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
U.S. Patent No. 10,695,151

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,695,151

TABLE OF CONTENTS

I. INTRODUCTION 1
II. GROUNDS FOR STANDING 1
III. FEES 1
IV. PRECISE RELIEF REQUESTED 1
A. Prior Art 2
1. Korten 2
2. Lehmann I 2
3. Pye 3
4. Lehmann II 3
5. Babayoff 3
B. IPR Grounds 3
V. The ’151 Patent 4
A. Overview of the ’151 Patent 4
B. Prosecution History 9
VI. Level of ordinary skill in the art 10
VII. Claim Construction 10
A. “deriving a certainty score” 11
VIII. OVERVIEW OF THE PRIOR ART 12
A. Prior Art References 12
1. Overview of Korten 12
2. Overview of Lehmann I 15
3. Overview of Lehmann II 17
4. Overview of Pye 19
5. Overview of Babayoff 21
IX. THE CHALLENGED CLAIMS ARE UNPATENTABLE AND SHOULD BE CANCELLED 23
A. Ground 1: Claims 1, 12, 14, 15 Are Anticipated by Korten 23
1. Claim 1 is Anticipated 23
2. Claim 12 is Anticipated 28
3. Claim 14 Is Anticipated 28

4. Claim 15 is Anticipated 29

B. Ground 2: Claims 1, 2, 4, 5, 9, 12-16 Are Rendered Obvious by Korten in View of Lehmann II 30

1. Claim 1 is Rendered Obvious 30

2. Claim 2 is Rendered Obvious 32

3. Claim 4 is Rendered Obvious 33

4. Claim 5 is Rendered Obvious 34

5. Claim 9 is Rendered Obvious 35

6. Claim 12 is Rendered Obvious 36

7. Claim 13 is Rendered Obvious 36

8. Claim 14 Is Rendered Obvious 41

9. Claim 15 is Rendered Obvious 43

10. Claim 16 is Rendered Obvious 43

C. Ground 3: Claims 10, 16, and 17 Are Rendered Obvious by Korten in View of Lehmann II and in further view of Babayoff 44

1. Claim 10 is Rendered Obvious 44

2. Claim 16 is Rendered Obvious 46

3. Claim 17 is Rendered Obvious 49

D. Ground 4: Claims 1, 2, 9, 12, and 14 - 16 Are Rendered Obvious by Korten in View of Lehmann I.....50

1. Claim 1 is Rendered Obvious 50

2. Claim 2 is Rendered Obvious 53

3. Claim 9 is Rendered Obvious 54

4. Claim 12 is Rendered Obvious 55

5. Claim 14 is Rendered Obvious 55

6. Claim 15 is Rendered Obvious 56

7. Claim 16 is Rendered Obvious 56

E. Ground 5: Claim 13 Is Rendered Obvious by Korten in View of Pye 57

1. Claim 13 is Rendered Obvious by Korten in View of Pye.....57

2. A POSITA Would Be Motivated to Combine the Tooth-Shade-Averaging Features for Regions of a Patient's Tooth Disclosed in Pye with the System Disclosed in Korten.....59

F. Ground 6: Claims 10, 16, and 17 Are Rendered Obvious by Korten in View of Babayoff.....61

1. Claim 10 is Rendered Obvious 61

2. Claim 16 is Rendered Obvious 61

3. Claim 17 is Rendered Obvious 61

X. INSTITUTION SHOULD NOT BE DISCRETIONARILY DENIED 62

A. An Exercise of Discretion Under 35 U.S.C. § 314(a) Would Be Improper.....62

B. An Exercise of Discretion under 35 U.S.C. § 325(d) Would be Improper 62

XI. MANDATORY NOTICES 64

A. Real Parties in Interest— 37 C.F.R. § 42.8(b)(1) 64

B. Related Matters— 37 C.F.R. § 42.8(b)(2) 65

C. Lead and Back-Up Counsel— 37 C.F.R. § 42.8(b)(3) 65

D. Service Information— 37 C.F.R. § 42.8(b)(4).....66

XII. CONCLUSION.....66

TABLE OF AUTHORITIES

Page(s)

Cases

3Shape A/S v. Carestream Dental, LLC,
1:22-cv-01829 (N.D. Ga.) 65

3Shape A/S v. Carestream Dental LLC,
6:21-cv-01110 (W.D. Tex.) 65

3Shape A/S v. Medit Corp.,
Case No. W-22-CV-00443-ADA-DTG (W.D. Tex.) 65

Advanced Micro Devices Inc. v. Monterey Research LLC
IPR2021-00776, Paper 13 (PTAB Oct. 13, 2021) 64

Apple Inc. v. Uniloc 2017 LLC
IPR2018-00580 (PTAB) 62, 63

Apple Inc. v. Uniloc 2017 LLC
IPR2020-00854, Paper 9 (PTAB Oct. 28, 2020) (precedential) 63

DEXIS v. 3Shape A/S
IPR2023-00400 (PTAB) 63, 65

General Plastic Indus. Co., Ltd. v. Canon Kabushiki Kaisha
IPR2016-01357, Paper 19 (PTAB Sept. 6, 2017) (precedential) 63

Google v. Express Mobile
IPR2022-00791, Paper 15 (PTAB Oct. 7, 2022) 64

Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.,
868 F.3d 1013 (Fed. Cir. 2017) 10

Phillips v. AWH Corp.,
415 F.3d 1303 (Fed. Cir. 2005) 10

Sotera Wireless, Inc. v. Masimo Corp.,
IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020) 62

Target Corp. v. Proxicom Wireless, LLC,
IPR2020-00904, Paper 11 (PTAB Nov. 10, 2020) 11

Western Digital Corp. v. Spex Techs., Inc.,
IPR2018-00084, Paper 14 (PTAB April 25, 2018) 11

Statutes

35 U.S.C. §§102, 103 1

35 U.S.C. §102(a)(1) 2, 3

35 U.S.C. §102(a)(2) 2

35 U.S.C. § 112 11

35 U.S.C. §311 1

35 U.S.C. §311(c) 1

35 U.S.C. § 314(a) 62

35 U.S.C. § 325(d) 62

LIST OF EXHIBITS

Ex. No.	Description
1001	U.S. Patent No. 10,695,151
1002	Excerpts of the File History for U.S. Pat. No. 10,695,151
1003	Claim Construction Order, *3Shape A/S v. Medit Corporation,* Case No. 6:22-cv-00443, Dkt. No. 76 (W.D. Tex. May 2, 2023)
1004	Curriculum Vitae of Hassan Foroosh, Ph.D.
1005	[intentionally omitted]
1006	Petition for *Inter Partes* Review of U.S. Patent No. 10,695,151, *Dental Imaging Technologies Corporation v. 3Shape A/S*, IPR2023-00400, Paper 2 (PTAB Dec. 21, 2022).
1007	Dictionary Definition - Accuracy, Merriam-Webster.com, https://www.merriam-webster.com/dictionary/accuracy (last visited Aug. 16, 2023).
1008	Decision Denying Institution of *Inter Partes* Review of U.S. Patent No. 10,695,151, *Dental Imaging Technologies Corporation v. 3Shape A/S*, 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")
1014	Rade D. Paravina, "Performance assessment of dental shade guides," Journal of Dentistry (2009)
1015	Expert Declaration of Hassan Foroosh, Ph.D.

Ex. No.	Description
1016	Patent Owner's Preliminary Response, *Dental Imaging Techs. Corp. v. 3Shape A/S*, IPR2023-00400 (PTAB April 17, 2023)
1017	Excerpt of File History for Korten – Certified Copy of Foreign Priority Document, European Patent Application No. 13165808
1018	DITC's First Supplemental Invalidity Contentions (11/07/2022)

Challenged Claims of U.S. Patent No. 10,695,151

Claim element	**Claim 1**
[Claim 1Pre]	A method for determining shade of a patient's tooth, wherein the method comprises:
[Claim 1a]	Obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth;
[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,
[Claim 1c]	Wherein the method comprises deriving a certainty score expressing the certainty of the determined tooth shade value.
Claim element	**Claim 2**
[Claim 2]	The method according to claim 1, wherein determining the tooth shade value for the point comprises selecting the reference tooth shade value with the known texture value closest to the texture data of the point.
Claim element	**Claim 4**
[Claim 4]	The method according to claim 1 wherein the method comprises generating a visual representation of the certainty score and displaying this visual representation in a user interface.
Claim element	**Claim 5**
[Claim 5]	The method according to claim 4, wherein the visual representation of the certainty score is displayed together with or is mapped onto the digital 3D representation of the tooth.
Claim element	**Claim 9**
[Claim 9]	The method according to claim 1, wherein the one or more reference tooth shade values relate to shade values for natural teeth with intact surface and/or to shade values for

	teeth prepared for a dental restoration.
Claim element	**Claim 10**
[Claim 10]	The method according to claim 1, wherein the method comprises comparing the texture data with known texture values for soft oral tissue, such as gum tissue and gingiva.
Claim element	**Claim 12**
[Claim 12]	The method according to claim 1, wherein the method comprises creating a shade profile for the tooth from shade values determined one or more points on the tooth.
Claim element	**Claim 13**
[Claim 13Pre]	A method for determining shade of a patient's tooth, wherein the method comprises:
[Claim 13a]	Obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth;
[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,
[Claim 13c]	Wherein the method comprises creating a shade profile for the tooth from shade values determined one or more points on the tooth,
[Claim 13d]	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.
Claim element	**Claim 14**
[Claim 14Pre]	A method for determining shade of a patient's tooth, wherein the method comprises:
[Claim 14a]	Obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth;
[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,
[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.
Claim element	**Claim 15**
[Claim 15]	The method according to claim 14, wherein the texture data at least partly are derived by combining the texture information from corresponding parts of a number of the sub-scans.
Claim element	**Claim 16**
[Claim 16]	The method according to claim 15, wherein combining the texture information from the sub-scans comprises interpolating the texture information and/or calculating an average value of the texture information
Claim element	**Claim 17**
[Claim 17]	The method according to claim 16, wherein the calculated average value is a weighted average of the texture information. ture information

I. INTRODUCTION

Dental Imaging Technologies Corporation ("Petitioner") petitions for institution of *inter partes* review ("IPR") of claims 1, 2, 4, 5, 9, 10, and 12-17 ("challenged claims") of U.S. Patent No. 10,695,151 ("the '151 patent"). Ex-1001. This is a copycat Petition, filed in conjunction with a timely motion for joinder, in which Petitioner agrees to assume a passive understudy role. Petitioner requests institution of IPR and joinder with the IPR in *Medit Corporation v. 3Shape A/S*, IPR2023-01315 (the "Medit IPR") in view of the Board's decision to institute trial on March 28, 2024 (Medit IPR, Paper 6).

II. GROUNDS FOR STANDING

Petitioner certifies that the '151 patent is available for review under 35 U.S.C. § 311(c); Petitioner is not estopped from requesting *inter partes* review of the challenged claims on the grounds identified in this Petition.

III. FEES

The Commissioner is authorized to charge or credit the fee specified by 37 C.F.R. § 42.15(a), and any other additional fees, to Quinn Emanual Urquhart & Sullivan, LLP Deposit Account No. 50-5708.

IV. PRECISE RELIEF REQUESTED

Petitioner requests review of the challenged claims under 35 U.S.C. § 311 and cancellation of the challenged claims under post-AIA 35 U.S.C. §§ 102, 103 in view of the grounds described herein.

A. Prior Art

For purposes of this Petition only, Petitioner assumes that the earliest priority date for the ’151 patent is February 7, 2014. Petitioner does not concede that any ’151 patent claim is entitled to that priority date and reserves its right to challenge any claim of priority related to the ’151 patent.

Each of the references on which Petitioner relies qualifies as prior art in view of the assumed priority date of February 7, 2014.

1. Korten

Petitioner relies on U.S. Patent No. 10,028,810 (“Korten”). Ex-1009. Korten issued on July 24, 2018, and claims priority to a foreign application filed on April 29, 2013, prior to the alleged priority date of the ’151 patent. Korten qualifies as a prior art printed publication under post-AIA 35 U.S.C. § 102(a)(2). Further, the foreign application to which Korten claims priority contains verbatim disclosures, including all the same figures, as Korten and therefor fully supports and describes all the subject matter, including the claims, of Korten. *Compare* Ex-1017 with Ex-1009.

2. Lehmann I

Petitioner relies on U.S. Patent No. 6,206,691 (“Lehmann I”). Ex-1010. Lehmann I issued on March 27, 2001, over one year prior to the alleged priority date of the ’151 patent, and qualifies as a prior art printed publication under post-AIA

35 U.S.C. § 102(a)(1).

3. Pye

Petitioner relies on U.S. Patent No. 7,341,450 ("Pye"). Ex-1012. Pye issued on March 11, 2008, over one year prior to the alleged priority date of the '151 patent and qualifies as a prior art printed publication under post-AIA 35 U.S.C. § 102(a)(1).

4. Lehmann II

Petitioner relies on U.S. Patent Application Publication No. US 2011/0188086 ("Lehmann II"). Ex-1011. Lehmann II published on August 4, 2011, over one year prior to the alleged priority date of the '151 patent and qualifies as a prior art printed publication under post-AIA 35 U.S.C. § 102(a)(1).

5. Babayoff

Petitioner relies on United States Patent No. 7,698,068 ("Babayoff"). Ex-1013. Babayoff published on December 22, 2005, over one year prior to the alleged priority date of the '151 patent and qualifies as prior art printed publication under post-AIA 35 U.S.C. § 102(a)(1).

B. IPR Grounds

Ground	Claims	Statutory Basis
1	1, 12, 14, 15	Anticipation under post-AIA §102 by Korten
2	1, 2, 4, 5, 9, 12-16	Obviousness under post-AIA § 103 in view of Korten and Lehmann II
3	10, 16, and	Obviousness under post-AIA § 103 in view of Korten,

Ground	Claims	Statutory Basis
	17	Lehmann II, and Babayoff
4	1, 2, 9, 12, and 14 - 16	Obviousness under post-AIA § 103 in view of Korten and Lehmann I
5	13	Obviousness under post-AIA § 103 in view of Korten and Pye
6	10, 16 and 17	Obviousness under post-AIA §103 in view of Korten and Babayoff

V. THE '151 PATENT

A. Overview of the '151 Patent

The '151 Patent, titled "Detecting Tooth Shade," is directed towards "methods and a user interfaces [*sic*] for determining the shade of a patient's tooth." Ex-1001, code (54), 1:19-22. According to the '151 Patent, "[w]hen designing and manufacturing a dental restoration for a patient, . . . it is advantageous that both the shape and shade of the manufactured restoration is adapted to the patient's natural teeth surrounding the restoration." *Id.* at 1:23-27.

The '151 Patent further describes that "[t]he tooth color can be represented by many different color spaces," such as the L*C*h* color space or the L*a*b* color space. *Id.* at 1:32-36. To assist in matching the color of the restoration with the surrounding teeth, "the tooth colors are often expressed in terms of reference tooth shade values of a tooth shade system (often referred to as a tooth shade guide). Each reference tooth shade value in a tooth shade guide represents a predetermined and

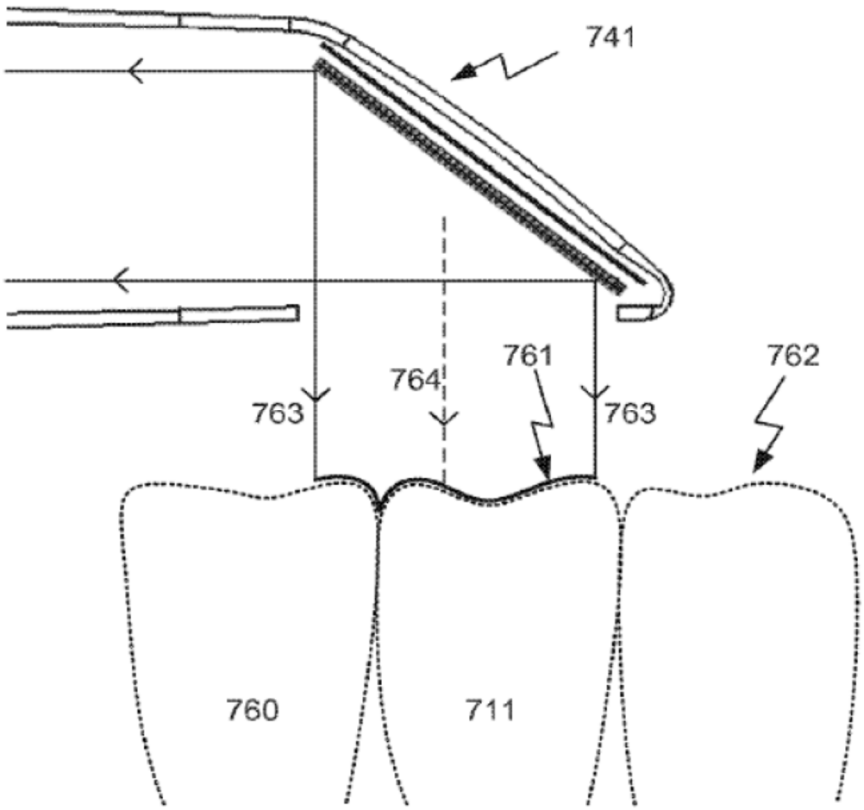
known tooth color value and often correspond [*sic*] to the color of commercially available ceramics for the production of dental restorations." *Id.* at 1:40-48. Examples of tooth shade guides include the VITA 3D-Master or the VITA Classic shade guides. *Id.* at 1:44-50. By using a reference system, dentists can "describe the shade of the patient's tooth in terms that a dental technician immediately understands," allowing the technician to choose the correct ceramics. *Id.* at 1:56-60.

A dentist using the conventional method would "manually determin[e] which reference tooth shade value best matches the color of a patient's tooth" by holding "different pre-manufactured teeth of the shade guide at the tooth for comparison." *Id.* at 1:61-64. Moreover, as explained in the '151 Patent, "[i]n many cases, the dental restoration is manufactured with a shade profile where the shade differs from the incisal edge towards cervical end [*sic*] of the restoration." *Id.* at 2:57-59. Ceramic makers manufacture ceramic blocks with gradations of colors based on the reference tooth shades to account for this typical shade differentiation along a tooth.

The '151 Patent describes technology "for determining shade of a patient's tooth." *See, e.g., id.* at 2:6-7. As described in the '151 Patent, the technology "obtain[s] a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth." *Id.* at 2:8-10. The technology then "determin[es] 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." *Id.* at 2:11-15.

Figure 7A of the '151 Patent depicts a schematic of an intra-oral scanner, according to an embodiment of the patent:



According to the '151 Patent, scanner 741 "is held in one position relative to" teeth 711, 760 "while recording a sequence of 2D images for one sub-scan." *Id.* at 16:10-14. The solid line 761 illustrates the field of view of the scanner and "is determined by the light source, the optical components and the image sensor of the scanner." *Id.* at 16:15-18. The probe light rays 763 from the scanner "define the

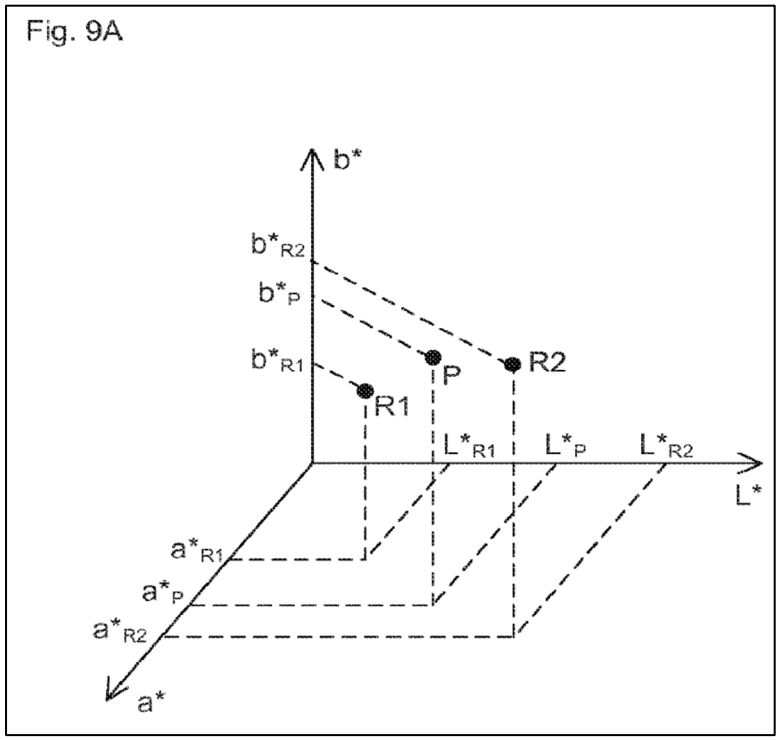
optical path 764 of the scanner probe light at the tooth 711." *Id.* at 16:28-32. According to the '151 patent, a digital 3D representation of the tooth is "generated by combining sub-scans acquired from different orientations relative to the teeth." *Id.* at 16:33-35.

According to the '151 patent, digital 3D representations of a patient's set of teeth could be captured from various commercially available devices, such as "the TRIOS intra-oral color scanner manufactured by 3 shape A/S." *Id.* at 15:12-16. The '151 Patent further discloses that "[m]any scanning devices have Bayer color filters with Red, Green and Blue filters and hence record color information in the RGB color space. . . . The processor 644 then comprises algorithms for transforming the recorded data into e.g. the L*a*b or L*C*h color spaces." *Id.* at 15:33-35. Thus, "[t]exture data relating to the tooth color can be obtained using a scanner having a multi-chromatic light source, *e.g.*, a white light source and a color image sensor." *Id.* at 15:65-67.

The '151 Patent describes that "[a] digital 3D representation of the tooth can be generated by combining sub-scans acquired from different orientations relative to the teeth, e.g., by sub-scan registration." *Id.* at 16:33-35. The '151 Patent further describes that such "sub-scan registration" can be accomplished using various well-known methods, such as the Iterative Closest Point (ICP) algorithm. *Id.* at 16:39-44. "When the sub-scans are registered to generate a digital 3D representation of

the tooth, a correlation between these segments is established and the texture information of these sub-scan segments can be combined to determine the texture data for point P on the generated digital 3D representation of the tooth." *Id.* at 16:46-51.

Further, according to the '151 Patent, "[w]hen the color data is derived for a point on the tooth, the tooth shade value for that point can be determined by comparing the derived color data with the known color data of the reference tooth shade values of a tooth shade guide." *Id.* at 17:13-17. Such a process is illustrated, according to the '151 patent, in Figure 9A:



As shown in this Figure, "the color data of the digital 3D representation and the known color values of the reference tooth shades are expressed in the L*a*b*

color space, and the reference tooth shade are those from the VITA classical shade guide." *See id.* at 18:1-5. Figure 9A shows only the two closest reference tooth shades within the L*a*b* color space, denoted as reference values R1 and R2. *Id.* at 18:27-29. To determine the reference tooth shade value corresponding to point P, "[i]t can be seen that the Euclidean distance in the color space from P to R2 is the smallest, and the tooth shade in point P is hence selected as that of R2." *Id.* at 18:29-32.

The '151 Patent further discloses the use of a certainty score that is "determined for a point P depend[ing] on how close the color data of the point P is to the known color value of the selected reference tooth shade value. This can be quantified by the Euclidian distance and the since the point P is not particularly close to R2 in FIG. 9A the determined tooth shade has a poor certainty score." *Id.* at 18:33-38.

B. Prosecution History

In the first office action for the '151 Patent, the examiner rejected pending claims 1-3 and 10-13 as obvious over U.S. Patent No. 8,532,355 to Quadling in view of U.S. Patent No. 8,570,530 to Liang. Ex-1002 at 50-57. The examiner further objected to pending claims 4-9 and 14-18 as depending from rejected claims, but noted that these claims would otherwise be allowable. *Id*. The examiner also issued a double patenting rejection based upon U.S. Patent No. 10,010,387, from which the

'151 patent claims priority. *Id*. In response, the applicant incorporated the following limitation from original claim 4 into pending claim 1 to gain allowance of that claim:

> <u>wherein the method comprises deriving a certainty score expressing the certainty of the determined tooth shade value.</u>

See Ex-1002 at 35 (Office Action Response, dated Dec. 16, 2019). In addition, the applicant re-wrote pending claims 14 and 15 to be in independent format, amending both of those claims to add the elements and limitations of original claim 1 and any intervening claims. Ex-1002 at 32-49. The applicant also filed a terminal disclaimer. *Id*. On February 25, 2020, the examiner issued a notice of allowance, and the application issued as the '151 Patent on June 30, 2020. Ex-1002 at 3, 9.

VI. LEVEL OF ORDINARY SKILL IN THE ART

As of the priority date, for the purposes of this Petition, a POSITA would have had at least a bachelor's degree in Computer Engineering, Computer Science, Computer Vision, or an equivalent field, as well as at least two years of imaging/image analysis experience, or alternatively, at least six years of comparable industry experience. Ex-1015 ¶ 67.

VII. CLAIM CONSTRUCTION

In an IPR, claim terms are construed according to the *Phillips* standard. *See Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); *see also*

37 C.F.R. § 42.100(b). The Board need only construe terms to the extent necessary to resolve a controversy. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). The Board must also consider "[a]ny prior claim construction determination concerning a term of the claim in a civil action . . . that is timely made of record." 37 C.F.R. § 42.100(b).

For 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.[1] Regarding the term below, Petitioner applies the claim construction adopted by the District Court in the co-pending litigation between 3Shape and Medit. Ex-1010.

A. "deriving a certainty score"

Claim 1 recites "deriving a certainty score," which the District Court

[1] While Petitioner proposes certain constructions for purposes of this proceeding, Petitioner reserves its right to revise or amend these constructions in any other action or forum. *Western Digital Corp. v. Spex Techs., Inc.*, IPR2018-00084, Paper 14 at 11 (PTAB April 25, 2018). Petitioner also reserves the right to challenge the validity of the challenged claims under 35 U.S.C. § 112 in another action or forum. *See Target Corp. v. Proxicom Wireless, LLC*, IPR2020-00904, Paper 11 at 12-13 (PTAB Nov. 10, 2020).

construed to mean "determining an accuracy value based on the tooth shade value, the texture data, and/or texture information." Ex-1003 at 3.

VIII. OVERVIEW OF THE PRIOR ART

A. Prior Art References

1. Overview of Korten

Korten discloses technology "for capturing the shape and for measuring the color in independent steps and for providing a correlation between the captured shape and the location at which the color is measured." Ex-1009 at 1:9-13. Korten discloses capturing data from a patient's dentition through the following steps:

- "positioning a first optical sensor relative to [*sic*] patient's dentition";
- "capturing . . . at least a portion of the shape of a tooth in the patient's dentition and based thereon providing a first virtual dentition model representing that shape in a three-dimensional coordinate system";
- "measuring a first color at a first location on the tooth portion"; and

"providing a correlation between the first location of the first color and a coordinate in the first virtual dentition model."

System 10 that "can be used to capture via the first optical sensor the shape of one or more teeth in the patient's dentition 500":

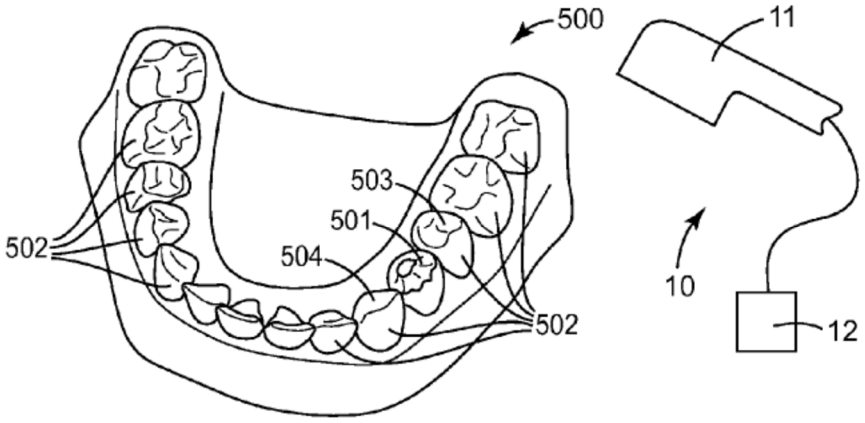


FIG. 1

Id. at 7:64-66. "The system 10 is adapted such that it can provide—based on the captured shape—a first virtual dentition model representing that shape in a three-dimensional coordinate system." *Id.* at 7:66-8:2. According to Korten, the shape data may include X, Y, and Z coordinates. *Id.* at 4:48-56.

Korten further discloses the capture of "continuous 3D video images" that are used to "create a digital impression used for the fabrication of CAD/CAM dental restorations." *Id.* at 4:34-37. Korten also discloses that commercial scanners can be used to generate the 3D model. *Id.* at 4:27-31.

Korten further discloses that "[t]he system 10 is further adapted to measure a color at the patient's dentition." *Id.* at 8:5-6. "The system is preferably used to capture at least a portion of the shape of a tooth, for example one of the healthy teeth 502, in the patient's dentition 500 and to measure a first color at a first location on that tooth portion." *Id.* at 8:10-13. The color measurement in Korten may include

color data for a tooth adjacent to the prepared tooth so that the dental restoration will include "a color that fits the color of the adjacent tooth or teeth (503/504)." *See id.* at 8:14-20.

Korten also discloses that the color measurement is associated with "at least one coordinate in the first virtual dentition model based on the correlation between the first location of the first color and the coordinate in the first virtual dentition model." *Id.* at 4:41-45. "The shape data and color data are preferably subsequently correlated such that particular measured colors are brought into association with particular coordinates or locations in the corresponding first virtual dentition model of the tooth portions of which the color were [*sic*] measured." *Id.* at 8:34-39. "Such a method preferably provides for precise color measuring including determination of location information of measured colors associated with the patient's dentition." *Id.* at 8:41-44.

Korten also discloses "the step of matching at least the first color with a standard color from a standard color scheme." *See id.* at 5:28-30. As noted above, the "first color" corresponds to the color obtained for the first location, or point, on the patient's tooth. *See id.* at 4:41-45 (noting a "correlation between the first location of the first color and the coordinate in the first virtual dentition model"). According to Korten, "[s]uch a standard color scheme may for example correspond to the widely used VITAPAN™ Classical tooth color scheme which typically

provides the different tooth colors." *Id.* at 5:30-34.

Korten additionally 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." *Id.* at 5:9-11. As part of this process, 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." *Id.* at 5:14-16. "The measured colors may be mapped relative to the first virtual dentition model at coordinates which correspond to the location at the dentition." *Id.* at 5:24-27.

As a result, "the first virtual dentition model 1000 represents different tooth colors 1011, 1012, 1013 and 1014 of the first tooth 1010 and different tooth colors 1021, 1022, 1023 and 1024 on a second tooth 1020. . . . The colors are measured at location of the patient's tooth which correspond to the locations in the first virtual dentition model." *Id.* at 10:37-43. The determination of different colors for different portions of a tooth may be used when building up the dental restoration such that the dental restoration may include different color shades. *See id.* at 10:65-11:7.

2. Overview of Lehmann I

Lehmann I discloses technology "for tooth shade determination using digital signal processing" in which color images of one or more teeth are analyzed and compared to known tooth shades for use in certain clinical or cosmetic procedures.

Ex-1010, at 1:16-21. Lehmann I notes the deficiencies in the traditional method of matching tooth shade by attempting to "eyeball" the shade of various reference tooth shade tabs to find the closest match. *Id.* at 1:50-59. Lehmann I also identifies and discusses some of the same reference tooth shade guides, such as the VITA shade guide, mentioned in Korten.

According to Lehmann I, a solid state camera captures a digital image of each known conventional tooth shade. *Id.* at 5:5-8. As described in Lehmann I and as is well known in the art, the digital image is comprised of a number of pixels, each pixel "representing the light intensity and color properties of a given spatial location on the tooth." *See id.* at 5:21-25. By describing the distance between pixels Lehmann I makes clear that the "spatial location" of a pixel refers to a point.

According to Lehmann I, each reference image is processed so that 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. *See* Lehmann I at cols. 5:50-6:18. The intensity and color "are computed or otherwise formed as an average (or other statistical measure) of the actual pixels forming the pseudo-pixel." *Id.* at 6:15-18. Lehmann I then describes that a Reference Image for the reference tooth shade "is generated as an average (or other statistical measure) of the Pseudo-Image series of images," for example, of the VITA A2 shade guide. *Id.* at 7:3-6.

According to Lehmann I, "an actual digital image of a patient's tooth" is

taken, which is called a Snapshot. *Id.* at 7:39-47. The "Snapshot can be scaled to approximate the Reference Image size, or vice versa," and/or "the Snapshot can also be processed into pseudo-pixels," resulting in a Real Image. *Id.* at cols. 7:50-53; 9:15-19. The "Real Image is compared (i.e., correlated) to each Reference Image in the database" using a correlation algorithm. *Id.* at 9:30-35. This correlation results in a composite match number ("CMN") that "indicat[es] 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.* at 9:37-42.

3. Overview of Lehmann II

Lehmann II relates to technology "for determining a patient's tooth shade comprising the steps of electronically imaging a patient's tooth to obtain an image which includes color information representative of tooth color; determining the patient's tooth color from the color information of the image; and displaying the determined tooth color to identify one or more tooth shades having a combined color corresponding to the determined tooth color." Ex-1011 ¶ [0011].

"The identification of tooth shade(s) is generally made by comparing the determined tooth color to a plurality of electronically stored tooth shades." *Id.* ¶[0013]. 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.* at ¶¶[0044]-[0045]. Lehmann II describes the same types of reference tooth shade guides as disclosed in Korten and Lehmann I. *See, e.g., id.* ¶[0058] (disclosing Vita shade guide).

According to Lehmann II, color data can be obtained on a per pixel basis (*see, e.g., id.*, ¶[0066]) or "the image of the tooth 60 can be averaged over a selected area by selecting a particular region for which color imagery is averaged." *Id.* ¶[0067]. "For example, if the tooth 60 is to be averaged over the two pixels identified by the outline 68, then the subsystem 29 averages the two RGB values and specifies the tooth shade match in block 42b as an average of the two." *Id.*

Lehmann II further discloses that "[i]n a preferred embodiment the method further comprises displaying the color information of the tooth and that which is representative of the tooth shades on a monitor for visual comparison." *Id.* ¶[0017]. "[T]he color information of the patient's tooth is compared with the stored color information relating to the tooth shades by a computer. The color information of the patient's tooth may be compared to the plurality of tooth shade guides on a pixel-by-pixel basis." *Id.* "Advantageously, the system further comprises a monitor for simultaneously displaying color information of the tooth and tooth shade information so that visual comparisons can be made," as shown in the following figure:

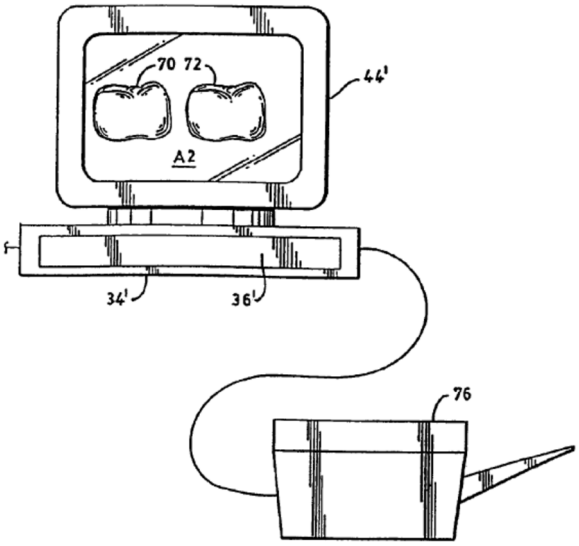


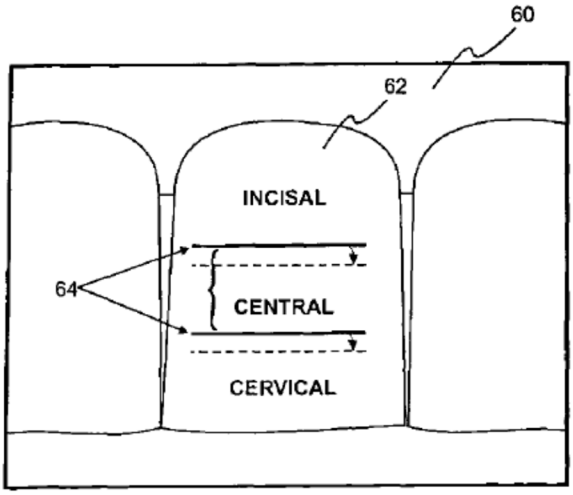
FIG. 7

See id., Fig. 7; ¶[0022]. "In the illustrated embodiment, an image 70 of a patient's tooth is matched to the appropriate shade, as above, and then an image 72 of the matched shade is also displayed on the monitor 44'. The system 34' further generates and displays the tooth shade identifying match, e.g., 'A2,' on the screen 44' so that the ordering information about the tooth reconstruction is easily ascertained." *Id.* ¶[0068].

4. Overview of Pye

Pye discloses "tooth shade analysis tools." Ex-1012 at 5:6-7. According to Pye, "tooth shade scan systems and methods are provided in which shade information for a restorative product for a patient's tooth is obtained." *Id.* at 2:44-46. "The system may capture image information for a patient's tooth and compile the image information to a database of shade guide information." *Id.* at 2:46-48.

Pye further discloses dividers that may be used to "divide the tooth into regions of interest or into regions that correspond to major tooth regions (e.g., the incisal, central, etc.)." *Id.* at 2:49-53. The user can move the dividers allowing "the operator to identify the appropriate regions for which corresponding information is available from a database of shade guide information." *Id.* at 2:54-58. The patient's tooth may be broken into separate regions, as illustrated by the following diagram:



Id., Fig. 5.

As disclosed in Pye, "a shade analyzing system is illustratively shown in FIG. 2" in which "shade analyze system 30 may include sufficient hardware and software for identifying shade information for a patient's tooth from a shade guide. Such a system may include "[h]andheld imaging equipment" that "may be imaging equipment that is used to capture shape and color information for a patient's tooth." *Id.* at 5:35-39.

5. Overview of Babayoff

Babayoff discloses a system that obtains a 3D color numerical entity of an intraoral cavity. Ex-1013 at 8:23-24. This system includes a device that has detection optics 60, main optics 41, and an image processor 24:

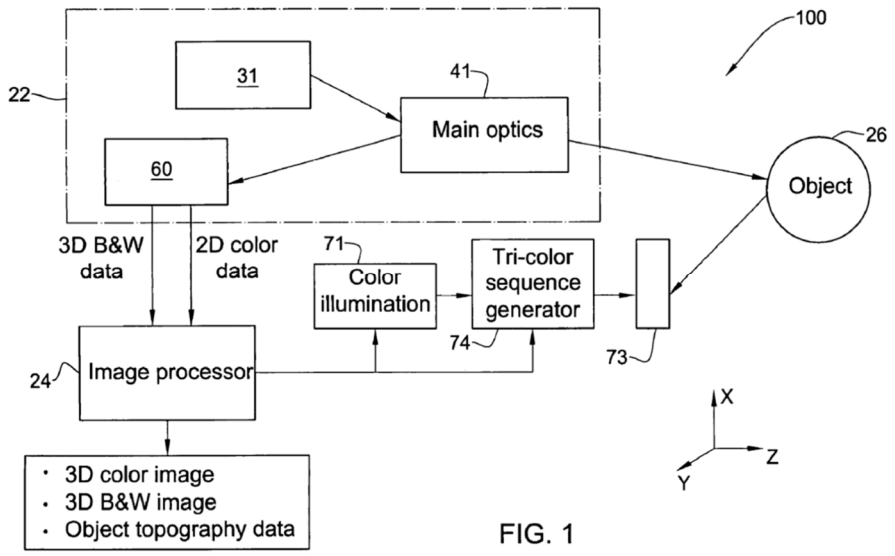


FIG. 1

Id., Fig. 1; 8:39-44. To obtain a 3D, manipulable image, "[t]he detection optics 60 receives image data from the main optics 41 and the image processor 24 determines the depth Z values for each X-Y point illuminated on the object 26 based on this image data." *Id.* ¶100. "The device 100 further comprises color illuminating means, such as for example a tri-color sequence generator 74, for selectively illuminating the object 26 with suitable colors, typically Green, Red and Blue, and for each such monochromatic illumination, a two dimensional image of the object 26 is captured by the detection optics 60." *Id.* at 8:45-50. "The device 100 is configured for providing color data for an array of X-Y points that is according to the same frame

of reference as the X-Y array used for obtaining the 3D entity." *Id,* at 8:53-56. Babayoff further discloses aligning "the 2D color image with the 3D entity previously created, and then provid[ing] color values to this entity by mapping color values to the entity at aligned X-Y points." *Id.* at 8:57-60.

According to Babayoff, it might be necessary to obtain a 3D definition of a large area of the intraoral cavity, which might require multiple scans that are then "stitched" together. *Id.* at 2:1-5. In these cases, common structures on the hard surfaces (e.g., the tooth surfaces) may be readily identified, which will aid in the stitching process. *Id.* at 2:5-16. "However, the data sets often include surface data relating to the soft tissues such as gums, cheeks and tongue, for example, which may distort and move while the different scans are performed," such that stitching together these types of surfaces becomes "problematic." *Id.* at 2:16-23.

To address this issue, Babayoff discloses a method in which the color data for each point in the entity is "compared with at least one color criterion, and typically with at least two color ranges R1, R2" that each "represent the values of the color parameter expected for one or another of the two tissues, such as the teeth and gums." *Id.* at 21:23-28. The data points for the entity "are sorted into at least two sub-data sets I1, I2, according to the color criteria." *Id.* at 22:22-25. Once the hard, tooth surfaces of the entity have been identified and isolated, "the new entity may be further manipulated as desired." *Id.* at 22:47-50.

In addition, Babayoff discloses a method for combining the color data from various "sub-entities." According to Babayoff, "transformed sub-entities are combined to a single transformed sub-entity, wherein color data corresponding to said plurality of numerical sub-entities . . . are combined in a predetermined manner." *Id.* at 5:60-64. "Such a predetermined manner comprises averaging the color value at each corresponding data point of said plurality of numerical sub-entities," and optionally, "weight averaging the color value at each corresponding data point of said plurality of numerical sub-entities." *Id.* at 5:64 – 6:2.

IX. THE CHALLENGED CLAIMS ARE UNPATENTABLE AND SHOULD BE CANCELLED

A. Ground 1: Claims 1, 12, 14, 15 Are Anticipated by Korten

1. Claim 1 is Anticipated

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

The preamble of claim 1 is not limiting. Nevertheless, Korten teaches this limitation. For example, Korten discloses technology that "allows for capturing the shape and for measuring the color in independent steps and for providing a correlation between the captured shape and the location at which the color is measured." *See* Ex-1009 at 1:9-13; Ex-1015, ¶107. Korten also discloses "the step of matching at least the first color with a standard color from a standard color scheme." *See* Ex-1009 at 5:28-30; Ex-1015, ¶108.

b. [Claim 1a]: Obtaining a digital 3D representation of

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

Korten shows a system 10 that "can be used to capture via the first optical sensor the shape of one or more teeth in the patient's dentition 500":

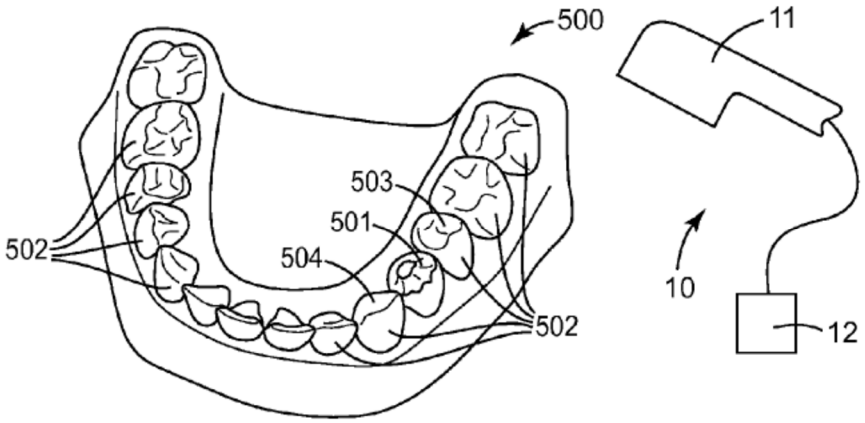


FIG. 1

Ex-1009, Fig. 1; 7:64-66; Ex-1015, ¶ 109. Further, "[t]he system 10 is adapted such that it can provide—based on the captured shape—a first virtual dentition model representing that shape in a three-dimensional coordinate system." *See* Ex-1009 at 7:66-8:2; Ex-1015, ¶109. Korten also discloses that "[t]he system 10 is further adapted to measure a color at the patient's dentition." *See* Ex-1009 at 8:5-6; Ex-1015, ¶110. Korten discloses that the color measurement is associated with "at least one coordinate in the first virtual dentition model based on the correlation between the first location of the first color and the coordinate in the first virtual dentition model." *See* Ex-1009 at 4:41-45; Ex-1015, ¶110.

The method disclosed by Korten of combining the three-dimensional coordinates obtained by one system with the two-dimensional color data obtained by a second overlaps with the method that Patent Owner has previously admitted can be used for determining color data for points on a tooth. Ex-1015, ¶111. In an earlier filing with the PTAB, Patent Owner described a particular prior art reference as "plac[ing] the color data in the same reference as the X-Y array used for the 3D model." *See* Ex-1016 at 27. Thus, by using the corresponding X-Y data to correlate the 3D shape data with the color data, Patent Owner described this system as "obtain[ing] color data for points on the tooth." *See id.* Korten associates color data with points on the tooth in the same way. Ex-1015, ¶111.

Finally, the '151 Patent specifies that texture data may comprise color data. *See* Ex-1001 at 5:51. Ex-1015, ¶112. Accordingly, Korten discloses this claim limitation. *Id.*

c. [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 discloses this limitation. For example, Korten discloses "matching at least the first color with a standard color from a standard color scheme." *See* Ex-1009 at 5:28-30; Ex-1015, ¶113. Korten further describes that "[s]uch a standard color scheme may for example correspond to the widely used VITAPAN™ Classical

tooth color scheme." *See* Ex-1009 at 5:30-34; Ex-1015, ¶113.

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. *See supra,* Section IX.A.1.a. Thus, Korten's reference to "the first color" corresponds to the color obtained for a location on the tooth. Indeed, 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. *See* Ex-1009 at 4:41-45; Ex-1015, ¶114.

d. [Claim 1c]: Wherein the method comprises deriving a certainty score expressing the certainty of the determined tooth shade value.

Korten discloses this limitation. 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. *See supra*, Section IX.A.1.a. *See also* Ex-1009 at 5:28-30; Ex-1015, ¶115. Korten further describes that it is desirable to provide "precise color measuring," *see* Ex-1009 at 8:41-44, and that the technology it describes is directed towards "minimizing errors in color measurement." *See id.* at 2:13-23; Ex-1015, ¶115. Thus, 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. To make this determination, 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. Ex-1015, ¶115. Korten, in fact, 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* Ex-1009 at cols. 4:60-5:6; Ex-1015, ¶115. 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." *See* Ex-1009 at cols. 5:2-6; Ex-1015, ¶115.

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." The term "accuracy" refers to how close a value is with a reference value. *See* Ex-1007 at 2(b); Ex-1015, ¶ 116. 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. As part of this process, accuracy values must be calculated, and the accuracy values must be based on a comparison of the reference tooth shade values and the color values (*i.e.* texture values) for the teeth. Ex-1015, ¶ 116.

2. Claim 12 is Anticipated

a. [Claim 12]: The method according to claim 1, wherein the method comprises creating a shade profile for the tooth from shade values determined one or more points on the tooth.

As discussed below, Korten discloses this limitation. *See infra*, Section IX.B.7.d.

3. Claim 14 Is Anticipated

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

Korten discloses this limitation. *See supra*, Section IX.A.1.a.

b. [Claim 14a]: Obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth;

Korten discloses this limitation. *See supra*, Section IX.A.1.b.

c. [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,

Korten discloses this limitation. *See supra*, Section IX.A.1.c.

d. [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.

Korten discloses this limitation. For example, 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." *See* Ex-1009 at 5:9-11; Ex-1015, ¶ 127. As part of this process, 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." *See* Ex-1009 at 5:14-16; Ex-1015, ¶ 127. Further, "[t]he measured colors may be mapped relative to the first virtual dentition model at coordinates which correspond to the location at the dentition." *See* Ex-1009 at 5:24-27; Ex-1015, ¶ 127.

The capture of the first location corresponds to the first subscan in this claim limitation, and the capture of shape and color data associated with the second location correspond to the second subscan. By 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. Ex-1015, ¶ 128.

4. Claim 15 is Anticipated

a. [Claim 15]: The method according to claim 14, wherein the texture data at least partly are derived by combining the texture information from corresponding parts of a number of the sub-scans.

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." *See* Ex-1009 at 5:9-11; Ex-1015 at ¶131. Korten further discloses that "colors may be measured on the same tooth or further teeth and the

first virtual dentition model may be further updated by the shape of any further teeth. . . . The measured colors may be mapped relative to the first virtual dentition model at coordinates which correspond to the location at the dentition." *See* Ex-1009 at 5:17-27; Ex-1015 at ¶131.

B. Ground 2: Claims 1, 2, 4, 5, 9, 12-16 Are Rendered Obvious by Korten in View of Lehmann II

1. Claim 1 is Rendered Obvious

a. [Claim 1Pre]

Korten teaches the preamble. *See supra*, Section IX.A.1.a.

b. [Claim 1a]

Korten teaches this limitation. *See supra*, Section IX.A.1.b.

c. [Claim 1b]

Lehmann II discloses this limitation. According to Lehmann II, "[t]he identification of tooth shade(s) is generally made by comparing the determined tooth color to a plurality of electronically stored tooth shades." *See* Ex-1011 at [0013]; Ex-1015, ¶ 137. 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. *See* Ex-1011, at ¶¶ [0044]-[0045]; Ex-1015, ¶137. Lehmann II further 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." *See* Ex-1011, at [0017] ; Ex-1015,

¶137.

d. [Claim 1c]

Lehmann II discloses this limitation. Lehmann II relates to technology "for determining a patient's tooth shade." *See* Ex-1011 at ¶ [0011]; Ex-1015, ¶138. According to Lehmann II, "[t]he identification of tooth shade(s) is generally made by comparing the determined tooth color to a plurality of electronically stored tooth shades." *See* Ex-1011 at ¶ [0013]; Ex-1015, ¶138. Moreover, according to Lehmann II, "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." *See* Ex-1011 at ¶ [0062]; Ex-1015, ¶139. 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. Ex-1015, ¶139.

e. A POSITA Would Be Motivated to Combine Accuracy Features in Lehmann II with the System Disclosed in Korten

A POSITA would be motivated to include the "best fit" technology from Lehmann II into the shape and color measuring system from Korten. Both references disclose overlapping technology related to providing image, color, and tooth shade information. 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. Ex-1015, ¶ 141.

Indeed, both Korten and Lehmann II describe as objectives of each respective system the ability to provide accurate representations related to the colors of the patient's teeth. *See, e.g.,* Ex-1009 at 2:13-16; Ex-1011 at ¶ [0010]; Ex-1015, ¶142. Moreover, both references disclose matching the color data from a point on the patient's tooth to the color data from the standard tooth shades from a tooth shade guide. *See, e.g.,* Ex-1009 at 5:28-34; Ex-1011 at ¶ [0062]; Ex-1015, ¶142. While Korten describes "matching," Lehmann II provides a method for determining "a best fit" by comparing the RGB values, thus providing a specific way for the matching process in Korten to be performed. *See* Ex-1011 at ¶ [0062]; Ex-1015, ¶142.

Further, the "best fit" technique from Lehmann II could be successfully incorporated into the system and methods disclosed in Korten. Ex-1015, ¶144.

Thus, a POSITA would have been motivated to incorporate the shade matching feature of Lehmann II into the systems and methods disclosed by Korten and would have expected such combination to succeed. Ex-1015, ¶145.

2. Claim 2 is Rendered Obvious

a. [Claim 2] The method according to claim 1, wherein determining the tooth shade value for the point comprises selecting the reference tooth shade value

with the known texture value closest to the texture data of the point.

Lehmann II discloses this element. As noted above, Lehmann II discloses that "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***." *See* Ex-1011 at ¶ [0062]; Ex-1015, ¶147. The "best fit or match" is the reference tooth shade value with the known texture value closest to the texture data of the point. *See* Ex-1011 at ¶ [0062]; Ex-1015, ¶147.

b. A POSITA Would Be Motivated to Combine the Accuracy Features in Lehmann II with the System Disclosed in Korten

A POSITA would have an overwhelming motivation for this combination. *See supra*, Section IX.B.1.

3. Claim 4 is Rendered Obvious

a. [Claim 4] The method according to claim 1 wherein the method comprises generating a visual representation of the certainty score and displaying this visual representation in a user interface.

Lehmann II discloses that "an image 70 of a patient's tooth is matched to the appropriate shade, as above, and then an image 72 of the matched shade is also displayed on the monitor 44'. The system 34' further generates and displays the tooth shade identifying match, e.g., 'A2,' on the screen 44'." *See* Ex-1011 at ¶ [0068]; Ex-1015, ¶151. Because the shade "A2" is the "best fit" or the closest match to the tooth shade, the projection of "A2" onto the screen provides a visual

representation of the certainty score. Ex-1015, ¶ 151.

b. A POSITA Would Be Motivated to Combine the Display Features in Lehmann II with the System Disclosed in Korten

A POSITA would be motivated to use the display feature from Lehmann II in the system described in Korten. The technology in Lehmann II substantially overlaps with that from Korten. *See supra* Section IX.B.1.

Lehmann II provides a number of advantages of generating a visual representation of the tooth shade having the best fit. *See* Ex-1011 at ¶ [0022]; Ex-1015, ¶156. In addition, "generat[ing] and display[ing] the tooth shade identifying match, e.g., 'A2,' on the screen 44'" allows for "the ordering information about the tooth reconstruction [to be] easily ascertained." *See* Ex-1011 at ¶ [0068]; Ex-1015, ¶156. The same advantages identified by Lehmann II in displaying the tooth shade of the best fit would also apply to the display disclosed in Korten. Ex-1015, ¶157. For this reason, a POSITA would have a motivation to use this feature from Lehmann II in the system disclosed in Korten and would easily expect this combination to succeed. *Id.*

4. Claim 5 is Rendered Obvious

a. [Claim 5] The method according to claim 4, wherein the visual representation of the certainty score is displayed together with or is mapped onto the digital 3D representation of the tooth.

The system 34' in Lehmann II generates and displays the tooth shade

identifying match, e.g., 'A2,' on the screen 44'." *See* Ex-1011 at ¶ [0068]; Ex-1015, ¶159. Further, the "A2" visual representation is displayed together with the 3D representation of the patient's tooth. Ex-1015, ¶159.

b. A POSITA Would Be Motivated to Combine the Display Features in Lehmann II with the System Disclosed in Korten

A POSITA would be motivated to combine the display features in Lehmann II with the system disclosed in Korten for the same reasons discussed above for Claim 4. *See supra* Section IX.B.3.

5. Claim 9 is Rendered Obvious

a. [Claim 9]: The method according to claim 1, wherein the one or more reference tooth shade values relate to shade values for natural teeth with intact surface and/or to shade values for teeth prepared for a dental restoration.

Korten in view of Lehmann II discloses that tooth shade values from well-known tooth shade systems can be used to express the tooth shade of the patient's tooth. *See* Ex-1009 at 5:30-34; Ex-1015, ¶163. Korten discloses "[s]uch a standard color scheme may for example correspond to the widely used VITAPAN™ Classical tooth color scheme." *See* Ex-1009 at 5:30-34; Ex-1015, ¶163. As disclosed in Lehmann II, the Vita shade guide provides dental professionals with "standardized shade guides created by those companies which manufacture the reconstructive material." *See* Ex-1011 at ¶ [0005]; Ex-1015, ¶164.

6. Claim 12 is Rendered Obvious

a. [Claim 12]

As discussed below, Korten discloses the limitations of claim 12. *See infra*, Section IX.B.7.d.

7. Claim 13 is Rendered Obvious

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

Korten discloses the preamble. *See supra*, Section IX.A.1.a.

b. [Claim 13a]: Obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth;

Korten discloses this limitation. *See supra*, Section IX.A.1.b.

c. [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,

Korten in view of Lehmann II discloses this limitation. *See supra*, Section IX.B.1.c.

d. [Claim 13c]: Wherein the method comprises creating a shade profile for the tooth from shade values determined one or more points on the tooth,

Korten discloses this limitation. Korten discloses determining shade values for at least one point on a patient's tooth. *See supra*, Section IX.A.1.c. Korten

further discloses "measuring a second color at a second location on the same tooth . . ." *See* Ex-1009 at 5:9-11; Ex-1015, ¶ 174. The determination of different colors for different portions of a tooth may be used when building up the dental restoration such that the dental restoration may be comprised of different color shades. *See* Ex-1009 at 10:65-11:7; Ex-1015, ¶ 174.

Korten further discloses determining standard tooth shade values for points on the patient's tooth that correspond to points in the 3D representation, by matching the color data obtained from the patient's tooth and the color data associated with the various reference tooth shades. *See* Ex-1009 at 5:30-34; Ex-1015, ¶ 175.

Patent Owner has asserted that the term "tooth shade profile" take on its plain and ordinary meaning. The disclosures in Korten, which teaches that tooth shade information be obtained at multiple points, satisfies this plain and ordinary meaning. Ex-1015, ¶176.

e. [Claim 13d]: 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.

Korten in view of Lehmann II discloses this limitation. Korten discloses that tooth shade values can be determined at multiple points of the tooth. *See supra*, Section IX.B.7.d. According to Korten, the determination of different colors for different portions of a tooth may be used when building up the dental restoration

such that the dental restoration may be comprised of different color shades. *See* Ex-1009 at 10:65-11:7; Ex-1015, ¶177.

Lehmann II further discloses that the tooth shade values may be averaged across multiple points of the tooth within a region of the tooth. According to Lehmann II, "the image of the tooth 60 can be averaged over a selected area by selecting a particular region for which color imagery is averaged." *See* Ex-1011 at ¶ [0067]; Ex-1015, ¶178.

Although the above disclosure in Lehmann II involves averaging using color data values, it would be well within the skills of a POSITA to use tooth shade values as well. Indeed, Lehmann II discloses "integrating at least a portion of the tooth to determine an average color over that portion of the tooth by combining color fractions of tooth shades." *See* Ex-1011 at ¶ [0016]; Ex-1015, ¶ 179. Lehmann II further describes a process by which standardized tooth shades from various points within a region of the patient's tooth can be combined:

> The color correlation section of the invention can also identify a combination of tooth shades having a combined color corresponding to the color of the patient's tooth. As such, the system can (i) ***associate each of the tooth shades in the combination with at least one standardized shade*** corresponding to an particular manufacturer's porcelain product, (ii) ***specify fractions of each of the standardized shades*** needed to form the combined color, and (iii) communicate information identifying the fractions of each of the tooth shades in the combination to a user of the

system.

See Ex-1011 at ¶ [0046]; Ex-1015, ¶ 179.

Accordingly, Korten in view of Lehmann II discloses this claim limitation. Ex-1015, ¶163.

f. A POSITA Would Be 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

A POSITA would be motivated to use the tooth-shade-determining feature for tooth regions described in Lehmann II with the system described in Korten. Both references disclose substantially overlapping technology related to providing image, color, and tooth shade information for a patient's tooth. Moreover, both references describe as objectives the ability to provide accurate representations related to the colors of the patient's teeth. *See, e.g.,* Ex-1009 at 2:13-16; Ex-1011 at ¶ [0010]; Ex-1015, ¶ 181. And both references disclose matching the color data from a point on the patient's tooth to the color data from the standard tooth shades from a tooth shade guide to associate a tooth shade with a point on the patient's tooth. *See, e.g.,* Ex-1009 at 5:28-34; Ex-1011 at ¶ [0062]; Ex-1015, ¶181. In addition, both Korten and Lehmann II use the same types of color and shade systems. Because of this significant amount of overlap, a POSITA would expect that this feature from Lehmann II could be successfully used in the system from Korten. Ex-1015, ¶181.

A POSITA would also have been motivated to combine the tooth-shade-

determining feature from Lehmann II that averages the tooth shades across a region of the patient's tooth into the system disclosed in Korten. Lehmann II discloses that "unlike the tooth shades from the shade guides, which are very uniform in color, a patient's tooth can include a myriad of different shades." *See* Ex-1011 at ¶[0065]; Ex-1015, ¶ 182. For example, "[t]ooth stains and the like alter the tooth's color spatially, ***so that a selection or integration of color is preferred.***" *See* Ex-1011 at ¶ [0065]; Ex-1015, ¶182. Lehmann II describes that one way to address this issue is to average the color values across a selected area of the tooth. *See* Ex-1011 at ¶[0067]; Ex-1015, ¶182. The same lack of color uniformity would also arise in the patient's dentition being captured by the system in Korten. Accordingly, a POSITA would be motivated to address the lack of uniformity by incorporating the averaging technique disclosed in Lehmann II.

Lehmann II also discloses "integrating at least a portion of the tooth to determine an average color over that portion of the tooth by combining color fractions of tooth shades." *See* Ex-1011 at ¶ [0016]; Ex-1015, ¶183. Lehmann II also describes a process by which this integration of tooth shades can occur:

> The color correlation section of the invention can also identify a combination of tooth shades having a combined color corresponding to the color of the patient's tooth. As such, the system can (i) ***associate each of the tooth shades in the combination with at least one standardized shade*** corresponding to a particular manufacturer's porcelain

> product, (ii) ***specify fractions of each of the standardized shades*** needed to form the combined color, and (iii) communicate information identifying the fractions of each of the tooth shades in the combination to a user of the system.

See Ex-1011 at ¶ [0046]; Ex-1015, ¶183.

The tooth-shade-determining technique from Lehmann II could also be successfully used in the system and with the methods disclosed in Korten. Both references disclose that tooth shade values can be determined for specific points on the tooth. Accordingly, a POSITA could easily implement the tooth-shade-determining technique from Lehmann II into Korten because doing so involves a calculation using values that the system in Korten has already obtained. Implementing this technique from Lehmann II into the system of Korten would be a straightforward exercise for a POSITA. Ex-1015, ¶184.

Thus, a POSITA would be motivated to incorporate the fractional-tooth-shade-determining feature for tooth regions described in Lehmann II into the systems and methods disclosed by Korten. Ex-1015, ¶185.

8. Claim 14 Is Rendered Obvious

a. [Claim 14Pre]

Korten discloses the preamble. *See supra*, Section IX.A.1.a.

b. [Claim 14a]

Korten discloses this limitation. *See supra*, Section IX.A.1.b.

c. [Claim 14b]

Korten in view of Lehmann II discloses this limitation. *See supra*, Section IX.B.1.c.

d. [Claim 14c]

Korten discloses this limitation. For example, 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." *See* Ex-1009 at 5:9-11; Ex-1015, ¶ 190. As part of this process, 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." *See* Ex-1009 at 5:14-16; Ex-1015, ¶ 190. Further, "[t]he measured colors may be mapped relative to the first virtual dentition model at coordinates which correspond to the location at the dentition." *See* Ex-1009 at 5:24-27; Ex-1015, ¶179.

The capture of the first location corresponds to the first subscan in this claim limitation, and the capture of shape and color data associated with the second location correspond to the second subscan. By 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. Ex-1015, ¶ 191.

e. A POSITA Would Be Motivated to Combine the Accuracy Features in Lehmann II with the System

Disclosed in Korten

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. *See supra*, Section IX.B.1.e.

9. Claim 15 is Rendered Obvious

a. [Claim 15]

Korten discloses this limitation. *See supra*, Section IX.A.4.

10. Claim 16 is Rendered Obvious

a. [Claim 16]: The method according to claim 15, wherein combining the texture information from the sub-scans comprises interpolating the texture information and/or calculating an average value of the texture information.

Lehmann II discloses averaging the color values across the points included within a region of the tooth. *See supra* Section IX.B.7.e. Accordingly, using the averaging technique from Lehmann II in the system described in Korten in which multiple subscans are used to render a 3D image will result in the color information in Korten being averaged, and this limitation is met. Ex-1015 at ¶198.

b. A POSITA Would Be Motivated to Combine the Tooth-Color-Averaging Feature for Regions of a Patient's Tooth Disclosed in Lehmann II with the System Disclosed in Korten

A POSITA would be motivated to combine the tooth-color-averaging features in Lehmann II with the system disclosed in Korten for the same reasons discussed above. *See supra*, Section IX.B.1.e. Ex-1015 at ¶182.

C. Ground 3: Claims 10, 16, and 17 Are Rendered Obvious by Korten in View of Lehmann II and in further view of Babayoff

1. Claim 10 is Rendered Obvious

a. [Claim 10] The method according to claim 1, wherein the method comprises comparing the texture data with known texture values for soft oral tissue, such as gum tissue and gingiva.

Babayoff discloses this limitation. Ex-1015 ¶ 202. For example, Babayoff discloses a method for differentiating between a first tissue and a second tissue where "said first tissue comprises substantially different color characteristics from those of said second tissue." Ex-1013 at 4:26-28; Ex-1015 ¶ 202. Babayoff further describes that the "first tissue comprises hard tissues such as teeth, and the soft tissue comprises at least one of gums, tongue, cheeks and lips." Ex-1013 at 4:37-39; Ex-1015 ¶202. Babayoff discloses that the color data of the second tissue "is correlated with a color representative of said second tissue." Ex-1013 at 4:35-36; Ex-1015 ¶203.

Babayoff also discloses that "the color parameter c is analysed [*sic*] for each data point in I, and compared with at least one color criterion, and typically with at least two color ranges R_1, R_2" where the ranges "each represent the values of the color parameter expected for one or another of the two tissues, such as for the teeth and gums." Ex-1013 at 21:23-28; Ex-1015 ¶204. As an example, "the color range R_2 for the soft tissues will include values for c typically associated with gums,

cheeks, lips, and the tongue." Ex-1013 at 21:28-38; Ex-1015 ¶204.

As explained above, the combination of Korten with Lehmann II discloses each of the limitations and elements of claim 1. *See supra* Section IX.B.1. Accordingly, the combination of Korten and Lehmann II, along with Babayoff renders claim 10 obvious. Ex-1015 ¶205.

b. A POSITA Would Be Motivated to Combine the Gingiva Identification Feature in Babayoff with the Combined System of Korten and Lehmann II

A POSITA would be motivated to combine the gingiva identification feature from Babayoff into the combined system of Korten and Lehmann II. Ex-1015 ¶206. For example, Babayoff teaches that implementing the gingiva identification scheme allows a user to display only the surface of interest, *i.e.*, the patient's teeth. *See* Ex-1013 at 22:47-56; Ex-1015 ¶206. Doing so allows the user to manipulate the representation of the patient's teeth as desired, such as by isolating individual teeth on the display. *See* Ex-1013 at 22:50; Ex-1015 ¶206. Moreover, the technique in Babayoff allows for the stitching together of various sub-scans captured of the patient's teeth to be accomplished more effectively. *See* Ex-1013 at 2:1-23; Ex-1015 ¶206.

As with Korten and Lehmann II, the underlying technology described in Babayoff substantially overlaps with that described in the other two references. Ex-1015 ¶207. For example, Babayoff discloses capturing color data as RGB values,

similarly to Korten and Lehmann II. *Id*. Further, Korten, Lehmann II, and Babayoff all further disclose obtaining color data for points on the patient's teeth. *Id*.

Because the three references all use the same type of color systems, a POSITA would expect the gingiva identification technique from Babayoff could be successfully used in the combined system of Korten and Lehmann II. *Id*. ¶208.

Further, the gingiva identification technique from Babayoff could be successfully used in the combined system of Korten and Lehmann II. *Id*. at ¶209. The combined Korten/Lehmann II system captures the same type of color data as Babayoff to identify the two different types of tissue. *Id*. Accordingly, incorporating this feature into the Korten/Lehmann II system would involve nothing more than implementing the additional programming as described in Babayoff. *Id*.

Because Korten, Lehmann II, and Babayoff are in the same field, teach analogous solutions to the same shade-matching issue, and have the same purpose of providing representations of patient's teeth, a POSITA would be motivated to combine the gingiva identification feature of Babayoff with the combination of Korten/Lehmann II. *Id*. ¶193. Moreover, as discussed above, a POSITA would have a high expectation that such a combination would be successful. *Id*.

2. Claim 16 is Rendered Obvious

a. [Claim 16]: The method according to claim 15, wherein combining the texture information from the sub-scans comprises interpolating the texture

information and/or calculating an average value of the texture information.

Babayoff discloses this limitation. Ex-1015 ¶212. For example, Babayoff discloses that "a plurality of separate numerical sub-entities associated with a corresponding plurality of teeth within said intra-oral cavity are provided," and are "combined to a single transformed sub-entity, wherein color data corresponding to said plurality of numerical sub-entities are combined to a single transformed sub-entity." Ex-1013 at 5:57-62; Ex-1015 ¶212. According to Babayoff, the "color data corresponding to said plurality of numerical sub-entities in (a) are combined in a predetermined manner," including by "averaging the color value at each corresponding data point of said plurality of numerical sub-entities." Ex-1013 at 5:62-66; Ex-1015 ¶212.

Further, the combination of Korten with Lehmann II discloses each of the limitations and elements of claims 14 and 15. *See supra* Section IX.B.9.a. Accordingly, the combination of Korten and Lehmann II, along with Babayoff renders claim 16 obvious. Ex-1015 ¶ 213.

b. A POSITA Would Be Motivated to Combine the Color Averaging Feature in Babayoff with the Combined System of Korten and Lehmann II

A POSITA would be motivated to combine the color averaging feature from Babayoff into the combined system of Korten and Lehmann II. Ex-1015 ¶214. As discussed above, all three references disclose substantially overlapping technology

related to providing image and color information for a patient's tooth. *See supra* Section IX.C.1.b. Moreover, all three references describe as objectives of each respective system the ability to provide accurate representations related to the colors of the patient's teeth. *See id*., *see also* Ex-1013 at 8:15-18; Ex-1015 ¶212.

As with Korten and Lehmann II, the underlying technology described in Babayoff substantially overlaps with that described in the other two references. Ex-1015 ¶215. For example, Babayoff discloses capturing color data as RGB values, similarly to Korten and Lehmann II. *Id.* Further, Korten, Lehmann II, and Babayoff all further disclose obtaining color data for points on the patient's teeth. *Id*.

Because the three references all use the same type of color systems, a POSITA would expect the color averaging technique from Babayoff could be successfully used in the combined system of Korten and Lehmann II. *Id*. ¶216.

Further, the color averaging technique from Babayoff could be successfully used in the combined system of Korten and Lehmann II. *Id*. ¶217. The combined Korten/Lehmann II system captures the same type of color data that is used by Babayoff to average the various color values in the sub-entities. *Id*. Accordingly, incorporating this feature into the Korten/Lehmann II system would involve nothing more than implementing the additional programming as described in the Babayoff reference. *Id*. Doing so would be a straightforward exercise for a POSITA. *Id*.

Thus, because Korten, Lehmann II, and Babayoff are in the same field, teach

analogous solutions to the same shade-matching issue, and have the same purpose of providing accurate representations of patient's teeth, a POSITA would have been motivated to combine the color averaging feature of Lehmann II with the systems and methods disclosed by Korten and would expect such combination to succeed. *Id*. at ¶218.

3. Claim 17 is Rendered Obvious

a. [Claim 17]: The method according to claim 16, wherein the calculated average value is a weighted average of the texture information.

Babayoff discloses this limitation. Ex-1015 ¶203. For example, as discussed above, Babayoff discloses that "a plurality of separate numerical sub-entities associated with a corresponding plurality of teeth within said intra-oral cavity are provided," and are "combined to a single transformed sub-entity, wherein color data corresponding to said plurality of numerical sub-entities are combined to a single transformed sub-entity." *See supra* Section IX.C.2.a., Ex-1013 at 5:57-62; Ex-1015 ¶220. According to Babayoff, the "color data corresponding to said plurality of numerical sub-entities in (a) are combined in a predetermined manner," including by "weight averaging the color value at each corresponding data point of said plurality of numerical sub-entities." Ex-1013 at 5:66-6:2; Ex-1015 ¶220.

Accordingly, the combination of Korten and Lehmann II, along with Babayoff renders claim 17 obvious. Ex-1015 ¶ 221.

b. A POSITA Would Be Motivated to Combine the Weighted Averaging Feature for Color in Babayoff with the Combined System of Korten and Lehmann II

A POSITA would be motivated to combine the color averaging feature from Babayoff into the combined system of Korten and Lehmann II. *See supra* Section IX.C.2.b. This same motivation applies here because the weighted color averaging technique is one way for implementing the color averaging feature. Ex-1015 ¶222.

D. Ground 4: Claims 1, 2, 9, 12, and 14 - 16 Are Rendered Obvious by Korten in View of Lehmann I

1. Claim 1 is Rendered Obvious

a. [Claim1Pre]

Korten teaches this limitation. *See supra* IX.A.1.a; Ex-1015 ¶225.

b. [Claim 1a]

Korten discloses this limitation. *Supra* IX.A.1.b; Ex-1015 ¶226.

c. [Claim 1b]

Korten in view of Lehmann I discloses this limitation. According to 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. Ex-1010 at 5:50-6:18; Ex-1015 ¶227. When this process is performed on a reference tooth, it results in a Reference Image, Ex-1010 at 7:3-6, and when it is performed on a patient's tooth, it results in a Real Image, *see id.* at 7:39-53. Ex-1015 ¶227.

The color for the "Real Image is compared (i.e., correlated) to each Reference

Image in the database" using a correlation algorithm. Ex-1010 at 9:30-35; Ex-1015 ¶228. This correlation results in a composite match number ("CMN") that "indicat[es] 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." Ex-1010 at 9:37-42; Ex-1015 ¶228.

d. [Claim 1c]

Korten in view of Lehmann I disclose this limitation. Lehmann I disclose technology "for tooth shade determination using digital signal processing" in which color images of one or more teeth are analyzed and compared to known tooth shades for use in certain clinical or cosmetic procedures. Ex-1010 at 1:16-21; Ex-1015 ¶84.

Lehmann I discloses the use of a of a correlation algorithm that results in a composite match number being determined that can be used to find a "best fit." *See supra* § IX.D.1.c. The determination of the "best fit" amongst the Reference Images, described above, requires the use of certainty scores because the "best fit" corresponds to the reference tooth shade that has the highest certainty score. Ex-1015 ¶231.

Accordingly, Korten in view of Lehmann I discloses this limitation because Korten discloses that tooth shade values are determined for each point on the 3D image of the tooth, and Lehmann I discloses a process for determining the various

shades. Ex-1015 ¶232.

e. A POSITA Would Be Motivated to Combine the Accuracy Features in Lehmann I with the System Disclosed in Korten

A POSITA would be motivated to include the "best fit" technology from Lehmann I in the system described in Korten. Ex-1015 ¶233. Both references disclose overlapping technologies for tooth image, color, and tooth shade information. The difference between Lehmann I (analyzing 2D images) and Korten (rendering and displaying 3D models) is immaterial for determining the certainty score of the selected shade value. Ex-1015 ¶233. It is equally important to identify the closest matching reference shade value in a 2D image as it is in a 3D image. Ex-1015 ¶233.

Lehmann I disclosing finding the "best fit" for a reference tooth shade based on pseudo pixels is inconsequential for the "best fit" concept's use in the system and methods disclosed in Korten. Ex-1015 ¶234. Lehmann I explains the "best fit" is determined by comparing a number of color values from the Real Image (*e.g.*, a color value associated with each pseudo pixel) with corresponding color values associated with each Reference Image. *Id*. The following equation can be used to make this "best fit" determination, wherein "q" corresponds to each set of matching pixels in the Real Image and the Reference Image. :

$$CMN_x = \sum_{q=1}^{n} \sqrt{\left(\frac{R_{x,q} - R_{i,q}}{Pcount_x}\right)^2 + \left(\frac{G_{x,q} - G_{i,q}}{Pcount_x}\right)^2 + \left(\frac{B_{x,q} - B_{i,q}}{Pcount_x}\right)^2}$$

Ex-1010 at 11:40; Ex-1015 ¶234.

If "n" is 1, then this equation can be used to find the closest match for a reference tooth shade for a single color value. Ex-1015 ¶235. A POSITA would certainly recognize that Lehmann I's "best fit" concept, involving a collection of points, can be used in Korten to find the "best fit" when the "collection of points" consists of a single point. *Id*. Doing so would achieve the objectives of Korten of providing a "matching" tooth shade value. *Id*.

Further, Lehmann I's "best fit" concept could be successfully used in the system disclosed in Korten. Ex-1015 ¶236. Both references have the same underlying color and tooth shade measurements obtained from both the patient's tooth and the tooth shade guides. *Id*. Accordingly, implementing Lehmann I's calculation into the system disclosed in Korten would be a straightforward exercise for a POSITA involving the summation algorithm in Lehmann I. *Id*. Moreover, as discussed above, a POSITA would have a high expectation that such a combination would be successful. *Id*.

2. Claim 2 is Rendered Obvious

a. [Claim 2]

Lehmann I discloses this limitation. According to Lehmann I, the "Real

Image is compared (i.e., correlated) to each Reference Image in the database" using a correlation algorithm. Ex-1010 at 9:30-35; Ex-1015 ¶239. This correlation results in a composite match number ("CMN") that "indicat[es] how well the Real Image matches to that Reference Image. Ex-1015 ¶239. 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." Ex-1010 at 9:37-42; Ex-1015 ¶239. A POSITA would understand that the "best fit" is the reference tooth shade value with the known texture value closest to the texture data of the point. Ex-1015 ¶240.

b. A POSITA Would Be Motivated to Combine the Accuracy Features in Lehmann I with the System Disclosed in Korten

A POSITA would be motivated to combine the accuracy feature from Lehman I into the system and methods disclosed in Korten. *See supra* Section IX.D.1.e; Ex-1015 ¶241. This same motivation applies here. *Id*.

3. Claim 9 is Rendered Obvious

a. [Claim 9]

Korten in light of Lehmann I disclose this limitation. Korten discloses that tooth shade values from well-known tooth shade systems can be used to express the tooth shade of the patient's tooth. *See* Ex-1009 at 5:30-34; Ex-1015 ¶244. For example, Korten discloses "[s]uch a standard color scheme may for example correspond to the widely used VITAPANTM Classical tooth color scheme." *See id.*

It is well-known in the art that the VITA Classical color scheme is used to

express the color for a prepared restoration. Ex-1015 ¶245. For example, as disclosed in Lehmann I, the Vita shade guide provides dental professionals with "standardized shade guides created by companies which manufacture the reconstructive material." Ex-1010 at 1:43-45; *see also* Ex-1009 at 2:15-18; Ex-1015 ¶245.

4. Claim 12 is Rendered Obvious

a. [Claim 12]

Korten discloses this limitation. *See supra* Section IX.B.7.d. Ex-1015 ¶249.

5. Claim 14 is Rendered Obvious

a. [Claim 14 pre]

Korten discloses this limitation to the extent it is limiting. *See supra* IX.A.1.a; Ex-1015 ¶251.

b. [Claim 14a]

Korten discloses this limitation. *Supra* IX.A.1.b; Ex-1015 ¶252.

c. [Claim 14b]

Korten in view of Lehmann I discloses this limitation. *Supra* IX.D.1.c; Ex-1015 ¶253.

d. [Claim 14c]

Korten discloses this limitation. *Supra* IX.A.3.d.

e. A POSITA Would Be Motivated to Combine the Accuracy Features in Lehmann I with the System Disclosed in Korten

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. *Supra* Section IX.D.1.e; Ex-1015 ¶256.

6. Claim 15 is Rendered Obvious

a. [Claim 15]

Korten discloses this limitation. *Supra* Section IX.A.4.

7. Claim 16 is Rendered Obvious

a. [Claim 16]

According to Lehmann I, each reference image is processed so that 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. Ex-1010 at 5:50-6:18; Ex-1015 ¶262. The intensity and color "are computed or otherwise formed as an average (or other statistical measure) of the actual pixels forming the pseudo-pixel." Ex-1010 at 6:15-18; Ex-1015 ¶ 262. Accordingly, using the averaging technique from Lehmann I in the system described in Korten in which multiple subscans are used to render a 3D image will result in the color information in Korten being averaged, meeting this claim's limitation. Ex-1015 ¶262.

b. A POSITA Would Be Motivated to Combine the Tooth-Color-Averaging Feature for Regions of a Patient's Tooth Disclosed in Lehmann I with the System Disclosed in Korten

A POSITA would be motivated to combine the tooth-color-averaging features in Lehmann I with the system disclosed in Korten. Ex-1015 ¶ 263. Both references

disclose substantially overlapping technology related to providing image, color, and tooth shade information for a patient's tooth. *Id*. As noted in Lehmann I, averaging the color data across pseudo pixels "reduces the total number of pixels per image and thus simplifies the task of aligning different images accurately." Ex-1010 at 7:34-37; Ex-1015 ¶263. Moreover, a POSITA would have a high expectation of success in using the pseudo pixel technique in Lehmann I with the methods and systems disclosed in Korten. Ex-1015 ¶ 263.

E. Ground 5: Claim 13 Is Rendered Obvious by Korten in View of Pye

1. Claim 13 is Rendered Obvious by Korten in View of Pye

a. [Claim 13Pre]

Korten discloses the preamble. *See supra*, Section IX.A.1.a.

b. [Claim 13a]

Korten discloses this limitation. *See supra*, Section IX.A.1.b.

c. [Claim 13b]

Korten discloses this limitation. *See supra*, Section IX.B.7.c.

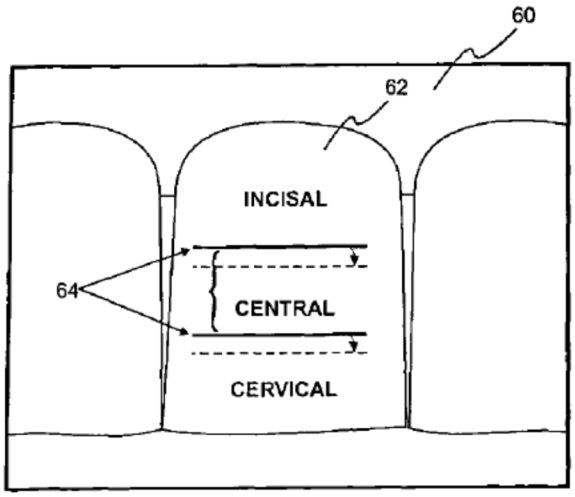
d. [Claim 13c]

Korten discloses this limitation. *See supra*, Section IX.B.7.d.

e. [Claim 13d]

Korten in view of Pye discloses this limitation. Ex-1015 ¶271. Pye discloses the use of dividers that may be used to "divide the tooth into regions of interest or into regions that correspond to major tooth regions (e.g., the incisal, central, etc.)."

See Ex-1012 at 2:49-53. Further, display equipment may be used to "view an image of a patient's tooth and to view and use shade analyzing software features." *See id.* at 4:44-46. The patient's tooth may be broken into separate regions, as illustrated by the following diagram:



See id., Fig. 5.

Thus, incorporating the technique from Pye into Korten results in a system in which tooth shade values are determined from data points located in at least three different regions of the tooth – the incisal region, the central region, and the cervical region. Ex-1015 ¶273.

Although the above disclosure in Pye involves averaging using color data values, a POSITA would be sufficiently skilled to use tooth shade values as well. *See, e.g., supra*, IX.B.7.e.

Accordingly, Korten in view of Pye discloses this limitation. Ex-1015 ¶275.

2. A POSITA Would Be Motivated to Combine the Tooth-Shade-Averaging Features for Regions of a Patient's Tooth Disclosed in Pye with the System Disclosed in Korten

A POSITA would be motivated to use the tooth-shade-averaging feature for tooth regions described in Pye in the system described in Korten. Ex-1015 ¶276. Both references disclose substantially overlapping technology related to providing image, color, and shade information for a patient's tooth. *Id.* Moreover, both Korten and Pye describe as objectives the ability to provide accurate representations related to the colors of the patient's teeth. *See, e.g.,* Ex-1009 at 2:13-16; Ex-1012 at 2:19-28 (discussing shortcomings of subjective color matching). In addition, both Korten and Pye use the same types of color and shade systems (*e.g.*, RGB for color and a VITA classic for shade). Ex-1015 ¶276. Because of this significant amount of overlap, a POSITA would expect that the shade averaging feature from Pye could be successfully used in the system described in Korten. *Id*.

In addition, a POSITA would have an overwhelming motivation to combine the tooth-shade-averaging features from Pye that averages the tooth shades across a region of the patient's tooth into the system disclosed in Korten. *Id.* ¶277. In particular, Pye discloses that "[t]he use of tooth regions (e.g., whole regions, major tooth region, etc.) for tooth shade identification allows for sufficiently accurate shade identification without requiring complex and time-consuming analysis." *See, e.g.,* Ex-1012 at 4:11-15.

Pye also discloses that once the tooth shade regions have been identified, "certain color characteristics for the regions may be captured from image 60 to generate discrete numerical values for the color characteristics for each region as a whole (e.g., RGB average values for each region)." *See id.* at 8:6-10. Further, such discrete numerical values may include average color values for each region. *See id.* at 8:12-15. Although Pye discloses the averaging of color values, as discussed above, a POSITA would also be capable of averaging tooth shade values, as discussed in Lehmann II. Ex-1015 ¶278.

Further, the tooth-shade-averaging technique from Pye could be successfully incorporated into the system disclosed in Korten. *Id.* ¶279. Both references disclose capturing the same type of tooth color data and determining tooth shade values from the color data. *Id.* Accordingly, a POSITA could easily implement the tooth-shade-averaging technique from Pye into Korten because doing so involves a calculation using values that the system in Korten has already obtained. *Id.*

Because Korten and Pye are in the same field, teach analogous solutions to the same shade-determining issue for teeth, and have the same purpose of providing accurate representations of a patient's teeth, a POSITA would be motivated to use the averaging technique for tooth regions described in Pye in the systems disclosed by Korten. *Id.* ¶280. Moreover, as discussed above, a POSITA would have a high expectation that such a combination would be successful. *Id.*

F. Ground 6: Claims 10, 16, and 17 Are Rendered Obvious by Korten in View of Babayoff

1. Claim 10 is Rendered Obvious

a. [Claim 10]

Babayoff discloses this limitation. *Supra*, Section IX.C.1.a.

b. A POSITA Would Be Motivated to Combine the Gingiva Identification Feature in Babayoff with the System of Korten

A POSITA would be motivated to combine the gingiva identification feature from Babayoff into the system of Korten for the same reasons discussed above with respect to the combined system of Korten and Lehmann II. *Supra*, Section IX.C.1.b.

2. Claim 16 is Rendered Obvious

a. [Claim 16]

Babayoff discloses this limitation. *Supra*, Section IX.C.2.a.

b. A POSITA Would Be Motivated to Combine the Color Averaging Feature in Babayoff with the System of Korten

A POSITA would be motivated to combine the color averaging feature from Babayoff into the system of Korten for the same reasons discussed above with respect to the combined system of Korten and Lehmann II. *Supra*, Section IX.C.2.b.

3. Claim 17 is Rendered Obvious

a. [Claim 17]

Babayoff discloses this limitation. *Supra*, Section IX.C.3.a.

b. A POSITA Would Be Motivated to Combine the Weighted Averaging Feature for Color in Babayoff with the System of Korten

A POSITA would be motivated to combine the color averaging feature from Babayoff into the system of Korten. *See supra* Section IX.F.2.b. This same motivation applies here because the weighted color averaging technique is one way for implementing the color averaging feature. Ex-1015 ¶222.

X. INSTITUTION SHOULD NOT BE DISCRETIONARILY DENIED

A. An Exercise of Discretion Under 35 U.S.C. § 314(a) Would Be Improper

Petitioner hereby stipulates that, should the Petition be granted, Petitioner will not pursue in the District Court the same grounds that are raised or could have reasonably been raised in this Petition pursuant to *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020) (precedential as to § II.A). The Director has stated that "the PTAB will not discretionarily deny institution of an IPR" in view of such a stipulation. Interim Procedures at 7; *id.* at 3 and n.3 (discussing *Sotera*).

Accordingly, Petitioner's stipulation is dispositive in establishing that institution should not be discretionarily denied under 35 U.S.C. § 314(a).

B. An Exercise of Discretion under 35 U.S.C. § 325(d) Would be Improper

Where, as here, a petitioner files a "copycat" petition in conjunction with a timely motion for joinder and agrees to assume a "passive understudy role," the *General Plastic* factors are "effectively neutraliz[ed]." *Apple Inc. v. Uniloc 2017*

LLC, IPR2018-00580, Paper 13 at 10-11 (Aug. 21, 2018). Although the present copycat petition is DITC's second petition challenging the '151 Patent, this case is distinguishable from *Apple Inc. v. Uniloc 2017 LLC*, IPR2020-00854, Paper 9 at 4 (Oct. 28, 2020) (precedential) ("*Uniloc II*"). Unlike the petitioner in *Uniloc II*, who "failed to set forth facts or offer an explanation concerning its knowledge, at the time it filed the first petition, of the prior art asserted in the [copycat petition]," *id.* at 9, DITC represents that, at the time it filed its first petition (IPR2023-00400), counsel for DITC in any of the actions involving 3Shape did not identify or consider three[2] of the five prior art references used in the Medit IPR proceeding and in the present copycat petition, despite diligent prior art search. 3Shape did not produce those references in the district court litigation and, to this day, has not produced them. As a result, *General Plastic*[3] factors 2, 4, and 5 favor institution.

Likewise, factors 6 and 7, which relate to Board resources and efficiency, favor institution. The Board has recognized numerous times since *Uniloc* that "Board resources are not a concern [where a new party joins a pending petition]

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[2] Korten (U.S. Patent No. 10,028,810), Pye (U.S. Patent No. 7,341,450), and Lehmann II (U.S. Publ. No. 2011/0188086).

[3] *General Plastic Indus. Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 at 16 (PTAB Sept. 6, 2017) (precedential as to § II.B.4.i).

because this panel has the capacity to see the [Medit] IPR to is conclusion regardless of the constitution of the petitioner." *See Google v. Express Mobile*, IPR2022-00791, Paper 15 at 12 (PTAB Oct. 7, 2022); *Advanced Micro Devices Inc. v. Monterey Research LLC*, IPR 2021-00776, Paper 13 at 17-18 (PTAB Oct. 13, 2021). Moreover, there is no reason why DITC joining the Medit IPR as an understudy would affect the Board's ability to timely issue a final written decision. *See Express Mobile* at 13; *Advanced Micro* at 18.

On balance, the *General Plastic* factors favor institution and joinder with the Medit IPR.

XI. MANDATORY NOTICES

A. Real Parties in Interest— 37 C.F.R. § 42.8(b)(1)

The following entities are real parties in interest to this proceeding:

- Dental Imaging Technologies Corporation.
- Carestream Dental LLC, which was the original defendant in related district court litigation and which as of April 20, 2022 has no past or future liabilities associated with the claims, accused products, or associated business in that litigation.

No other parties had access to or control over this Petition, and no other parties funded this Petition.

B. Related Matters— 37 C.F.R. § 42.8(b)(2)

To the best of Petitioner's knowledge, the '151 patent has been or is involved in the following cases:

- *Dental Imaging Technologies Corporation d/b/a/ DEXIS v. 3Shape A/S* IPR2023-00400 (PTAB). The Board denied institution and this case is no longer ongoing.
- *3Shape A/S v. Medit Corp.*, Case No. W-22-CV-00443-ADA-DTG (W.D. Tex.). This case is ongoing.
- *3Shape A/S v. Carestream Dental LLC*, 6:21-cv-01110 (W.D. Tex.). This case was transferred to the Northern District of Georgia, and is currently ongoing as *3Shape A/S v. Carestream Dental, LLC*, 1:22-cv-01829 (N.D. Ga.).
- *Medit Corporation v. 3Shape A/S*, IPR2023-01315. This case is ongoing.

Petitioner is not aware of any other matters involving the '151 patent.

C. Lead and Back-Up Counsel— 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

Lead Counsel	Backup Counsel
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D. Service Information— 37 C.F.R. § 42.8(b)(4)

Please address all correspondence and service to the address listed above. Petitioner consents to electronic service by email at the addresses listed above.

XII. CONCLUSION

The prior art references cited herein demonstrate that the challenged claims of the ’151 patent are anticipated and obvious. Petitioners thus request that the PTAB grant this Petition, institute *inter partes* review, and cancel the challenged claims.

Respectfully Submitted,

Dated: April 25, 2024

/s/ John T. McKee

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned certifies that the foregoing Petition for *Inter Partes* Review contains 13,834 words excluding the caption, table of contents, table of authorities, table of exhibits, claim listing, mandatory notices, certificate of service, and certificate of word count. Petitioner has relied on the word count feature of the word processing system used to create this paper in making this certification. This word count does not include the items excluded by 37 C.F.R. § 42.24 as not counting towards the word limit.

Dated: April 25, 2024

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CERTIFICATE OF SERVICE

I hereby certify that on April 25, 2024, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review, associated exhibits, and power of attorney to be served via overnight courier upon the following counsel of record for Patent Owner per 37 CFR §§ 42.105(a) and 42.205(a).

Patent Office Counsel of Record	**Litigation Counsel of Record**
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I further certify that I served courtesy copies of the foregoing documents via electronic mail on April 25, 2024, upon Patent Owner's counsel of record as follows:

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