a. Korten in view of Lehman II does not disclose [Claim 14b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values”**

Petitioner asserts that Korten in view of Lehman II discloses this element of Claim 14. Pet. at 42. Petitioner is mistaken. *See supra* §V.B.1.a.; *see also* EX2017, ¶100.

- b. Korten does not disclose [Claim 14c]: “wherein obtaining the digital 3D representation of the tooth comprises recording a series of sub-scans of the tooth, where at least one of said sub-scans comprises both texture information and geometry information for said tooth, and generating the digital 3D representation of the tooth from the recorded series of sub-scans.”**

Petitioner asserts that Korten discloses this element of Claim 14. Pet. at 42.

Petitioner is mistaken. *See supra* §V.A.4.; *see also* EX2017, ¶101.

- c. A POSITA would not have been motivated to combine the accuracy features in Lehmann II with the system disclosed in Korten**

Petitioner asserts that the motivation to combine the accuracy feature in Lehmann II with the system disclosed in Korten overlaps with the motivation to combine described with respect to Claim 1. Pet. at 42. Petitioner is mistaken. *See supra*, §V.B.1.c.; *see also* EX2017, ¶102.

- C. Petitioner fails to demonstrate a reasonable likelihood of success that Petitioner would prevail with respect to at least one of the claims challenged in Ground 3**

Petitioner asserts that Claims 10, 16, and 17 would have been obvious over Korten in view of Lehmann II and Babayoff. Pet. at 44-50. However, Petitioner fails to demonstrate a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in Ground 3. None of Korten, Lehmann II, or Babayoff either alone or in combination disclose each of the features of independent Claims 1 and 14. Petitioner asserts that the combination of Korten

with Lehmann II discloses each of the limitations of Claims 1 and 14. Pet. at 45. Petitioner is incorrect. *See supra* §V.B. Since Claims 1 and 14 would not have been obvious, Claims 10, 16, and 17 would not have been obvious. EX2017, ¶103.

D. Petitioner fails to demonstrate a reasonable likelihood of success that Petitioner would prevail with respect to at least one of the claims challenged in Ground 4

Petitioner asserts that Claims 1, 2, 9, 12, and 14-16 would have been obvious in view of Korten and Lehmann I. Pet. at 50. Petitioner fails to establish a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in Ground 4. Neither Korten nor Lehmann I disclose each of the features of independent Claims 1 and 14. Further, a POSITA would not have been motivated to combine Korten with Lehmann I as Petitioner suggests. Thus, none of Claims 1, 2, 9, 12, and 14-16 would have been obvious. EX2017, ¶104.

1. Claims 1, 2, 9, 12, and 14-16 would not have been rendered obvious by the combination of Korten and Lehmann I

Petitioner asserts that Claims 1, 2, 9, 12, and 14-16 would have been obvious over Korten in view of Lehmann I. Pet. at 50. Neither Korten nor Lehmann I alone or in combination disclose each of the features of independent Claim 1. Further, a POSITA would not have been motivated to combine Korten with Lehmann II as Petitioner suggests. Thus, none of Claims 1, 2, 9, 12, and 14-16 would have been obvious. EX2017, ¶105.

- a. **Korten in view of Lehman I does not disclose [Claim 1b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade value”**

Petitioner asserts that Korten in view of Lehmann I discloses this limitation.

Pet. at 50. Petitioner is mistaken. Neither Korten nor Lehmann I disclose this feature of the claimed invention. Here, Petitioner cites to Lehmann I as providing the requisite disclosures. *Id.* However, like Korten, Lehmann I does not provide a disclosure of determining a tooth shade value of a point on a tooth based on data of the corresponding point of a digital 3D representation containing both shape and color data. In fact, Lehmann I makes no reference to a 3D representation at all. EX2017, ¶¶106-107.

Petitioner asserts that in Lehmann I, a group of pixels covering a specific area of a tooth is identified, called a pseudo- pixel, and the intensity and color associated with the pseudo-pixel are computed by forming an average of the actual pixels. Pet. at 50. Petitioner further asserts that when this process is performed on a reference tooth, it results in a Reference Image, and when it is performed on a patient’s tooth, it results in a Real Image. *Id.* According to Petitioner, the color for the “Real Image is compared (i.e., correlated) to each Reference Image in the database” using a correlation algorithm and, the correlation results in a composite match number (“CMN”) that “indicat[es] how well the Real Image matches to that Reference Image.

Petitioner further asserts that the composite match numbers are compared to one another and one of the Reference Images is selected as the ‘best fit’ match to the Real Image.” *Id.* at 51. Petitioner does not point to any use of a 3D representation to determine a shade value. EX2017, ¶¶108-109.

In Lehmann I, a “camera captures digital color images of the tooth, which are processed to form pseudo-pixels corresponding to areas of the tooth surface, and then compared to images of tooth shades relating to reference shade guides.” EX1010, 3:27–31. “[T]he camera is equipped with a sleeve and illumination Subsystems that help reduce the variations in the color of digital images due to external factors.” *Id.*, 3:33–36. After taking images of known reference teeth colors, and images of subject teeth, each image is processed into “pseudo-pixels,” where “each pseudo-pixel 44 is made up of all or some of the real pixels within the area of the associated pseudo-pixel.” *Id.*, 5:5–62. Then, “the intensity and color associated with a pseudo-pixel are computed or otherwise formed as an average (or other statistical measure) of the actual pixels forming the pseudo-pixel.” *Id.*, 6:15–18. In a subsequent step:

each pseudo pixel of the REAL IMAGE is compared to each pseudo-pixel of the REFERENCE IMAGE; and a composite match number (“CMN”) is created indicating how well the REAL IMAGE matches to that REFERENCE IMAGE. The composite match numbers are compared to one another and one

of the REFERENCE IMAGES is selected as the “best fit” match to the REAL IMAGE.

Id., 9:35–42. Lehmann I does not disclose the use of a 3D representation to determine a shade value. EX2017, ¶109.

The '151 Patent describes and claims a method for determining shade of a patient's tooth including (1) obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises both shape data and texture data (which includes color data) for the tooth and (2) determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values. EX1001, 2:5-15; *see also* Figure 1 above. The 3D representation having both shape and texture data (including color) is obtained together with an intra-oral scanner that obtains sub-scans of the scanned teeth are reconstructed from a plurality of 2D images. EX1001, 11:9-13. The generated digital 3D representation comprises shape data expressing the shape of the tooth and texture data (including color and/or surface roughness) expressing a texture profile of the tooth. EX1001, 11:57-59. Instead of determining tooth shade values from measurements on the tooth, the '151 Patent describes and claims first obtaining a digital 3D representation having texture (including color and/or surface roughness) and then determining tooth

shade values based on the digital 3D. EX1001, 2:46-50; Claim 1. *See* Figure 1 above; *see also* EX2017, ¶110.

Petitioner fails to describe how Lehmann I discloses determining a tooth shade value for at least one point on the tooth based on data of the corresponding point of the digital 3D representation having both shape and color data. Lehmann I does not even disclose a process of making a 3D representation let alone a 3D representation containing both shape and color data. Thus, Lehmann I, like Korten, cannot disclose determining a tooth shade value based a point on a 3D representation and known texture values of one or more reference tooth shade values. There is no disclosure in either reference of first forming a 3D representation containing both shape and color data and then determining a tooth shade value based on the data of the 3D representation containing both shape and color data. Instead, both Korten and Lehmann I discloses comparing a measured tooth color with reference tooth shade. EX2017, ¶111.

b. Korten in view of Lehmann I does not disclose [Claim 1c]: “wherein the method comprises deriving a certainty score expressing the certainty of the determined tooth shade value.”

Petitioner asserts that Korten in view of Lehmann I discloses this limitation. Pet. at 51. Petitioner is mistaken. Petitioner asserts that Lehmann I relates to technology “for tooth shade determination using digital signal processing.” *Id.* Petitioner further asserts that, “color images of one or more teeth are analyzed and

compared to known tooth shades for use in certain clinical or cosmetic procedures.” *Id.* Moreover, according to Petitioner, “Lehmann I discloses the use of a [] correlation algorithm that results in a composite match number being determined that can be used to find a ‘best fit.’” *Id.* Once again, Petitioner fails to explain how any of these statements amount to deriving a certainty score or accuracy value expressing the certainty of the determined tooth shade value as required by Claim 1. Lehmann I does not disclose obtaining a certainty score of the tooth shade value based on data on the data of the digital 3D representation. Lehmann I does not disclose expressing the certainty of the determined tooth shade value. Comparing colors or finding the best match is simply not the same as obtaining a certainty score or accuracy value let alone the expression of the certainty of the determined tooth shade value as recited in Claim 1. EX2017, ¶¶112-114.

c. A POSITA would not have been motivated to combine accuracy features in Lehmann I with the system disclosed in Korten

Petitioner asserts that a POSITA would be motivated to include the “best fit” technology from Lehmann I into the shape and color measuring system from Korten. Pet. at 52-53. Petitioner is mistaken. For the same reasons that a POSITA would not have combined Lehmann II with Korten to arrive at the claimed invention, a POSITA would not have combined Lehmann I with Korten to arrive at the claimed invention. *See supra* §V.B.1.c.; *see also* EX2017, ¶115.

2. Claim 14 would not have been rendered obvious by the combination of Korten and Lehmann I

Petition asserts that Claims 14-16 would have been obvious based on Korten in view of Lehmann I. Pet. at 55-57. Petitioner is mistaken for at least the following reasons. Neither Korten nor Lehmann I discloses each of the features of Claim 14. Further, Petition is incorrect that one skilled in the art would have the motivation to combine Korten with Lehmann I to arrive at the claimed invention with a reasonable expectation of success. Thus, none of Claims 14-16 would have been obvious in view of the combination. EX2017, ¶116.

- a. Korten in view of Lehmann I does not disclose [Claim 14b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values”**

Petitioner asserts that Korten in view of Lehmann I discloses this element of Claim 14. Pet. at 55. Petitioner is mistaken. *See supra* §V.D.1.a.; *see also* EX2017, ¶118.

- b. Korten in view of Lehmann I does not disclose [Claim 14c]: “wherein obtaining the digital 3D representation of the tooth comprises recording a series of sub-scans of the tooth, where at least one of the sub-scans comprises both texture information and geometry information for said tooth, and generating the digital 3D representation of the tooth from the recorded series of sub-scans”**

Petitioner asserts that Korten discloses this feature of Claim 13. Pet. at 55.

Petitioner is mistaken. *See supra* §V.A.4.; *see also* EX2017, ¶118.

- c. A POSITA would not have been motivated to combine the accuracy features in Lehmann I with the system disclosed in Korten**

Petitioner asserts that the motivation to combine the accuracy feature in Lehmann I with the system disclosed in Korten overlaps with the motivation to combine described with respect to Claim 1. Petitioner is mistaken. For the same reasons that a POSITA would not have combined Lehmann II with Korten to arrive at the claimed invention, a POSITA would not have combined Lehmann I with Korten to arrive at the claimed invention. *See supra*, §V.B.1.c.; *see also* EX2017, ¶119.

- E. Petitioner fails to demonstrate a reasonable likelihood of success that Petitioner would prevail with respect to at least one of the claims challenged in Ground 5**

Petitioner asserts that Claim 13 would have been obvious over Korten in view of Pye. Pet. at 57. Petitioner is mistaken. Petitioner fails to demonstrate a reasonable likelihood that Petitioner would prevail with respect to the claims

challenged in Ground 5. Neither Korten nor Pye alone or in combination disclose each of the features of Claim 13. EX2017, ¶120.

1. **Korten does not disclose [Claim 13b]: “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values”**

Petitioner asserts that Korten discloses this feature of Claim 13. Pet. at 57.

Petitioner is mistaken. *See supra* §V.B.2.a.; *see also* EX2017, ¶121.

2. **A POSITA would not have been motivated to combine the tooth- shade-averaging features for regions of a patient’s tooth disclosed in Pye with the system disclosed in Korten with a reasonable expectation of success**

Petitioner asserts that a POSITA would be motivated to use the tooth-shade-averaging feature for tooth regions described in Pye in the system described in Korten. Petitioner, suggesting that a POSITA would be motivated to combine the teaching of Pye with Korten to arrive at Claim 13. Pet. at 59-60. Petitioner concludes that (1) a POSITA would be motivated to use the averaging technique for tooth regions described in Pye in the systems disclosed by Korten and (2) a POSITA would have a high expectation that such a combination would be successful. Pet. at 60. Petitioner is mistaken. EX2017, ¶122.

Pye relates to “tooth shade analysis tools.” EX1012, 1:6–7. Pye describes that “known techniques do not appear to desirably address limitations that exist in processing, communications, storage, and/or other capabilities with respect to

hardware or software equipment used in shade analyzing.” *Id.*, 2:34–38. To improve on known techniques, Pye discloses “tooth shade scan systems and methods . . . in which shade information for a restorative product for a patient’s tooth is obtained.” *Id.*, 2:43–46. Pye’s system “displays an image of the patient’s tooth and displays dividers by which an operator can divide the tooth into regions of interest or into regions that correspond to major tooth regions (e.g., the incisal, central, etc.).” *Id.*, 2:49–53. “Once regions of interest are identified, color characteristics for those regions are obtained.” *Id.*, 3:1–2; EX2017, ¶123.

Figure 5, reproduced below, shows

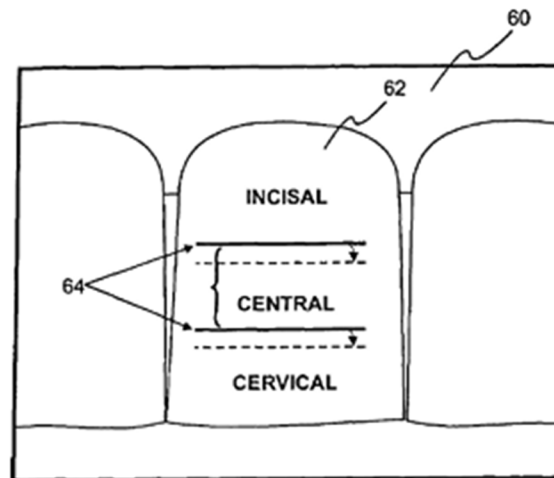


Figure 5 shows a diagram of a user interface in a shade analyzing system, showing image 60 or a patient’s mouth, with tooth 62, and lines 64 that divide the tooth into three regions: incisal, central, and cervical. EX1012, 7:51–61. Importantly, Pye discloses obtaining color characteristics of regions of interest. *Id.*, 3:1-9. Color

characteristics such as values for red, green, blue, intensity, and other characteristics may be obtained. *Id.* Average values over an area, such as a major tooth region, may be used for the color characteristics. *Id.* Thus, the color characteristics for several major regions of a tooth may be obtained. *Id.* EX2017, ¶¶124-125.

Korten describes that it associates color with at least one coordinate in the first dentition model based on the correlation between the location of the color and the coordinate in the first dentition model. EX1009, 4:41-45. Korten's color data is obtained and "stored in an appropriate format to define a unique position in a coordinate system, for example, in the format of X, Y, and Z coordinates based on an origin in a Cartesian coordinate system." *Id.* at 4:45-52. The association of color and at least one coordinate may be provided data based, for example by a virtual array defining associated data fields for storing colors. *Id.* EX2017, ¶126.

Neither Petitioner nor its expert provide any explanation how one might associate the areas or regions described in Pye with a point based system requiring the use of an X, Y, and Z coordinate system. Further, without such coordinates, one skilled in the art would not be able to obtain a virtual array defining associated data fields for storing colors and their associated coordinates. This is so because areas and regions are not points in and X, Y, and Z coordinate system. EX2017, ¶127.

Neither Petitioner nor its expert explain how a POSITA could have successfully combined the 2D imaging systems of Pye and the 3D imaging system of Korten to arrive at the claimed shade averaging feature of Claim 13.

- There is no explanation how a POSITA would have implemented the devices described in Pye in the Korten system such that the 2D color image in Pye would be placed into the 3D representation of Korten
- There is no explanation how one might associate a Z-coordinate of Korten with the color data obtained by the Pye 2D color image obtained by the Pye camera.
- There is no explanation of how a POSITA would have Korten's processor register the 2D color image areas obtained by the Lehmann II camera with the 3D entity previously created by Korten, and then provide color values to the entity at the appropriately registered X-Y-Z points.
- There is no explanation of how one would associate an existing shade guide acquired with a particular camera with the data gathered by Korten's imaging system.

EX2017, ¶128.

Again, Petitioner is also well-aware of the problems with associating 2D color with 3D representations from IPR2023-00400. *See* EX1016, pp. 35-36. Babayoff recognized that “[a]ssociating color information with three-dimensional objects is not straightforward, particularly when the position information is obtained by using a three-dimensional scanning method, while the color information is obtained by using a two-dimensional scanning method.” EX2021, 2:12-16; *see also* EX2022, 1:31-35. “The problem of conformally mapping the two-dimensional color information onto the three-dimensional surface model is difficult and it is common for mismatching of the color with three-dimensional points to occur.” EX2021, 2:16-20. “Essentially, where two-dimensional color detectors are used for obtaining the color information, it is difficult to accurately associate color information from the detectors with the correct points on the three-dimensional surface model, particularly where relative movement between the object and the device occurs between the acquisition of the three-dimensional topological data and acquisition of the two-dimensional image data.” EX2021, 2:20-27. Petitioner was well aware of these issues having cited IPR2023-00400 yet chose not to substantively address the issues. EX2017, ¶129.

F. Petitioner fails to demonstrate a reasonable likelihood of success that Petitioner would prevail with respect to at least one of the claims challenged in Ground 6

Petitioner asserts that Claims 10, 16, and 17 would have been obvious over Korten in view of Babayoff. Pet. at 61-62. Petitioner does not discuss the limitations of independent claims 1 and 14 under this ground. Apparently, Petitioner relies solely on Korten for the disclosure of the features of Claims 1 and 14. However, as discussed in §V.A and §V.B, Korten does not disclose each of the limitations of Claims 1 and 14. Since Claims 1 and 14 would not have been obvious, dependent Claims 10, 16 and 17 would not have been obvious. EX2017, ¶130.

G. The Petition should be denied under §325(d)

The claims at issue here were challenged in IPR2023-00400. Institution was denied. *See* EX1008. In the prior case, the Board stated:

We are unpersuaded that Petitioner has provided sufficient articulated reasoning, with adequate rational underpinnings, explaining why an ordinary artisan would have considered replacing Babayoff’s shade matching function with Chu’s shade matching function with a reasonable expectation of successfully arriving at the claimed subject matter. “[T]here must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006); *see also KSR*, 550 U.S. at 418 (“To facilitate review, this analysis should be made explicit.”)

Here, like in the prior IPR, Petitioner asserts combining 2D images multiple secondary references with the 3D representation of Korten without some rational underpinning to support the legal conclusion of obviousness. Petitioner's failure to address these issues should result in the Board using its discretion to deny institution.

More importantly, in the prior IPR, Patent Owner explained the deficiencies in the Petition of the combination of 2D images (here the secondary reference of Lehmann I and II with a 3D representation (here Korten). *See, e.g.*, EX 1016, pp.32-33. While art used in the present Petition is different than the art presented in the prior IPR, the art here suffers from the same deficiencies. Petitioner cites alternative art requiring the combination of 2D images with 3D representations to arrive at the claimed invention. Yet, like the prior Petitioner, the Petitioner cites to Expert testimony, unsupported by facts or evidence, in support of its assertions of motivation and reasonable expectation of success.

In the prior IPR, Patent Owner asserted that Petitioner has failed to address in the Petition the difficulties in using spectrophotometers to obtain color data of a tooth. EX1016, pp. 34-35. That "the data obtained using the spectrophotometric approach . . . has been found difficult to implement in practice." *See* EX2020, 3:54-58). "The use of a light scanning component for measuring different spectral components, generally employing a grating or filter wheel, tends to make the spectrophotometric system fairly bulky and complex." *Id.* at 58-61. "This makes it

difficult to measure teeth toward the back of the mouth.” *Id.* “Attempts to alleviate this problem have not shown great success.” *Id.* at 61-64. “To obtain a color mapping of an entire tooth surface requires numerous separate measurements with this approach.” *Id.* at 4:4-6. “The image capture process is time-consuming and does not provide consistent results.” *Id.* at 6-8. “Color mappings can be inaccurate using such an approach, since there can be considerable sensitivity to illumination and image capture angles and probe orientation during the imaging process.” *Id.* at 8-12.

In the prior IPR, Patent Owner asserted that even after the effective filing date of the ’151 Patent, the art including Babayoff himself recognized that “[a]ssociating color information with three-dimensional objects is not straightforward, particularly when the position information is obtained by using a three dimensional scanning method, while the color information is obtained by using a two dimensional scanning method.” EX1016; EX2021, 2:12-16; *see also* EX2022, 1:31-35. “The problem of conformally mapping the two dimensional color information onto the three dimensional surface model is difficult and it is common for mismatching of the color with three-dimensional points to occur.” EX2021, 2:16-20. “Essentially, where two-dimensional color detectors are used for obtaining the color information, it is difficult to accurately associate color information from the detectors with the correct points on the three dimensional surface model, particularly where relative movement

between the object and the device occurs between the acquisition of the three-dimensional topological data and acquisition of the two-dimensional image data.”

EX2021, 2:20-27.

Despite knowing of the prior IPR proceeding and even citing the relevant documents here, Petitioner did not address these arguments which at a minimum are evidence the secondary considerations of failures of others and skepticism by experts. The Board has cautioned petitioners in prior proceedings that petitions may be denied if they do not address known evidence. *See Stryker Corporation and Howmedica Osteonics Corp. v. KFX Medical, LLC*, IPR2019-00817, Paper 10 (PTAB Sep. 16, 2019), *Robert Bosch Tool Corp. v. SD3 LLC*, IPR2016-01751, Paper 15 (PTAB Mar. 22, 2017) (denying institution for failure to address objective indicia presented during an ITC proceeding); *see also Coalition for Affordable Drugs V LLC v. Hoffman–LaRoche, Inc.*, IPR2015-01792, Paper 14 (PTAB Mar. 11, 2016) (denying institution for failure to address objective indicia considered by Examiner during original prosecution); *see also Merial Ltd. v. Virbac*, IPR2014-01279, Paper 13 (PTAB Jan. 22, 2015) (denying institution for failure to address objective indicia considered by Examiner during original prosecution and noting “Merial was aware of the unexpected results showing which the Examiner found persuasive Merial should have addressed unexpected results in the first instance.”); *see also Omron Oilfield & Marine, Inc. v. MD/TOTCO A Division of Varco, L.P.*, IPR2013-00265,

Paper 11 (PTAB Oct. 31, 2013) (denying institution for failure to address objective indicia successfully argued in a reexamination).

Here, Petitioner's failure to address the known evidence weighs in favor of denying institution particularly when this is the second attack made on the subject patent through IPR proceeding.

H. The Petition should be denied under §314(a)

As discussed in Patent Owner's Opposition to Petitioner's Motion for Joinder (Paper 7) in this proceeding, the *Gen. Plastic Indus. Co. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 (P.T.A.B. Sept. 6, 2017) factors apply here and weigh in favor of denial of the Petition. Regarding those factors, (1) DITC does not dispute that it previously filed a Petition directed to most of the same claims of the same patent; (2) DITC failed to demonstrate whether at the time of filing its first Petition against the '151 Patent, DITC knew of the prior art asserted in the current Petition or should have known of it; (3) there is no dispute that DITC had received the Patent Owner's Preliminary Response to its first Petition and received the Board's decision on whether to institute review in the first Petition when DITC filed the current Petition; (4) DITC did not provide any statement or evidence that anyone outside of counsel for DITC (*e.g.*, DITC employees, privies of DITC, real parties in interest of DITC, or outside counsel for privies and real parties in interest of DITC) had not identified or considered the prior art references cited in the current Petition; (5) DITC

failed to provide an adequate explanation for the time elapsed between the multiple petitions directed to the same claims of the same patent or demonstrate that the present facts correlate to an extremely limited circumstance permitting institution and joinder; (6) DITC has taxed the finite resources of the Board.

Regarding *Gen. Plastic* Factor (2) in particular, DITC alleged that it did not have knowledge of “Korten” (EX1009), “Lehmann II” (EX1011), and “Pye” (EX1012). However, as discussed in Patent Owner’s Opposition, DITC should have reasonably been aware of the disclosures of (i) Korten, based on the face page of the ’151 Patent; (ii) Pye, based on the fact that Pye is the patent that issued from U.S. Appl. No. 10/678,543 which published as DITC’s previously asserted “Graham” reference; and (iii) Lehmann II, based on a the fact that related family members appear on the face page of DITC’s previously asserted prior art and in DITC’s Supplemental Invalidity Contentions.

As such, the present case is indistinguishable from *Apple Inc. v. Uniloc 2017 LLC*, IPR2020-00854, Paper 9 (P.T.A.B. Oct. 28, 2020). Here, as in Apple, “Petitioner’s understudy argument is not persuasive ... where the copied petition is Petitioner’s second challenge to the patent, and should [Medit] settle, Petitioner would stand in to continue a proceeding that would otherwise be terminated.” *Id.*, 4. It would be as if DITC had brought the second challenge to the patent in the first instance and “[t]his is the kind of serial attack that General Plastic was intended to

address.” *Id.* Further, as in *Apple*, DITC’s inability to provide adequate facts and/or explanations weighs in favor of denying institution of the proceeding. *Id.*, 11.

VI. CONCLUSION

Petitioner fails to demonstrate that any of the challenged claims of the ’151 Patent are unpatentable. Thus, the Petition should be denied.

Date: August 9, 2024

Respectfully submitted,

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APPENDIX A - LIST OF EXHIBITS

Exhibit No.	Description
1001	U.S. Patent No. 10,695,151
1003	Claim Construction Order, <i>3Shape A/S v. Medit Corporation</i> , Case No. 6:22-cv-00443, Dkt. No. 76 (W.D. Tex. May 2, 2023)
1006	Petition for <i>Inter Partes</i> Review of U.S. Patent No. 10,695,151, <i>Dental Imaging Technologies Corporation v. 3Shape A/S</i> , IPR2023-00400, Paper 2 (PTAB Dec. 21, 2022)
1008	Decision Denying Institution of <i>Inter Partes</i> Review of U.S. Patent No. 10,695,151, <i>Dental Imaging Technologies Corporation v. 3Shape A/S</i> , IPR2023-00400, Paper 7 (PTAB July 12, 2023).
1009	U.S. Patent No. 10,028,810 (“Korten”)
1010	U.S. Patent No. 6,206,691 (“Lehmann I”)
1011	U.S. Publication No. 2011/0188086 (“Lehmann II”)
1012	U.S. Patent No. 7,341,450 (“Pye”)
1013	U.S. Patent No. 7,698,068 (“Babayoff”)
1015	Expert Declaration of Hassan Foroosh, Ph.D.
1016	Patent Owner’s Preliminary Response, <i>Dental Imaging Techs. Corp. v. 3Shape A/S</i> , IPR2023-00400 (PTAB April 17, 2023)
2017	Declaration of Eli Saber, Ph.D.
2018	<i>Curriculum Vitae</i> of Eli Saber, Ph.D.
2019	Decision Granting Institution of <i>Inter Partes</i> Review, IPR2023-01315, Paper 6 (Mar. 28, 2024)
2020	U.S. Patent No. 8,208,704, issued June 26, 2012 to V. Wong and J. Milch
2021	U.S. Patent No. 11,418,770, issued August 16, 2022 to N. Babayoff

2022	U.S. Patent No. 10,363,118, issued July 30, 2019 to Y. Moalem
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CERTIFICATE OF COMPLIANCE WITH 37 C.F.R. §42.24

I hereby certify that the word count for the foregoing Patent Owner's Preliminary Response totals 13,193 words, excluding the parts which are exempted by 37 C.F.R. §42.24(a).

Date: August 9, 2024

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing **PATENT OWNER'S PRELIMINARY RESPONSE** is being served on counsel for Petitioner by electronic mail this 9th day of August, 2024 as follows:

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