

IPR2023-01316
Patent No. 11,076,146

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MEDIT CORPORATION,

Petitioner,

v.

3SHAPE A/S,

Patent Owner.

Case No.: IPR2023-01316
U.S. Patent No. 11,076,146

**PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 11,076,146**

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LIST OF EXHIBITS

Ex. No.	Description
1001	U.S. Patent No. 11,076,146
1002	Excerpts of the File History for U.S. Patent No. 11,076,146
1003	U.S. Patent No. 6,008,905 (“Breton”)
1004	U.S. Patent No. 7,336,375 (“Faul”)
1005	WIPO Publication No. 01/84479 A1 (“Orametrix”)
1006	Claim Construction Order, <i>3Shape A/S v. Medit Corporation</i> , Case No. 6:22-cv-00443, Dkt. No. 76 (W.D. Tex. May 2, 2023)
1007	R.J. Valkenburg, A.M. McIvor, “Accurate 3D measurement using a structured light system”, <i>Image and Vision Computing</i> (1998) (“Valkenburg”)
1008	U.S. Patent No. 7,494,338 (“Durbin”)
1009	Curriculum Vitae of Dr. Rongguang Liang
1010	U.S. Patent Application Publication No. 2008/0118143 (“Gordon”)
1011	Nathan S. Birnbaum, et al. “3D Digital Scanners: A High Tech Approach to More Accurate Dental Impressions”, <i>Inside Dentistry</i> (April 2009) (“Birnbaum”)
1012	Declaration of Dr. Rongguang Liang

Challenged Claims of U.S. Patent No. 11,076,146

Claim element	Claim 1
[Claim 1 pre]	An intraoral scanner for determining the 3D geometry and color of at least a part of the surface of an object in an oral cavity, the intraoral scanner comprising:
[Claim 1a]	at least one camera accommodating an array of sensor elements;
[Claim 1b]	a pattern generator configured to generate, using a light source, a probe light with a plurality of configurations in the form of a time-varying illumination pattern;
[Claim 1c]	an optical system for transmitting the probe light towards the object along an optical path thereby illuminating at least a part of the object with the time-vary illumination pattern, . . .
[Claim 1d]	an optical system for transmitting at least a part of the light returned from the object to the at least one camera to form a plurality of 2D images,
[Claim 1e]	wherein the 3D geometry is determined based on the plurality of 2D images and the time-varying illumination pattern
[Claim 1f]	a tip configured to be inserted into the oral cavity; and
[Claim 1g]	a hardware processor configured to: selectively switch a color of the probe light, thereby illuminating the object with different colors at different times
[Claim 1h]	a hardware processor configured to: ... record different images by the at least one camera at the different times, thereby recording images of the object with the different colors; and
[Claim 1i]	a hardware processor configured to: ... combine the different colors from the different images, thereby obtaining the color of the surface of the object
[Claim 1j]	wherein the intraoral scanner is wireless, and
[Claim 1k]	wherein the at least one camera is a high-speed camera.

Claim element	Claim 3
[Claim 3]	The intraoral scanner according to claim 1, wherein the pattern generator is based on a projector such as a liquid crystal display (LCD) projector or a digital light processing (DLP) projector.
Claim element	Claim 4
[Claim 4]	The intraoral scanner according to claim 1, wherein the different colors are provided by at least three monochromatic light sources of the light source.
Claim element	Claim 5
[Claim 5]	The intraoral scanner according to claim 4, wherein the at least three monochromatic light sources are light-emitting diodes (LEDs) or a segmented LED.
Claim element	Claim 6
[Claim 6]	The intraoral scanner according to claim 4, wherein the hardware processor is configured to selectively switch the color of the probe light by switching on and off the at least three monochromatic light sources.
Claim element	Claim 8
[Claim 8]	The intraoral scanner according to claim 1, wherein the optical system is substantially achromatic.
Claim element	Claim 9
[Claim 9]	The intraoral scanner according to claim 1, wherein the hardware processor is further configured to locally process raw 3D data into data for the 3D geometry, such that the data for the 3D geometry is wirelessly transmitted instead of the raw 3D data, and wherein the raw 3D data is based on the plurality of 2D images.
Claim element	Claim 10
[Claim 10]	The intraoral scanner according to claim 1, wherein the hardware processor is further configured to locally process raw 3D data into data for the 3D geometry, such that the data for the 3D geometry is wirelessly transmitted at a reduced data rate in comparison with transmission of raw 3D data,

	and wherein the raw 3D data is based on the plurality of 2D images.
Claim element	Claim 11
[Claim 11]	The intraoral scanner according to claim 9, wherein the data for the 3D geometry is wireless transmitted to a workstation.
Claim element	Claim 12
[Claim 12]	The intraoral scanner according to claim 9, wherein the hardware processor processes the raw 3D data into data for the 3D geometry in real time.
Claim element	Claim 13
[Claim 13]	The intraoral scanner according to claim 1, wherein a temporal correlation measure is computed with sensor signals, in the [sic] at least one camera, recorded at different times while the plurality of configurations in the form of a time-varying illumination pattern are changed.
Claim element	Claim 15
[Claim 15]	The intraoral scanner according to claim 13, wherein the temporal correlation measure is based on a reference signal that is based on knowledge or on calibration of the plurality of configurations of the time-varying illumination pattern.
Claim element	Claim 16
[Claim 16]	The intraoral scanner according to claim 1, wherein the high-speed camera records images at a frame rate of at least 500 frames per second or at a frame rate of at least 2000 frames per second.
Claim element	Claim 21
[Claim 21 pre]	A method for determining the 3D geometry and color of at least a part of the surface of an object in an oral cavity, said method comprising the steps of:
[Claim 21a]	using a light source and a pattern generator to generate a probe light with a plurality of configurations in the form of a time-varying illumination pattern;
[Claim 21b]	transmitting the probe light, through a tip of intraoral scanner

	inserted into the oral cavity, towards the object along an optical path, thereby illuminating at least a part of the object with the time-varying illumination pattern;
[Claim 21c]	transmitting at least a part of the light returned from the object to at least one camera accommodating an array of sensor elements to form a plurality of 2D images,
[Claim 21d]	wherein the 3D geometry is determined based on the plurality of 2D images and the time-varying illumination pattern;
[Claim 21e]	selectively switching a color of the probe light, thereby illuminating the object with different colors at different times;
[Claim 21f]	recording different images by the [sic] at least one camera at the different times, thereby recording images of the object with the different colors;
[Claim 21g]	combining the different colors from the different images to obtain the color of the surface of the object; and
[Claim 21h]	wirelessly transmitting the data for the 3D geometry.
Claim element	Claim 22
[Claim 22]	The method according to claim 21, wherein the plurality of 2D images is recorded using a high-speed camera.
Claim element	Claim 23
[Claim 23]	The method according to claim 21, wherein the method further comprises a step of locally processing, on the intraoral scanner, raw 3D data into data for the 3D geometry, such that the data for the 3D geometry is wireless transmitted instead of the raw 3D data, and wherein the raw 3D data is based on the plurality of 2D images.
Claim element	Claim 24
[Claim 24]	The method according to claim 21, wherein the method further comprises a step of locally processing, on the intraoral scanner, raw 3D data into data for the 3D geometry, such that the data for the 3D geometry is wirelessly transmitted at a reduced data rate in comparison with

	transmission of raw 3D data, and wherein the raw 3D data is based on the plurality of 2D images.
Claim element	Claim 25
[Claim 25]	The method according to claim 23, wherein the step of wirelessly transmitting the data for the 3D geometry is to a workstation.
Claim element	Claim 26
[Claim 26]	The method according to claim 23, wherein the step of locally processing is in real time.
Claim element	Claim 27
[Claim 27]	The method according to claim 21, where the method further comprises a step of computing a temporal correlation measure with sensor signals, in the at least one camera, recorded at different times while the plurality of configurations in the form of a time-varying illumination pattern are changed.
Claim element	Claim 29
[Claim 29]	The method according to claim 27, wherein the temporal correlation measure is based on a reference signal that is based on knowledge or on calibration of the plurality of configurations of the time-varying illumination pattern.

I. INTRODUCTION

Medit Corporation (“Petitioner”) petitions for institution of *inter partes* review (“IPR”) of claims 1, 3-6, 8-13, 15, 16, 21-27, and 29 (“challenged claims”) of U.S. Patent No. 11,076,146 (“the ’146 patent”). Ex-1001.

II. GROUNDS FOR STANDING

Petitioner certifies that the ’146 patent is available for review under 35 U.S.C. § 311(c) and that 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 hereby authorized to charge or credit the fee specified by 37 C.F.R. § 42.15(a), and any other additional fees, to Bracewell LLP Deposit Account No. 50-0259.

IV. PRECISE RELIEF REQUESTED

Petitioner requests review of the challenged claims under 35 U.S.C. § 311 and cancellation of the challenged claims under pre-AIA 35 U.S.C. § 103(a) in view of the prior art and grounds described herein.

A. Prior Art

1. Orametrix

Petitioner relies on WIPO Publication No. 01/84479 A1 (“Orametrix”). Ex-1005. Orametrix was published on November 8, 2001, more than a year before the

alleged priority date for the '146 patent, and qualifies as a prior art printed publication under at least pre-AIA 35 U.S.C. § 102(b).

2. Faul

Petitioner relies on U.S. Patent No. 7,336,375 (“Faul”). Ex-1004. Faul was issued on February 26, 2008, more than a year before the alleged priority date for the '146 patent, and qualifies as a prior art printed publication under at least pre-AIA 35 U.S.C. § 102(b).

3. Breton

Petitioner relies on U.S. Patent No. 6,008,905 (“Breton”). Ex-1003. Breton was published on December 28, 1999, more than a year before the alleged priority date for the '146 patent, and qualifies as a prior art printed publication under at least pre-AIA 35 U.S.C. § 102(b).

4. Durbin

Petitioner relies on U.S. Patent No. 7,494,338 (“Durbin”). Ex-1008. Durbin was published on February 24, 2009, more than a year before the alleged priority date for the '146 patent, and qualifies as a prior art printed publication under at least pre-AIA 35 U.S.C. § 102(b).

B. IPR Grounds

Ground	Claims	Statutory Basis
1	1, 3-6, 8-13,	Obviousness under pre-AIA § 103(a) in view of

Ground	Claims	Statutory Basis
	15, 21-27, and 29	Orametrix, Faul, and Breton
2	16	Obviousness under pre-AIA § 103(a) in view of Orametrix, Faul, Breton, and Durbin

V. THE '146 PATENT

A. Overview of the '146 Patent

The '146 patent describes a scanner configured to measure the shape and color of an object, such as teeth. *See, e.g.*, Ex-1001 at Abstract; 1:24-30, claim 1. The scanner obtains the 3D geometry and color of at least part of the surface of the scanned object. *Id.* at 2:43-45; 33:45-34:18. Figure 8 illustrates an example embodiment of a scanner configured for simultaneous measurement of color and shape:

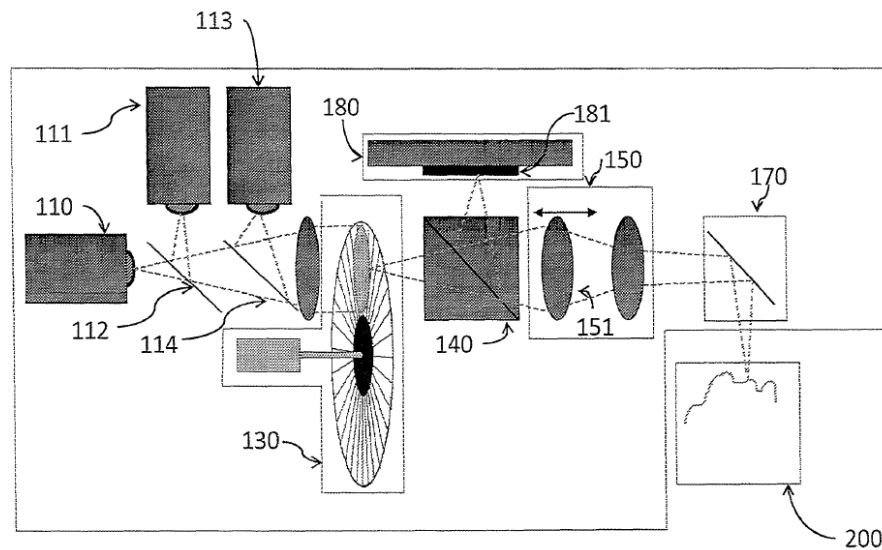


Fig. 8

The scanner includes pattern generation 130, which is used to generate a time-varying pattern that is projected onto the surface of scanned object 200. *Id.* at 28:4-13; 29:47-61. The pattern is changed over time by rotating the pattern generator, but may also be varied by translating the pattern over the object to be scanned. *See, e.g., id.* at 3:9-14; 8:38-58; 10:57-59; 28:5-13. The scanner also varies the position of the focal plane for the scanner via the focusing element 151 in optical system 150 and obtains images of the projected time varying pattern on the scanned object at different positions. *Id.* at 3:34-46; 6:62-7:50; 12:1-5; 27:33-37. These images are then used to determine the 3D surface information for each pixel. *See, e.g., id.* at 3:59-4:8.

In order to determine the color of the scanned object, the scanner describes using three lights sources (110, 111, 113) emitting red, blue, and green light. *See*

e.g., id. at 33:45-67. In one example embodiment, the lights sources are activated sequentially, providing a single color image of the time-varying pattern on the object. *Id.* The color of the scanned object surface is determined by weighting the detected amplitude signals for each color. *Id.* at 33:64-67.

The '146 patent briefly discusses that the scanner may be wireless, but that wireless operation increases the need for local data processing because the transmission of raw 3D data is to be avoided. *Id.* at 9:16-24.

The '146 patent also mentions that the camera (*e.g.*, 180/181) may be a standard camera element or a high-speed camera that incorporates multiple A/D converters per line of pixels. *Id.* at 8:1-8.

B. Prosecution History

The claims that issued for the '146 patent were added by preliminary amendment before examination, and the issued claims were allowed by the examiner on the first office action. Ex-1002.

VI. LEVEL OF ORDINARY SKILL IN THE ART

As of June of 2009, the priority date of the '146 patent, a POSITA would have had a bachelor's degree in computer engineering, computer science, electrical engineering, physics, or an equivalent field, as well as at least one or two years of design experience, or alternatively, at least five years of comparable industry experience. Ex-1012 ¶ 51-53. Furthermore, a POSITA would have had experience

with, and knowledge of, 3D imaging systems and 3D modeling techniques. *Id.*

VII. CLAIM CONSTRUCTION

In an IPR, claim terms should be 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).

For purposes of this proceeding only, Petitioner submits constructions for the following terms.¹ Petitioner does not believe that construction of any other term is

¹ While Petitioner proposes these constructions for purposes of this proceeding, Petitioner reserves their 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) (“37 C.F.R. § 104(b)(3) does not require [a p]etitioner to express its subjective agreement regarding correctness of its proffered claim constructions or to take ownership of those constructions”). Petitioner also reserves the right to challenge the validity of the challenged claims under 35 U.S.C. § 112 in another other action or forum. *See Target Corp. v. Proxicom Wireless, LLC*, IPR2020-00904, Paper 11 at 12-13 (PTAB Nov. 10, 2020)

necessary.

A. The Preamble to Independent Claim 1 Is Not Limiting

The District Court has determined that the preamble of claim 1 is not limiting and should be afforded its plain and ordinary meaning. Ex-1006 at 4.

B. “data for the 3D geometry” (Claims 12, 23, 24)

Claims 12, 23, and 24 recite “data for the 3D geometry.” The District Court has construed “data for the 3D geometry” to mean “the data for the 3D geometry.” Ex-1006 at 4.

VIII. OVERVIEW OF THE PRIOR ART

A. Prior Art References

1. Orametrix

53. Orametrix describes systems and methods for scanning an object surface and generating a three-dimensional model of the scanned surface utilizing triangulation. *See, e.g.*, Ex-1005 at 1:16-21; 46:3-14; 82, claim 32. The scanning in Orametrix is accomplished through projecting patterns that cast structured light onto a surface to be scanned. *Id.* at 25:11-26:5; 27:8-21; 29:8-19; Figs. 16, 19, 23. As

(instituting IPR despite indefiniteness arguments in parallel lawsuit, explaining that this kind of “alternative pleading before a district court is common practice, especially where it concerns issues outside the scope of *inter partes* review”).

depicted below in Figure 23, the projected patterns include both measuring features, e.g., (elements 1011-1013 at T1), and encoding features, e.g., (elements 1021-1023 at T2).

SHAPE NUMBER	BAR CODE	COLOR	PATTERN
0		RED	
1		ORANGE	
2		YELLOW	
3		GREEN	
4		BLUE	
5		INDIGO	
6		VIOLATE	
7		BROWN	

FIGURE 16

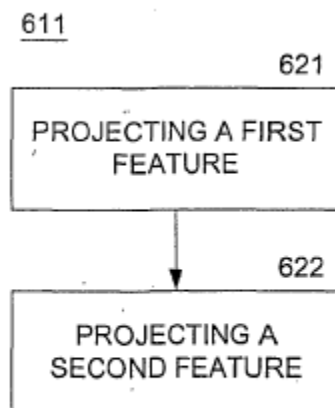


FIGURE 19

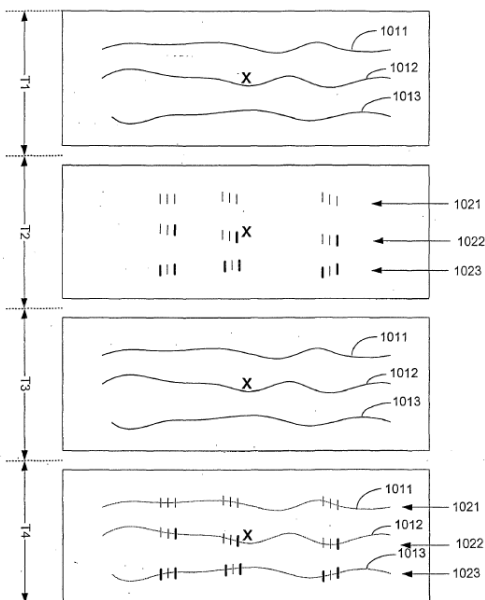
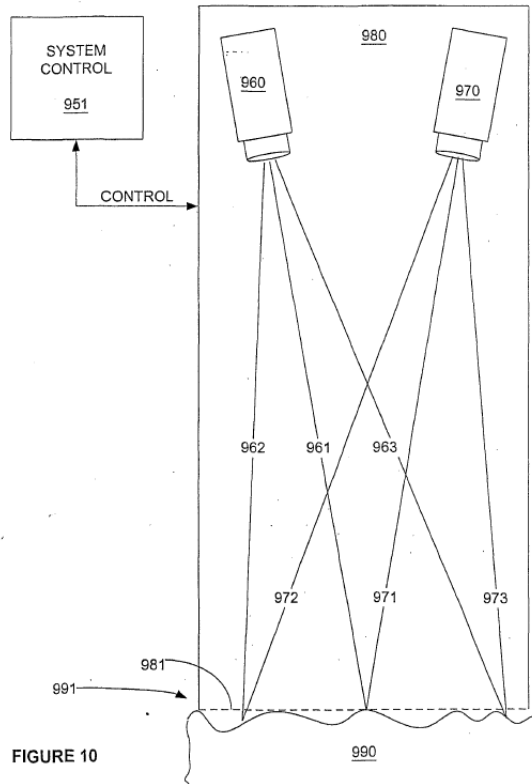


Figure 23

As shown between T1 and T4 in Figure 23, the projected patterns can vary in shape. Reflections from the surface of multiple two-dimensional images of the patterns are imaged by a high speed camera. *Id.* at 4:3-10; 16:6-13; 34:1-21. From these two dimensional images, the shape of the scanned surface is determined. *Id.* at 1:15-22; 15:19-21; 30: 15-23; Fig. 10. Orametrix also describes an intermediary step of adding photo data containing color information to the scan data underlying the three-dimensional virtual model, so that color can also be determined for the model, which may be pertinent to the intended application of the model (e.g., design and manufacture of an anatomical device). *Id.* at 64:6-15.



Orametrix additionally discloses that in the scanning process, different patterns are projected over different periods of time. *Id.* at 29:8-19; Figs. 16, 19, 23. Orametrix also illustrates the scanning device in a handheld configuration, described, for example in 56:11-22, and depicted, for example, by element 4401 in Figure 44:



2. Faul

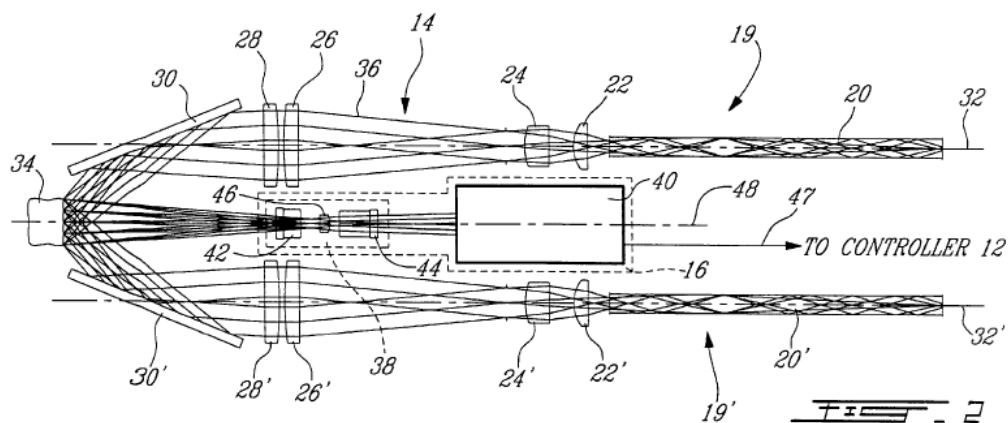
Faul describes a handheld scanner for three dimensional shape sensing utilizing projected structured light and triangulation. *See, e.g.*, Ex-1004 at Abstract; 1:61-2:15; 5:38-41; 7:29-31; 16:58-59; Figs. 2, 5.



This shape determination is made by projecting dynamically-varied, structured light on a surface to be measured by means of a digital video projector. *See id.* at 4:36-53. The structured light is varied over time so that varying patterns are projected on the scanned surface. *Id.* at 4: 25-35. Faul also describes measuring the color of the scanned surface by dynamically altering the color of the projected structured light. *See, e.g., id.* at 6:60-67; 10:64-11:4. Reflections of the structured light projections from the scanned surface are detected by optical imaging sensors to determine the color and shape of the surface. *Id.* at 4:59-5:9; 5:38-51 (describing the process for transforming 2D data to 3D data); 6:60-67 (describing that surface model 80 includes color or texture data in addition to geometrical shape data); Fig. 2. Faul also describes performing processing within the wireless scanner to reduce the amount of transmitted data to a workstation. *See, e.g., id.* at 12:43-63.

3. Breton

58. Breton describes a method and apparatus for determining the color and shape of a scanned object, such as a tooth. *See, e.g., Ex-1003 at Abstract; 5:35-55; Fig. 2.*



The wavelength of the light emitted by illumination assembly 14 is stepped over a range in order to change the color of the projected light that is used to scan the surface of object 34. *Id.* at 6:62-7:20. Illumination assembly 14 includes multiple light sources (not pictured). *Id.* at 4:16-26. The shape of surface 34 is determined by acquiring spatial resolution data that is used to build a position registry. *Id.* at 7:39-52. This position registry corresponds to a spectral map that is built from a complete spectral decomposition of every scanned point. *Id.* From the position registry and spectral map, the shape and color of the scanned surface is determined. *Id.* Breton also discloses that the color of the teeth can be accurately measured only using 3 sampling bands in the red, blue, and green portions of the wavelength spectrum, and that limiting the spectral band samples can reduce computation time. *Id.* at 8:24-36.

4. Durbin

Durbin teaches a three-dimensional dental scanner that uses a fixed coordinate reference frame to generate a three-dimensional representation of a dental structure in an oral cavity. *See* Ex-1008 at Abstract; Fig. 1. Durbin teaches that this scanner acquires images along a pre-scan traced path, and that these images may be used to generate a three-dimensional model of a dental structure, which may also be based on structured light illumination. *Id.* at 4:33-44; 5:37-43; 6:20-26; 10:48-11:17. Durbin teaches a CMOS-based imager which may be used to capture images at over 1000 frames per second and allows for resizing of the imaging window during the scanning process. *See id.* at 17:4-9.

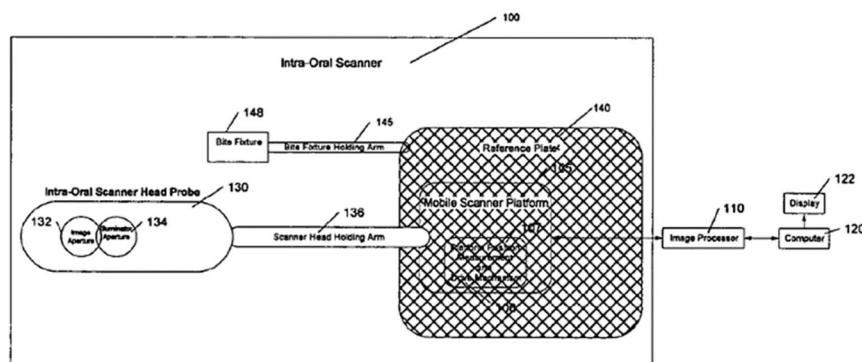


Figure 1

B. A POSITA Would Have Been Motivated to Combine the Prior Art

1. It Would Have Been Obvious to Combine Orametrix, Faul, and Breton

As explained in the attached declaration of Dr. Rongguang Liang, a POSITA would have been motivated to combine Orametrix, Faul, and Breton and have a reasonable likelihood of success in making said combination. Ex.-1003 ¶¶ 62, 66. Both Orametrix and Faul recognize the need for obtaining accurate scans of objects for three-dimensional modeling and mapping. *Id.*, ¶ 63. For example, Orametrix describes the need for accurate three-dimensional models to develop medical and dental devices and appliances that will reduce the level of subjective criteria required in manufacturing or reproducing them. *See, e.g.*, Ex-1005 at 1:17-22; 2:1-3:20. Similarly, Faul describes the desirability of obtaining three-dimensional models of real-world objects that are enhanced through wireless optical scanning, which does not require cables or other mechanical linkage or any physical contact with the object. *See, e.g.*, Ex-1004 at 1:18-34; 2:36-39; 2:42-3:32; 15:16-19. Moreover, both Orametrix and Breton describe the need to obtain an objective three-dimensional model of a tooth to create an accurate reproduction for a replacement tooth that minimizes subjectivity. *See, e.g.*, Ex-1003 at 1:14-40. Finally, Breton discusses the difficulty in matching the color shade of a reproduction tooth. *Id.* at 1:29-34.

In sum, Orametrix, Faul, and Breton, all describe measuring systems for

acquiring the color and shape of scanned objects. Ex-1012 ¶ 62. These three references belong to the same technical field, provide similar scanning systems, and have the same purpose to increase objectivity and accuracy in three-dimensional modeling of real-world objects. *Id.*, ¶¶ 62, 64. Therefore, a POSITA would have been motivated to combine the various elements of these three references to increase the accuracy of the color and shape measurements underlying the subsequent three-dimensional modeling of the real-world objects. *Id.*, ¶ 64. Furthermore, a POSITA would have had a reasonable expectation of success in combining the features and teachings of Orametrix, Faul, and Breton, because these optical systems all rely on similar scanning arrangements, and the substitution and combinations of features would be simple and yield the expected results of more accurate and objective optical measurements to make three-dimensional models of real-world objects. *Id.*, ¶ 65.

2. It Would Have Been Obvious to Combine Orametrix, Faul, Breton, and Durbin

As explained in the attached declaration of Dr. Rongguang Liang, a POSITA would have been motivated to combine Orametrix, Faul, Breton, and Durbin and have a reasonable likelihood of success in making said combination. *Supra* VIII.B.1 explains why a POSITA would have been motivated to combine Orametrix, Faul, Breton and why a POSITA would have a reasonable likelihood of success in making said combination.

Both Orametrix and Faul recognize the need for obtaining accurate scans of objects for three-dimensional modeling and mapping. Ex-1012 ¶ 191. For example, Orametrix describes the need for accurate three-dimensional models to develop medical and dental devices and appliances that will reduce the level of subjective criteria required in manufacturing or reproducing them. *See, e.g.*, Ex-1005 at 1:17-22; 2:1-3:20. Similarly, Faul describes the desirability of obtaining three-dimensional models of real world objects that are enhanced through wireless optical scanning, which does not require cables or other mechanical linkage or any physical contact with the object. *See, e.g.*, Ex-1004 at 1:18-34; 2:36-39; 2:42-3:32; 15:16-19.

As with Orametrix and Faul, Durbin describes generating a three-dimensional model of a scanned surface using two-dimensional images from structured light projection. *See, e.g.*, Ex-1008 at 5:37-43; 6:20-26. Durbin describes the need for accurate in vivo three-dimensional imaging of teeth and dental structures. *See, e.g., id.* at 4:12-20. And as with Orametrix and Durbin, Breton describes the need to obtain an objective three-dimensional model of a tooth to create an accurate reproduction for a replacement tooth that minimizes subjectivity. *See, e.g.*, Ex-1003 at 1:14-40. Breton discusses the difficulty in matching the color shade of a reproduction tooth. *Id.* At 1:29-34.

In sum, Orametrix, Faul, Breton, and Durbin describe measuring systems for

acquiring the color and shape of scanned objects. Ex-1012 ¶ 190. These four references belong to the same technical field, provide similar scanning systems, and have the same purpose to increase objectivity and accuracy in three-dimensional modeling of real-world objects. *Id.*, ¶ 193. Therefore, a POSITA would have been motivated to combine the various elements of these four references to increase the accuracy of the color and shape measurements underlying the subsequent three-dimensional modeling of the real-world objects. *Id.* Furthermore, a POSITA would have had a reasonable expectation of success in combining the features and teachings of Orametrix, Faul, Durbin, and Breton, because these optical systems all rely on similar scanning arrangements, and the substitution and combinations of features would be simple and yield the expected results of more accurate and objective optical measurements to make three-dimensional models of real-world objects. *Id.*, ¶ 194.

IX. THE CHALLENGED CLAIMS ARE UNPATENTABLE AND SHOULD BE CANCELLED

A. Ground 1: Claims 1, 3-6, 8-13, 15, 21-27, and 29 are Rendered Obvious by Orametrix In View of Faul Further in View of Breton

1. Claim 1 Is Rendered Obvious by Orametrix, Faul, and Breton

- a. [Claim 1 pre]: “An intraoral scanner for determining the 3D geometry and color of at least a part of the surface of an object in an oral cavity, the intraoral scanner comprising:”**

Orametrix teaches a scanning system for determining the shape and color of

tooth in an oral cavity. *See, e.g.*, Ex-1005 at 1:15-22; 15:19-21; 30:15-23; 31:11-33:7; 66:6-15, Figs. 10, 27, 28, 29; *see also* Ex-1012 ¶ 68.

b. [Claim 1a]: “at least one camera accommodating an array of sensor elements;”

Orametrix teaches a camera or viewer for capturing the reflected projected structured light pattern from an object to be scanned, including a CCD. *See* Ex-1005 at 4:3-10; 16:6-13; 34:4-6. *See also* Ex-1012 ¶ 69. A POSITA would understand that the camera/viewer of Orametrix would necessarily include an array of sensor elements. Therefore, Orametrix renders obvious this claim element. Ex-1012 ¶ 69.

c. [Claim 1b]: “a pattern generator configured to generate, using a light source, a probe light with a plurality of configurations in the form of a time-varying illumination pattern;”

Orametrix describes system controller 951 which includes data processor 952, projection image representation 953, projector controller 954, and viewer controller 955. Ex-1005 at 16:19-22; Figs. 10, 11; Ex-1012 ¶ 70. System controller 951 provides specific information to scanner 980 specifying a specific image to be projected onto surface 991 of object 990. Ex-1005 at 15:19-21; *see also* Ex-1012 ¶ 70. Orametrix describes that the image to be projected can be a digital image that is stored in memory by data processor 952. Ex-1005 at 17:11-19; Ex-1012 ¶ 70. Orametrix further describes that in the scanning process, different patterns can be projected over different periods of time. Ex-1005 at 29:8-19; Figs. 16, 19, 23; Ex-

1012 ¶ 70. Orametrix teaches that changing the projected patterns with different encoding and measuring features over time allows for more information to be obtained about the surface. Ex-1005 at 29:8-19; Figs. 16, 19, 23; Ex-1012 ¶ 70.

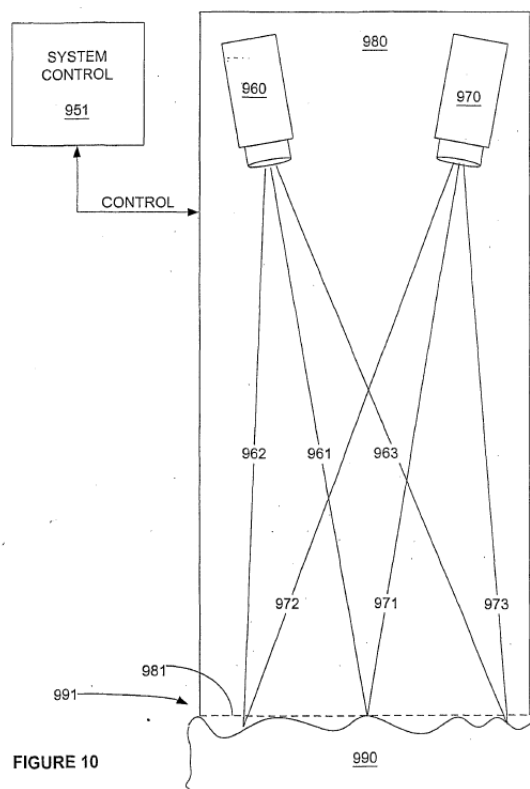
Faul also describes projecting a time-varying pattern of structured light to determine the shape of an object. *See* Ex-1004 at 4:36-53; *see also* Ex-1012 ¶ 71. Faul describes generating a time-varying pattern with a digital video projector. *See* Ex-1004 at 4:35-53; 5:52-57; Ex-1012 ¶ 71. Faul discloses that the scanner includes a microprocessor and memory, Ex-1004 at 7:64-8:8; Ex-1012 ¶ 71, and a POSITA would understand that this microprocessor would be utilized to implement the measurement process, including light source and camera control, as well as image processing.

A POSITA would have considered the digital image projection of Orametrix or Faul’s projected pattern of structured light to be “a probe light with a plurality of configurations in the form of a time-varying illumination pattern,” as claimed. Ex-1012 ¶ 72. Thus, Orametrix and Faul each teaches, and/or renders obvious this element in claim 1. *Id.*

- d. **[Claim 1c]: “an optical system for transmitting the probe light towards the object along an optical path thereby illuminating at least a part of the object with the time-varying illumination pattern . . .;”**

Figure 10 of Orametrix illustrates an optical system according to this claim

element:

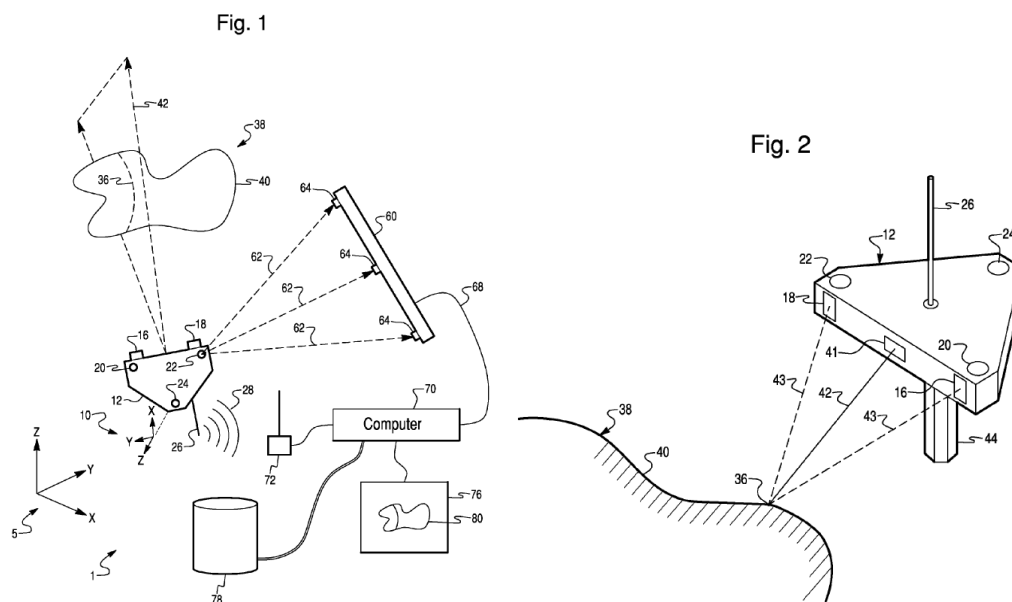


Ex-1012 ¶ 73.

Orametrix shows projector 960 that transmits the patterned probe light beam along an optical path to the surface of object 990 thereby illuminating at least a part of the object with the time-varying illumination pattern. Ex-1005 at 16:6-13; Ex-1012 ¶ 74. The reflected light from the object is detected by viewing device 970. Ex-1005 at 16:6-13. Orametrix further describes that the scanner receives a projected frame pattern that is digitized into a 2D image frame. Ex-1005 at 30:7-8; Ex-1012 ¶ 74. The 2D image frames are then converted into three dimensions using

conventional 3D imaging techniques. Ex-1005 at 30:8-12. *See also id.* at 75 (claim 4); Ex-1012 ¶ 74.

Figures 1 and 2 of Faul illustrate the claimed optical system:



Ex-1012 ¶ 75.

Faul describes a light source 41 projected on an optical path to a surface 36 from which reflected light is detected by at least one imaging sensor 16 or 18. Ex-1004 at 4:59-5:3; 8:45-9:25; 10:37-60; Ex-1012 ¶ 76. Faul describes the two-dimensional video data based on the reflected time-varying pattern that are detected by 16 or 18 are used as the basis for a three-dimensional model of the scanned surface. Ex-1004 at 4:59-9:25; 7:11-29; Ex-1012 ¶ 76.

A POSITA would recognize that Orametrix's projector 960 and Faul's light source 41 are both "an optical system for transmitting the probe light towards the

object along an optical path thereby illuminating at least a part of the object with the time-varying illumination pattern,” as recited by this claim element. Ex-1012 ¶ 77. Therefore, both Orametrix and Faul each teach and/or renders this claim element obvious. *Id.*

- e. **[Claim 1d]: “an optical system . . . for transmitting at least a part of the light returned from the object to the at least one camera to form a plurality of 2D images . . .”**

Orametrix describes that light projected by projector 960 reflected from the surface of object 990 is detected by viewing device 970. Ex-1005 at 16:6-13; Fig. 10; Ex-1012 ¶ 79. *See supra* Section IX.A.1.d. Faul describes that projected light from light source 41 is projected onto surface 36, the reflection of which is then detected by imaging sensor 16 or 18. Ex-1004 at 2:63-3:10; 4:59-5:3; 8:45-9:25; 10:37-50; Ex-1012 ¶ 80.

A POSITA would recognize that Orametrix’s viewing device and Faul’s imaging sensors, in combination with the optical path of reflected light from surface, comprise this claim element. Ex-1012 ¶ 81. Therefore, Faul and Orametrix each teaches and/or renders this claim element obvious. *Id.*

- f. **[Claim 1e]: “wherein the 3D geometry is determined based on the plurality of 2D images and the time-varying illumination pattern;”**

Orametrix describes that the scanner receives a projected frame pattern that is

digitized into a 2D image frame. Ex-1005 at 30:7-8; Ex-1012 ¶ 83. *See supra* Section IX.A.1.d. The 2D image frames are then converted into three dimensions using conventional 3D imaging techniques. Ex-1005 at 30:8-12. *See also id.* at 75 (claim 4); Ex-1012 ¶ 83. Faul describes the two-dimensional video data based on the reflected time-varying pattern that are detected by 16 or 18 are used as the basis for a three-dimensional model of the scanned surface. Ex-1004 at 4:59-5:9; 5:38-41; 6:24-42; 7:11-29; Ex-1012 ¶ 84.

A POSITA would recognize that Orametrix's 2D image frame conversion and Faul's two-dimensional video data analysis teach this claim element. Ex-1012 ¶ 85. Therefore, Orametrix and Faul each teaches and/or renders this claim element obvious. *Id.*

g. [Claim 1f]: “a tip configured to be inserted into the oral cavity; and”

Orametrix describes a scanning device 4401 that shows a tip, as illustrated in Figure 44:

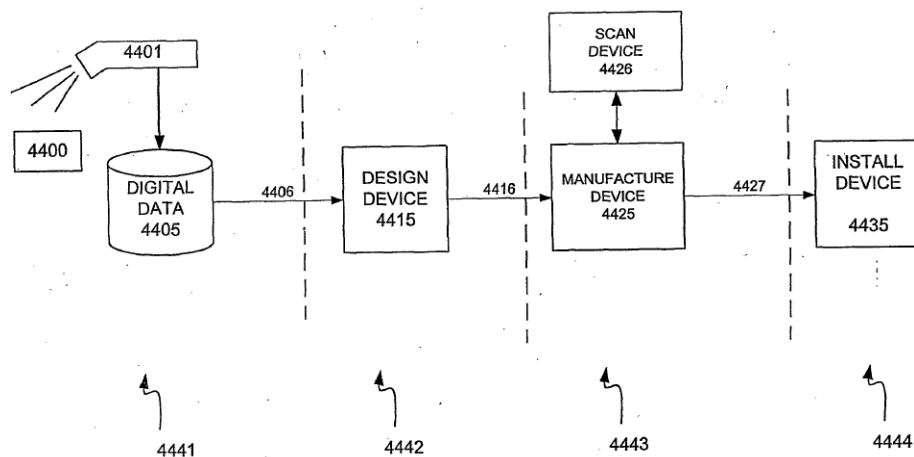


FIGURE 44

Ex-1012 ¶ 86.

Orametrix further discloses that the anatomical structure, such as a tooth, can be scanned directly by scanner 4401. Ex-1005 at 56:11-20; *see also id.* at 31:11-19; Fig. 27; Ex-1012 ¶ 87. The scanner illustrated in Figure 44, in combination with the description of direct scanning of anatomical structures teaches the claimed “tip” limitation. Furthermore, a POSITA would understand that in order to facilitate direct scanning of an anatomical structure, such as a tooth in a mouth, a housing that includes a tip would be needed to protect the scanning optics from damage or debris. Ex-1012 ¶ 87. Therefore, Orametrix renders this element of claim 1 obvious. Ex-1012 ¶ 88.

- h. [Claim 1g]: “a hardware processor configured to: selectively switch a color of the probe light, thereby illuminating the object with different colors at different times;”**

Orametrix describes scanning the object surface with a time-varying pattern to determine shape information. *See supra* Section IX.A.1.c. Furthermore, Orametrix describes changing the color of projected encoded features used for registration in multiframe scanning. Ex-1005 at 14:13-17; 25:11-26:5; Fig. 16; Ex-1012 ¶ 89. Orametrix also describes that photo data containing color information can be added to the digital data of the 3D virtual model of the anatomical structure. Ex-1005 at 64:6-15; Ex-1012 ¶ 89. Orametrix teaches that the measurement techniques may be implemented and executed by a hardware processor as part of the system. *See, e.g.*, Ex-1005 at 16:19-22; 64:6-15; 69:15-70:10; Fig. 46; Ex-1012 ¶ 89.

Faul also describes projecting a time-varying pattern to determine the shape of an object. *See* Ex-1004 at 4:36-53; Ex-1012 ¶ 90. Faul describes a digital video projector for generating a time-varying pattern. Ex-1004 at 4:25-53; 4:36-52; Ex-1012 ¶ 90. Faul also describes measuring the color of the scanned surface. *See, e.g.*, Ex-1004 at 6:60-67; Ex-1012 ¶ 90. Faul also describes dynamically altering the color of the projected structured light. *See* Ex-1004 10:64-11:4; Ex-1012 ¶ 90. Faul discloses that the scanner includes a microprocessor, Ex-1004 at 7:49-8:8, and a POSITA would understand that this microprocessor would be utilized to implement

the measurement process, including light source and camera control, as well as image processing. Ex-1012 ¶ 90.

Breton describes changing the wavelength of projected light from a controlled monochromatic light source over time to illuminate the scanned object with different colors at different times to measure the color of the surface of the scanned object. *See, e.g.*, Ex-1003 at 6:62-7:20; Fig. 2; Ex-1012 ¶ 91. Breton describes that the wavelength of the light source needs to be stepped through a number of discrete spectral bands at a maximum bandwidth in order to achieve adequate spectral resolution for the spectral map that corresponds to the color of the tooth surface. Ex-1003 at 6:62-7:20; Fig. 2; Ex-1012 ¶ 91. Breton further discloses that the color of the teeth can be accurately measured using only three sampling bands in the red, blue, and green portions of the wavelength spectrum, and that limiting the spectral bands can reduce computation time. Ex-1003 at 8:24-36; Ex-1012 ¶ 91.

It would have been obvious to a POSITA to combine the wavelength scanning of the monochromatic light source of Breton with time-varying pattern projection of Orametrix or Faul in order to measure the color of the scanned surface at an adequate spectral resolution, and therefore achieve an accurate color measurement. Ex-1012 ¶ 92. The processor of Orametrix is already configured to change the color of projected encoding features, and is configured to introduce color information from photo data into the three-dimensional model. *Id.* Faul itself teaches color

measurement and suggests dynamically changing the color of the projected time-varying structured light. *Id.* A POSITA would understand that the processors described by Orametrix and Faul would be configured to implement the color changing scheme as taught by Breton in the structured light projection in order to obtain sufficient spectral resolution to achieve an accurate color measurement of the scanned object surface. *Id.* Thus, Orametrix and Faul, further in view of Breton, teaches “a hardware processor configured to: selectively switch a color of the probe light, thereby illuminating the object with different colors at different times,” as recited by this claim element. *Id.*

- i. **[Claim 1h]: “a hardware processor configured to: ... record different images by the at least one camera at the different times, thereby recording images of the object with the different colors; and”**

Both Orametrix and Faul teach recording images of the scanned surface at different times with different projected patterns. *See supra* Section IX.A.1.c. For example, Orametrix describes that the data may be a composite of scans taken at different times. Ex-1005 at 57:7-16; Ex-1012 ¶ 93. Likewise, Faul describes assigning timestamps to each scanned image. Ex-1004 at 14:7-39; Ex-1012 ¶ 93. Faul also describes recording images of the object with different colors. Ex-1004 at 12:20-30; Fig. 4; Ex-1012 ¶ 93. A POSITA would be motivated to combine Breton’s color determination through wavelength scanning with either Orametrix or Faul. *See*

supra Section IX.A.1.h; Ex-1012 ¶ 93. A POSITA would understand that the wavelength scanning of this combination would necessarily require recording different images at different times reflecting the stepped wavelength changes. Ex-1012 ¶ 93. Thus, the combination of Orametrix or Faul in view of Breton teaches this claim element. Ex-1012 ¶ 94.

- j. **[Claim 1i]: “a hardware processor configured to: ... combine the different colors from the different images, thereby obtaining the color of the surface of the object,”**

Both Faul and Breton disclose dynamically varying the color of the projected light on the scanned object. Faul further teaches that the color data from a pattern with a variety of wavelengths is used to determine the color of the scanned surface. *See* Ex-1004 at 6:60-67; Ex-1012 ¶ 95. Faul also teaches measuring red-green-blue (RGB) color intensities for each location in the scanned image of the surface. Ex-1004 at 12:20-30. A POSITA would understand that these RGB intensities would be combined to obtain the color of the scanned surface. Ex-1012 ¶ 95. Similarly, Breton teaches building a color shade image map of the scanned surface out of several spectral images. *See* Ex-1003 at 6:47-54; 6:62-7:5; Ex-1012 ¶ 95. Breton also teaches that the color of a scanned surface can be measured by a linear combination of spectral sampling bands. *See* Ex-1003 at 9:43-47; Ex-1012 ¶ 95. A POSITA would be motivated to combine either Orametrix or Faul with Breton in

order to achieve an accurate color measurement of the scanned surface. *See supra* Section IX.A.1.e-f. Thus, Orametrix or Faul further in view of Breton teaches this claim element. Ex-1012 ¶ 95.

k. [Claim 1j]: “wherein the intraoral scanner is wireless, and”

Orametrix describes the direct measurement of anatomical structures, including teeth. Ex-1005 at 56:11-20; Ex-1012 ¶ 96. Orametrix describes wirelessly communicating scanning data from the system to a client. Ex-1005 at 58:21-59:13; Fig. 44; Ex-1012 ¶ 96. The scan data may be a dental structure, and Orametrix describes an example where the scanner may be performed at home by a user for monitoring the progress of a treatment plan. Ex-1005 at 58:1-14; Ex-1012 ¶ 96. A POSITA would understand that this scanner would be wireless and communicating data wirelessly for remote processing. Ex-1012 ¶ 96.

Faul teaches the advantages of a wireless handheld scanner for obtaining scanning data of three dimensional shapes in that it is unencumbered by a cable or mechanical linkage. *See, e.g.*, Ex-1004 at 2:36-39; Ex-1012 ¶ 97. It would have been obvious to a POSITA to configure the scanner of Orametrix with the wireless configurations taught by Faul. Ex-1012 ¶ 97. Therefore, Orametrix in view of Faul teaches this claim element. Ex-1012 ¶ 98.

1. [Claim 1k]: “wherein the at least one camera is a high-speed camera.”

Orametrix teaches that the scan rates can be chosen to allow for real-time viewing of a three-dimensional image. Ex-1005 at 34:12-21; Ex-1012 ¶ 99. A POSITA would understand the camera disclosed by Orametrix to be a high-speed camera. Ex-1012 ¶ 99. Thus, Orametrix teaches this claim element. *Id.* at ¶ 100.

2. Claim 3 Is Rendered Obvious by Orametrix, Faul, and Breton

a. [Claim 3]: “The intraoral scanner according to claim 1, wherein the pattern generator is based on a projector such as a liquid crystal display (LCD) projector or a digital light processing (DLP) projector.”

Orametrix describes using a digital projection image that is stored in memory. Ex-1005 at 17:11-19; Ex-1012 ¶ 102. *See supra* Section IX.A.1.c. A POSITA would understand this to be a digital light processing projector. Ex-1012 ¶ 102. Additionally, Faul teaches dynamically changing the projected pattern of the structured light using a digital video projector. Ex-1004 at 4:40-45; Ex-1012 ¶ 102. Thus, Orametrix and Faul both teach, and therefore render claim 3 obvious. Ex-1012 ¶ 102.

3. Claim 4 is Rendered Obvious by Orametrix, Faul, and Breton

- a. [Claim 4]: “The intraoral scanner according to claim 1, wherein the different colors are provided by at least three monochromatic light sources of the light source.”**

Orametrix in view of Faul in view of Breton teaches changing colors of the projected structured light pattern. *See supra* Section IX.A.1.f. Breton further describes that illumination assembly 14 contains a number of light sources that are not pictured. Ex-1003 at 3:53-56; 4:20-26; Ex-1012 ¶ 105. Breton also teaches the advantages of limiting the color band analysis to the red, blue, and green color bands to conserve processing resources. Ex-1003 at 11:21-27; Ex-1012 ¶ 105. A POSITA would have understood that the multiple light sources of Breton to include three monochromatic light sources to provide the red, blue, and green wavelength bands for scanning the object surface. Ex. 1003 ¶ 105.

Thus, Orametrix in view of Faul further in view of Breton renders claim 4 obvious. Ex-1012 ¶ 106.

4. Claim 5 is Rendered Obvious by Orametrix, Faul, and Breton

- a. [Claim 5]: “The intraoral scanner according to claim 4, wherein the at least three monochromatic light sources are light-emitting diodes (LEDs) or a segmented LED.”**

Breton describes illumination assembly 14 as containing multiple light

sources. *See supra* Section VIII.A.3; Ex-1012 ¶ 108. Faul discloses that the light source for scanning illumination could be a laser diode source. *See supra* Sections VIII.A.2, IX.A.1.c; Ex-1012 ¶ 108. A POSITA would know that LED light sources can be substituted for laser diode sources in a structured light projection system for many reasons, including that LEDs are cheaper and require lower drive current than laser diodes, and are also well known to be used as light sources in digital video projection. *See* Ex-1012 ¶ 108. It is well known to use LED lights sources in structured light projection. *See, e.g.,* Ex-1010 at [0337]; Ex-1011 at 2; Ex-1012 ¶ 108. As such a POSITA would have been motivated to use LED sources in the combination of Orametrix, Faul, and Breton to achieve those advantages. Ex-1012 ¶ 108. A POSITA would understand that illumination assembly of Breton could contain three monochromatic light source with the red, green, and blue wavelength bands. *See supra* Section IX.A.3; Ex-1012 ¶ 108. It would have been obvious to a POSITA to use LED sources in the illumination assembly to implement the wavelength scanning taught by Breton for the advantages discussed above. Ex-1012 ¶ 108. Therefore, Orametrix in view of Faul further in view of Breton renders claim 5 obvious. *Id.*

5. Claim 6 is Rendered Obvious by Orametrix, Faul, and Breton

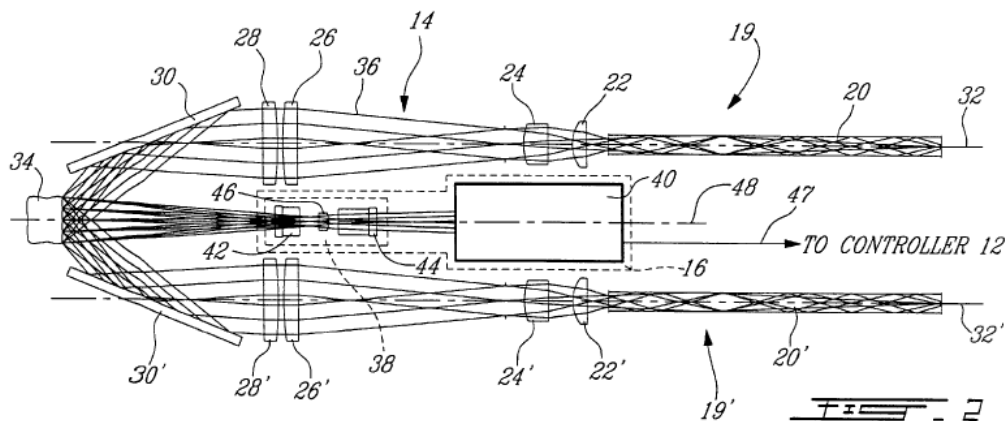
- a. **[Claim 6]: “The intraoral scanner according to claim 4, wherein the hardware processor is configured to selectively switch the color of the probe light by switching on and off the at least three monochromatic light sources.”**

Breton describes an illuminator assembly comprised of multiple light sources. *See supra* VIII.A.3, IX.A.3.a, IX.A.4.a; Ex-1012 ¶ 110. Breton also teaches changing the wavelength of the light used to scan the tooth surface. Ex-1003 at 6:62-11; Ex-1012 ¶ 110. A POSITA would selectively switch the three monochromatic light sources in the combination of Orametrix, Faul, and Breton to obtain an accurate color measurement of the tooth surface while conserving computational resources. Ex-1012 ¶ 110. Thus, Orametrix in view of Faul further in view of Breton renders claim 6 obvious. Ex-1012 ¶ 111.

6. Claim 8 is Rendered Obvious by Orametrix, Faul, and Breton

- a. **[Claim 8]: “The intraoral scanner according to claim 1, wherein the probe light is directed towards the object in a direction substantially parallel with the longitudinal axis of the tip, and wherein the probe light is further reflected towards the object by a single reflective mirror located in the tip.”**

As illustrated in Figure 2 of Breton, the measurement illumination is directed towards the tooth being measured in a direction parallel with the longitudinal axis of the device:



Ex-1012 ¶ 113.

Breton also describes directing the measurement illumination from integrator rod 20 towards tooth surface 34 using mirror 30. Ex-1003 at 4:1-26; Ex-1012 ¶ 114. Breton teaches that this configuration minimizes specular reflection. Ex-1003 at 4:19-26. Breton also teaches that other illumination and mirror configurations could be utilized. Ex-1003 at 4:1-26; Ex-1012 ¶ 114. A POSITA would be motivated to include a single mirror, as taught by Breton, in the tip of the scanner of the combination of Orametrix and Faul. Ex-1012 ¶ 114. Therefore, Orametrix in view of Faul further in view of Breton renders claim 8 obvious. Ex-1012 ¶ 115.

7. Claim 9 Is Rendered Obvious by Orametrix in view of Faul

- a. [Claim 9]: “The intraoral scanner according to claim 1, wherein the hardware processor is further configured to locally process raw 3D data into data for the 3D geometry, such that the data for the 3D geometry is wirelessly transmitted instead of the raw 3D data, and wherein the raw 3D data is based on the plurality of 2D images.”**

Orametrix and Faul describe determining the 3D geometry based on the plurality of 2D images. *See supra* Section IX.A.1.f; Ex-1012 ¶ 117. Faul describes processing two-dimensional image data locally in the scanning device to reduce the amount of data that is required to be transmitted from the scanning device to a workstation. Ex-1004 at 4:59-5:51; 12:43-50; Ex-1012 ¶ 118. Faul describes that subpixel coordinates of given points on the scanned 2D image are transformed into three-dimensional coordinates that are then transmitted. Ex-1004 at 12:27-32; Ex-1012 ¶ 118. A POSITA would implement the local processing taught by Faul in the combined scanning system of Orametrix, Faul, and Breton to reduce the amount of data required to be transmitted wirelessly and increase overall processing speed. Ex-1012 ¶ 118. Therefore, Orametrix in view of Faul further in view of Breton renders claim 9 obvious. Ex-1012 ¶ 119.

8. Claim 10 Is Rendered Obvious by Orametrix in View of Faul

- a. [Claim 10]: “The intraoral scanner according to claim 1, wherein the hardware processor is further configured to locally process raw 3D data into data for the 3D geometry, such that the data for the 3D geometry is wirelessly transmitted at a reduced data rate in comparison with transmission of raw 3D data, and wherein the raw 3D data is based on the plurality of 2D images.”**

Faul describes local processing of the imaging data before wirelessly transmitting the data for further processing at a workstation. *See supra* Section IX.A.7.a; Ex-1012 ¶ 121. Faul describes local processing of the imaging data before wirelessly transmitting the data for further processing at a workstation. *See supra* Section IX.A.7.a; Ex-1012 ¶ 121. In addition to local processing data to reduce the burden of wireless transmission Faul specifically describes locally processing 2D data into 3D data. Ex-1004 at 4:59-5:51; Ex-1012 ¶ 121. Faul describes this local processing as significantly reducing the amount of transmitted geometric and color data, as compared to conventional transmission. Ex-1004 at 12:43-50; Ex-1012 ¶ 121. Therefore, Orametrix in view of Faul renders claim 10 obvious. Ex-1012 ¶ 122.

9. Claim 11 Is Rendered Obvious by Orametrix in View of Faul

- a. [Claim 11]: “The intraoral scanner according to claim 9, wherein the data for the 3D geometry is wirelessly transmitted to a workstation.”**

Faul describes wireless transmission of the data for the 3D geometry to a workstation. *See supra* Sections IX.A.1, IX.A.7, and IX.A.8; Ex-1004 at 4:59-5:51; 12:43-50; Ex-1012 ¶ 124. A POSITA would incorporate the wireless teachings of Faul into Orametrix to achieve an untethered scanning instrument. *See supra* Section IX.A.1.j; Ex-1012 ¶ 124. Therefore, Orametrix in combination with Faul renders claim 11 obvious. Ex-1012 ¶ 125.

10. Claim 12 Is Rendered Obvious by Orametrix and Faul

- a. [Claim 12]: “The intraoral scanner according to claim 9, wherein the hardware processor processes the raw 3D data into data for the 3D geometry in real time.”**

Orametrix describes allowing for real-time viewing of a three-dimensional image of the scanned object. Ex-1005 at 34:12-15; Ex-1012 ¶ 127. Faul also describes rendering the geometry of a three-dimensional object in real-time. Ex-1004 at 8:56-60; Ex-1012 ¶ 127. Therefore, Orametrix and Faul each render claim 12 obvious. Ex-1012 ¶ 128.

11. Claim 13 Is Rendered Obvious by Orametrix in View of Faul

- a. **[Claim 13]: “The intraoral scanner according to claim 1, wherein a temporal correlation measure is computed with sensor signals, in the at least one camera, recorded at different times while the plurality of configurations in the form of a time-varying illumination pattern are changed.”**

Faul describes temporal correlation of the pattern of light and the scanner position that allows for accurate three-dimensional coordinate transformation. Ex-1004 at 2:49-62; 3:11-24; 9:27-42; Ex-1012 ¶ 130. A POSITA would be motivated to combine the correlation described by Faul in the system of Orametrix in order to obtain accurate coordinate data based on the changing projected pattern and the location of the scanning device. Ex-1012 ¶ 130. Therefore, Orametrix in view of Faul renders claim 13 obvious. Ex-1012 ¶ 131.

12. Claim 15 is Rendered Obvious by Orametrix, Faul, and Breton

- a. **[Claim 15]: “The intraoral scanner according to claim 13, wherein the temporal correlation measure is based on a reference signal that is based on knowledge or on calibration of the plurality of configurations of the time-varying illumination pattern.”**

Faul teaches calibrating the handheld scanner including details about the pattern of structured light. Ex- at 7:64-8:8; Ex-1012 ¶ 133. A POSITA would be motivated to incorporate the calibration of Faul into the system and methods of

Orametrix in order to accurately determine the three-dimensional shape of the scanned object. Ex-1012 ¶ 133. Therefore, Orametrix in view of Faul renders obvious claim 15. Ex-1012 ¶ 134.

13. Claim 21 Is Rendered Obvious by Orametrix, Faul, and Breton

- a. [Claim 21 pre]: “A method for determining the 3D geometry and color of at least a part of the surface of an object in an oral cavity, said method comprising the steps of:”**

To the extent the preamble is limiting, Orametrix teaches this limitation. Ex-1012 ¶ 136. Orametrix teaches a method for determining the shape and color of a tooth in an oral cavity. Ex-1005 at 1:15-22; 15:19-21; 30:15-23; 31:11-33:7; 66:6-15 Figs. 10, 27, 28, 29; Ex-1012 ¶ 137.

- b. [Claim 21a]: “using a light source and a pattern generator to generate a probe light with a plurality of configurations in the form of a time-varying illumination pattern;”**

Orametrix and Faul teach this claim limitation and therefore render it obvious. Ex-1012 ¶ 137. Orametrix describes system controller 951, which includes data processor 952, projection image representation 953, projector controller 954, and viewer controller 955. Ex-1005 at 16:19-22; Figs. 10, 11; Ex-1012 ¶ 137. System controller 951 provides specific information to scanner 980 specifying a specific image to be projected onto surface 991 of object 990. Ex-1005 at 15:19-21; Ex-1012 ¶ 137. Orametrix describes that the image to be projected can be a digital image that

is stored in memory by data processor 952. Ex-1005 at 17:11-19; Ex-1012 ¶ 137. Orametrix further describes that in the scanning process, different patterns can be projected over different periods of time. Ex-1005 at 29:8-19; Figs. 16, 19, 23; Ex-1012 ¶ 137. Orametrix teaches that changing the projected patterns with different encoding and measuring features over time allows for more information to be obtained about the surface. Ex-1005 Orametrix teaches that the measurement techniques may be implemented and executed by a hardware processor as part of the system. *See, e.g.*, Ex-1005 at 16:19-22; 64:6-15; 69:15-70:10; Fig. 46; Ex-1012 ¶ 137. A POSITA would understand that the hardware processor of Orametrix would be utilized to implement the claimed method element. Ex-1012 ¶ 137.

Faul also describes projecting a time-varying pattern of structured light to determine the shape of an object. *See* Ex-1004 at 4:36-53; Ex-1012 ¶ 138. Faul describes generating a time-varying pattern with a digital video projector. Ex-1004 at 4:25-53; 5:52-74; Ex-1012 ¶ 138. Faul discloses that the scanner includes a microprocessor and memory, Ex-1004 at 7:64-8:8, therefore a POSITA would understand that this microprocessor would be utilized to implement the measurement process, including light source and camera control, as well as image processing. Ex-1012 ¶ 138. Therefore, Orametrix and Faul each teaches and/or renders obvious this claim element. Ex-1012 ¶ 139.

- c. **[Claim 21b]: “transmitting the probe light, through a tip of intraoral scanner inserted into the oral cavity, towards the object along an optical path, thereby illuminating at least a part of the object with the time-varying illumination pattern;”**

Orametrix describes a scanning device 4401 that appears to show a tip, as illustrated in Figure 44:

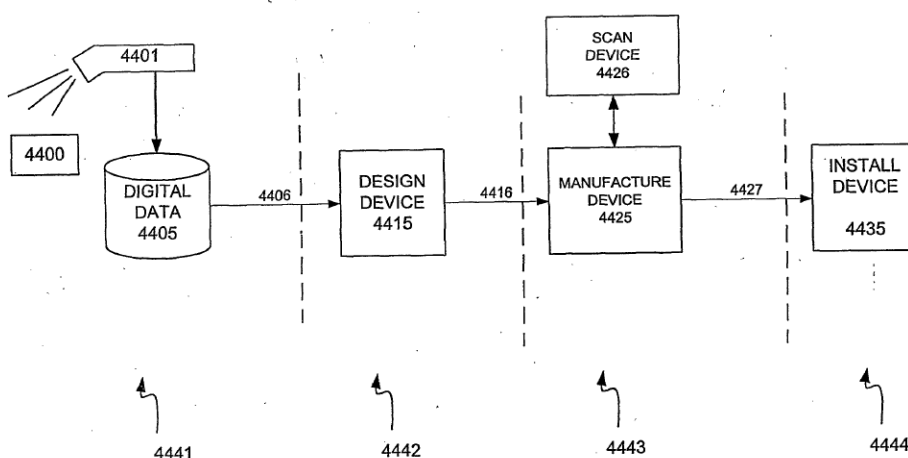
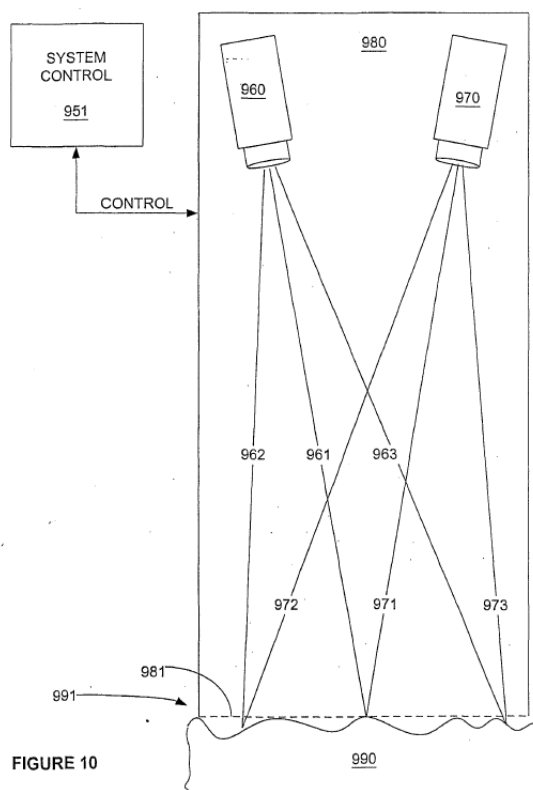


FIGURE 44

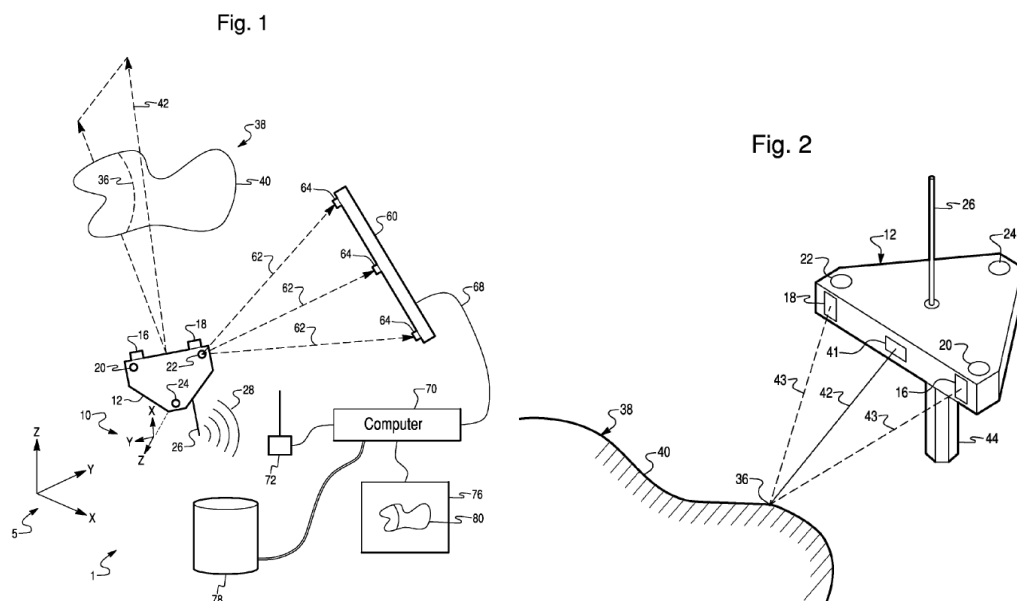
Orametrix further discloses that the anatomical structure, such as a tooth, can be scanned directly by scanner 4401. Ex-1005 at 56:11-20; *see also id.* at 31:11-19; Fig. 27 (describing scanning a tooth surface); Ex-1012 ¶ 142. The scanner illustrated in Figure 44, in combination with the description of direct scanning of anatomical structures teaches the claimed “tip” limitation. Ex-1012 ¶ 141. Furthermore, a POSITA would understand that in order to facilitate direct scanning of an anatomical structure, such as a tooth in a mouth, a housing that includes a tip would be needed to protect the scanning optics from damage or debris. Ex-1012 ¶ 141.

Figure 10 of Orametrix further illustrates additional limitations of this claim element:



As illustrated above, Orametrix shows projector 960, which transmits the patterned probe light beam along an optical path to the surface of object 990, thereby illuminating at least a part of the object with the time-varying illumination pattern. Ex-1005 at 16:6-13; Ex-1012 ¶¶ 142-43.

Faul also describes the elements of this claim limitation. Figures 1 and 2 of Faul illustrate the claimed optical system:



As illustrated above, Faul describes a light source 41 projected on an optical path to a surface 36 from which reflected light is detected by at least one imaging sensor 16 or 18. Ex-1009 at 4:59-5:3; 8:45-9:25; 10:37-60; Ex-1012 ¶ 144. Faul describes the two-dimensional video data based on the reflected time-varying pattern that are detected by 16 or 18 are used as the basis for a three-dimensional model of the scanned surface. Ex-1009 at 4:59-9:25; 7:11-29; Ex-1012 ¶ 144. Faul shows “transmitting the probe light, ... towards the object along an optical path, thereby illuminating at least a part of the object with the time-varying illumination pattern.”

Thus, Orametrix in view of Faul teaches this claim element. Ex-1012 ¶ 145.

- d. [Claim 21c]: “transmitting at least a part of the light returned from the object to at least one camera accommodating an array of sensor elements to form a plurality of 2D images,”**

Orametrix describes that light projected by projector 960 reflected from the surface of object 990 is detected by viewing device 970. *See supra* Section IX.A.1.d. *See also* Ex-1005 at 16:6-13; Fig. 10; Ex-1012 ¶ 147. Faul describes that projected light from light source 41 is projected onto surface 36, the reflection of which is then detected by imaging sensor 16 or 18. Ex-1004 at 2:63-3:10; 4:59-5:3; 8:45-9:25; 10:37-50; Ex-1012 ¶ 148. A POSITA would recognize that Orametrix’s viewing device and Faul’s imaging sensors, in combination with the optical path of reflected light from surface, comprise “an optical system . . . for transmitting at least a part of the light returned from the object to the at least one camera to form a plurality of 2D images . . .,” as recited in this claim element. Ex-1012 ¶149. Orametrix and Faul each teaches, and therefore renders obvious, this claim element. Ex-1012 ¶ 150.

- e. [Claim 21d]: “wherein the 3D geometry is determined based on the plurality of 2D images and the time-varying illumination pattern;”**

Orametrix describes that the scanner receives a projected frame pattern that is digitized into a 2D image frame. *See supra* Section IX.A.1.d , Ex-1005 at 30:7-8; Ex-1012 ¶ 152. The 2D image frames are then converted into three dimensions using conventional 3D imaging techniques. Ex-1005. at 30:8-12. *See also id.* at 75 (claim

4); Ex-1012 ¶ 152. Faul describes the two-dimensional video data based on the reflected time-varying pattern that are detected by 16 or 18 are used as the basis for a three-dimensional model of the scanned surface. Ex-1004 at 4:59-5:9; 5:38-41; 7:11-29; Ex-1012 ¶ 153. A POSITA would recognize that Orametrix's 2D image frame conversion and Faul's two-dimensional video data analysis teach that "the 3D geometry is determined based on the plurality of 2D images and the time-varying illumination pattern," as recited in this claim element. Ex-1012 ¶154. Orametrix and Faul each render this claim element obvious. Ex-1012 ¶ 154.

f. [Claim 21e]: "selectively switching a color of the probe light, thereby illuminating the object with different colors at different times;"

Orametrix describes scanning the object surface with a time-varying pattern in order to determine shape information. *See supra* Section IX.A.1.c ; *see also* Ex-1012 ¶ 155. Furthermore, Orametrix describes changing the color of projected encoded features used for registration in multiframe scanning. Ex-1005 at 14:13-17; 25:11-26:5; Fig. 16; Ex-1012 ¶ 155. Orametrix also describes that photo data containing color information can be added to the digital data of the 3D virtual model of the anatomical structure. Ex-1005 at 64:6-15; Ex-1012 ¶ 155. Orametrix teaches that the measurement techniques may be implemented and executed by a hardware processor as part of the system. *See, e.g.*, Ex-1005 at 16:19-22; 64:6-15; 69:15-70:10; Fig. 46; Ex-1012 ¶ 155.

Faul describes projecting a time-varying pattern in order to determine the shape of an object. *See* Ex-1004 at 4:36-53; Ex-1012 ¶ 156. Faul describes using digital video projection to generate a time-varying pattern. Ex-1004 at 4:25-53; 5:53-54; Ex-1012 ¶ 156. Faul also describes measuring the color of the scanned surface. *See, e.g.*, Ex-1004 at 6:60-67; Ex-1012 ¶ 156. Faul also describes dynamically altering the color of the projected structured light. *See* Ex-1004 at 10:64-11:4; Ex-1012 ¶ 156. Faul discloses that the scanner includes a microprocessor, Ex-1004 at 7:49-8:8; therefore, a POSITA would understand that this microprocessor would be utilized to implement the measurement process, including light source and camera control, as well as image processing. Ex-1012 ¶ 156.

Breton describes changing the wavelength of projected light from a controlled monochromatic source over time to illuminate the scanned object with different colors at different times in order to measure the color of the surface of the scanned object. *See, e.g.*, Ex-1003 at 6:62-7:20; Fig. 2; Ex-1012 ¶ 157. Breton describes that the wavelength of the light source needs to be stepped through a number of discrete spectral bands at a maximum bandwidth in order to achieve adequate spectral resolution for the spectral map that corresponds to the color of the tooth surface. Ex-1003 at 6:62-7:20; Fig. 2; Ex-1012 ¶ 157. Breton further discloses that the color of teeth can be accurately measured using only three sampling bands in the

red, blue, and green portions of the wavelength spectrum, and that limiting the spectral bands can reduce computation time. Ex-1003 at 78:24-36; Ex-1012 ¶ 157. It would have been obvious to a POSITA to combine the wavelength scanning of the monochromatic light source of Breton with time-varying pattern projection of Orametrix or Faul in order to measure the color of the scanned surface at an adequate spectral resolution, and therefore achieve an accurate color measurement. Ex-1012 ¶ 158.

The processor of Orametrix is already configured to change the color of projected encoding features, and is configured to introduce color information from photo data into the three-dimensional model. Ex-1012 ¶ 158. Faul teaches color measurement and suggests dynamically changing the color of the projected time-varying structured light. Ex-1012 ¶ 158. a POSITA would understand that the processors described by Orametrix and Faul would be configured to implement the color changing scheme as taught by Breton in the structured light projection in order to obtain sufficient spectral resolution to achieve an accurate color measurement of the scanned object surface. Ex-1012 ¶ 158. Thus, Orametrix, or Faul further in view of Breton teaches this claim element. Ex-1012 ¶ 159.

- g. [Claim 21f]: “recording different images by the at least one camera at the different times, thereby recording images of the object with the different colors;”**

Orametrix or Faul further in view of Breton teaches this claim element. Ex-1012 ¶ 160. Both Orametrix and Faul teach recording images of the scanned surface at different times with different projected patterns. *See supra* Section IX.A.1.c . *See also* Ex-1012 ¶ 160. For example, Orametrix describes that the data may be a composite of scans taken at different times. Ex-1005 at 57:7-16; Ex-1012 ¶ 160. Likewise, Faul describes assigning timestamps to each scanned image. Ex-1004 at 14:7-39; Ex-1012 ¶ 160. Faul also describes recording images of the object with different colors. Ex-1004 at 12:20-30; Fig. 4 (describing data format 403 that includes RGB color intensities for each point in the image); Ex-1012 ¶ 160.

A POSITA would be motivated to combine Breton’s color determination through wavelength scanning with either Orametrix or Faul in order to obtain sufficient spectral resolution in order to accurately measure the color of the scanned surface. *See supra* Section IX.A.1.h . *See also* Ex-1012 ¶ 160. A POSITA would understand that the wavelength scanning of this combination would necessarily require recording different images at different times reflecting the stepped wavelength changes. Ex-1012 ¶ 160. Thus, either Orametrix or Faul, in view of Breton, teaches this claim element. Ex-1012 ¶ 161.

h. [Claim 21g]: “combining the different colors from the different images to obtain the color of the surface of the object; and”

Faul and Breton disclose dynamically varying the color of the projected light on the scanned object. *See supra* Section X.A.1.h ; *see also* Ex-1012 ¶ 162. Faul further teaches that the color data from a pattern with a variety of wavelengths is used to determine the color of the scanned surface. *See* Ex-1004 at 6:60-67; Ex-1012 ¶ 162. . Faul also teaches measuring red-green-blue color intensities for each location in the scanned image of the surface. Ex-1004 at 12:20-30; Ex-1012 ¶ 162. A POSITA would understand that these RGB intensities would be combined to obtain the color of the scanned surface. Ex-1012 ¶ 162. Similarly Breton teaches building a color shade image map of the scanned surface out of several spectral images. *See* Ex-1003 at 6:47-54; 6:62-7:5; Ex-1012 ¶ 162. Breton also teaches that the color of a scanned surface can be measured by a linear combination of spectral sampling bands. *See* Ex-1003 at 9:43-47; Ex-1012 ¶ 162. A POSITA would be motivated to combine either Orametrix or Faul with Breton in order to achieve an accurate color measurement of the scanned surface. *See supra* Sections IX.A.1.e and IX.A.1.f; *see also* Ex-1012 ¶ 162. Thus, Orametrix or Faul in view of Breton teaches this claim element. Ex-1012 ¶ 163.

i. [Claim 21h]: “wirelessly transmitting the data for the 3D geometry.”

Orametrix describes wirelessly communicating data from the system to a client. Ex-1005 at 58:21-59:13; Ex-1012 ¶ 164. This client may be, for example, design device 4415 at facility 4442, which is a workstation located remotely from scanner 4401. Ex-1005 at 58:21-59:13; Ex-1012 ¶ 164. The scan data may be a dental structure, and Orametrix describes an example where the scanner may be performed at home by a user for monitoring the progress of a treatment plan. Ex-1005 at 58:1-14; Ex-1012 ¶ 164. A POSITA would understand that this scanner would be wireless and communicating data wirelessly for remote processing. Ex-1012 ¶ 164.

Faul teaches the advantages of a wireless handheld scanner for obtaining scanning data of three-dimensional shapes in that it is unencumbered by a cable or mechanical linkage. *See, e.g.*, Ex-1004 at 2:36-39; Ex-1012 ¶ 165. Faul describes processing two-dimensional image data locally in the scanning device to reduce the amount of data that is required to be transmitted from the scanning device to a workstation. Ex-1004 at 4:59-5:51; 12:43-50; Ex-1012 ¶ 165. A POSITA would implement the local processing taught by Faul in the combined scanning system of Orametrix, Faul, and Breton to reduce the amount of data required to be transmitted wirelessly and increase overall processing speed. Ex-1012 ¶ 165. Furthermore, it

would have been obvious to a POSITA to configure the scanner of Orametrix with the wireless configurations taught by Faul because Orametrix already contemplates the wireless transmission of data, and Faul teaches that making the handheld scanning unit wireless allows the user to scan objects without the encumbrance of a mechanical linkage or cables. Ex-1012 ¶ 165. Therefore, Orametrix in view of Faul teaches this claim element. Ex-1012 ¶ 166.

14. Claim 22 is Rendered Obvious by Orametrix, Faul, and Breton

- a. [Claim 22]: “The method according to claim 21, wherein the plurality of 2D images is recorded using a high-speed camera.”**

Orametrix teaches that the reflected structured light is imaged by a high-speed camera. Ex-1012 ¶ 168. For example, Orametrix teaches that the scan rates can be chosen to allow for real-time viewing of a three-dimensional image. Ex-1005 at 34:12-21; Ex-1012 ¶ 168. Based on this disclosure, a POSITA would understand the camera disclosed by Orametrix to be a high-speed camera in order to match the high-speed scan rates required for real-time viewing. Ex-1012 ¶ 168. Thus, Orametrix teaches this claim element. *Id.* at ¶ 169.

15. Claim 23 is Rendered Obvious by Orametrix, Faul, and Breton

- a. **[Claim 23]: “The method according to claim 21, wherein the method further comprises a step of locally processing, on the intraoral scanner, raw 3D data into data for the 3D geometry, such that the data for the 3D geometry is wirelessly transmitted instead of the raw 3D data, and wherein the raw 3D data is based on the plurality of 2D images.”**

Faul describes processing two-dimensional image data, such as 2D video image data, locally in the scanning device to reduce the amount of data that is required to be transmitted from the scanning device to a workstation. Ex-1004 at 4:59-5:51; 12:43-50; Ex-1012 ¶ 171. Faul describes that subpixel coordinates of given points on the scanned 2D image are transformed into three-dimensional coordinates that are then transmitted. Ex-1004 at 12:27-32; Ex-1012 ¶ 171. A POSITA would implement the local processing taught by Faul in the combined scanning system of Orametrix, Faul, and Breton to reduce the amount of data required to be transmitted wirelessly and increase overall processing speed. Ex-1012 ¶ 171. Therefore, Orametrix in view of Faul teaches, and therefore renders obvious claim 23. *Id.* at 172.

16. Claim 24 is Rendered Obvious by Orametrix in view of Faul

- a. [Claim 24]: “The method according to claim 21, wherein the method further comprises a step of locally processing, on the intraoral scanner, raw 3D data into data for the 3D geometry, such that the data for the 3D geometry is wirelessly transmitted at a reduced data rate in comparison with transmission of raw 3D data, and wherein the raw 3D data is based on the plurality of 2D images.”**

Faul describes local processing of the imaging data before wirelessly transmitting the data for further processing at a workstation. *See supra* Section IX.A.7.a (discussion for claim 9) and Section IX.A.16.a (discussion for claim 23). *See also* Ex-1012 ¶ 174. In addition to local processing data to reduce the burden of wireless transmission Faul specifically describes locally processing 2D data into 3D data. Ex-1004 at 4:59-5:51; Ex-1012 ¶ 174. Faul describes this local processing as significantly reducing the amount of transmitted geometric and color data, as compared to conventional transmission. Ex-1004 at 12:43-50; Ex-1012 ¶ 174. A POSITA would have been motivated to combine the local processing described by Faul into the method of scanning and processing described by Orametrix in order to achieve the advantage of reduced wireless data transmission burden. Ex-1012 ¶ 175. Therefore, Orametrix in view of Faul teaches, and therefore renders obvious claim 24. Ex-1012 ¶ 176.

17. Claim 25 is Rendered Obvious by Orametrix in View of Faul

- a. [Claim 25]: “The method according to claim 23, wherein the step of wirelessly transmitting the data for the 3D geometry is to a workstation.”**

Orametrix describes wirelessly communicating scanning data from the scanning system to a client. *See supra* Sections IX.A.1.k, X.A.7.a, and X.A.8.a (discussions for claims 1, 9, and 10) and IX.A.14.a, X.A.16.a, and X.A.17.a (discussions for claims 21, 23, and 24). *See also* Ex-1005 at 58:21-59:13; Fig. 44; Ex-1012 ¶ 178. As further discussed above in the same sections, Faul describes wireless transmission of the data for the 3D geometry to a workstation. Ex-1004 at 4:59-5:51; 12:43-50; Ex-1012 ¶ 178. A POSITA would incorporate the wireless teachings of Faul into Orametrix in order to achieve an untethered scanning instrument. *See supra* Section IX.A.1.k . *See also* Ex-1012 ¶ 178. Therefore, Orametrix in combination with Faul renders claim 25 obvious. Ex-1012 ¶ 179.

18. Claim 26 Is Rendered Obvious by Orametrix in View of Faul Further in View of Breton

- a. [Claim 26]: “The method according to claim 23, wherein the step of locally processing is in real time.”**

Orametrix describes allowing for real-time viewing of a three-dimensional image of the scanned object. Ex-1005 at 34:12-15; Ex-1012 ¶ 181. Faul also describes rendering the geometry of a three-dimensional object in real-time. Ex-1004 at 8:56-60; Ex-1012 ¶ 181. Therefore, Orametrix and Faul each render obvious

claim 26. Ex-1012 ¶ 182.

19. Claim 27 is Rendered Obvious by Orametrix in View of Faul

- a. [Claim 27]: “The method according to claim 21, where the method further comprises a step of computing a temporal correlation measure with sensor signals, in the at least one camera, recorded at different times while the plurality of configurations in the form of a time-varying illumination pattern are changed.”**

Faul describes temporal correlation of the pattern of light and the scanner position that allows for accurate three-dimensional coordinate transformation. Ex-1004 at 2:49-62; 3:11-24; 9:27-42; Ex-1012 ¶ 184. A POSITA would be motivated to combine the temporal correlation described by Faul in the system of Orametrix in order to obtain accurate coordinate data based on the changing projected pattern and the location of the scanning device. Ex-1012 ¶ 184. Therefore, Orametrix in view of Faul renders claim 27 obvious. Ex-1012 ¶ 185.

20. Claim 29 is Rendered Obvious by Orametrix in View of Faul

- a. [Claim 29]: “The method according to claim 27, wherein the temporal correlation measure is based on a reference signal that is based on knowledge or on calibration of the plurality of configurations of the time-varying illumination pattern.”**

Faul describes calibrating the handheld scanner including details about the pattern of structured light. Ex-1004 at 7:64-8:8; Ex-1012 ¶ 187. A POSITA would

be motivated to calibrate the scanning system of Orametrix as taught by Faul in order to ensure accurate determination of the three-dimensional shape of the scanned object. Ex-1012 ¶ 187. Therefore, Orametrix in view of Faul renders claim 29 obvious. Ex-1012 ¶ 188.

B. Ground 2: Claim 16 is rendered obvious by Orametrix, Faul, and Breton in View of Durbin

Orametrix in view of Faul and Breton teaches all the claim elements of claim 1. *See supra* Section IX.A. The combination of Orametrix, Faul, and Breton in view of Durbin renders claim 16 obvious.

Orametrix, Faul, and Breton all describe measuring systems for acquiring the color and shape of scanned objects. *See supra* Sections VIII.A.1-3. Durbin describes an optical scanning system for acquiring the three-dimensional shape of an object using structure light projection. *See supra* Section VIII.A.4. These four references provide elements and features that a POSITA would have looked to in order to arrive at the combination of elements comprising the invention described by the claims, and a POSITA would have had a reasonable expectation of success in combining these four references in order to achieve accurate color and shape measurements in three-dimensional models of scanned objects. Ex-1012 ¶ 190.

Orametrix and Faul recognize the need for obtaining accurate scans of objects for three-dimensional modeling and mapping. Orametrix describes the need for

accurate three-dimensional models to develop medical and dental devices and appliances that will reduce the level of subjective criteria required in manufacturing or reproducing them, and Faul describes the desirability of obtaining three-dimensional models of real world objects that are enhanced through wireless optical scanning, which does not require cables or other mechanical linkage or any physical contact with the object . *See, e.g.*, Ex-1005 at 1:17-22; 2:1-3:20; Ex-1004 at 1:18-34; 2:36-39; 2:42-3:32; 15:16-19; Ex-1012 at ¶ 191.

Similarly, Durbin describes generating a three-dimensional model of a scanned surface using two-dimensional images from structured light projection. *See, e.g.*, Ex-1008 at 5:37-43; 6:20-26; Ex-1012 ¶ 192. Durbin further teaches the need for accurate in vivo three-dimensional imaging of teeth and dental structures. *See, e.g.*, Ex-1008 at 4:12-20; Ex-1012 ¶ 192.

Further, Breton describes the need to obtain an objective three-dimensional model of a tooth to create an accurate reproduction for a replacement tooth that minimizes subjectivity. *See, e.g.*, Ex-1003 at 1:14-40; Ex-1012 ¶ 193. Breton also discloses the challenges associated with matching the color shade of a reproduction tooth. Ex-1003 at 1:29-34; Ex-1012 ¶ 193. Therefore, a POSITA would have been motivated to combine the various elements of these four references to increase the accuracy of the color and shape measurements underlying the subsequent three dimensional modeling of the real world objects. Ex-1012 ¶ 193. A POSITA also

would have had a reasonable expectation of success in combining the teachings of these four references. Ex-1012 ¶ 194. Therefore, the combined teachings of these references, the knowledge, creativity, and common sense of a POSITA and the nature of the problem to be solved would have led a POSITA to the claimed combination and would have indicated a reasonable likelihood of success. Ex-1012 ¶ 195.

- a. **[Claim 16]: “The intraoral scanner according to claim 1, wherein the high-speed camera records images at a frame rate of at least 500 frames per second or at a frame rate of at least 2000 frames per second.”**

Orametrix describes that scan rates greater than 20 frames per second can be used to allow for real-time viewing of a three-dimensional image. Ex-1005 at 34:12-21; Ex-1012 ¶ 196. It would therefore be obvious to a POSITA that the camera of Orametrix would necessarily be capable of recording images at a frame rate of at least 500 frames per second in order to correspond to a scanning frame rate that allows for real-time viewing of the three-dimensional image of the scanned object. Ex-1012 ¶ 196. Durbin teaches a three-dimensional dental scanner that uses a camera to capture images. *See* Ex-1008 at Abstract; Ex-1012 ¶ 196. Durbin further discloses that it can be advantageous to use a CMOS-based imager with higher-sensitivity in order to allow for image capturing at frame rates of greater than 1000 frames per second, and allow for dynamic resizing of an imaging window during the

scanning process. *See* Ex-1008 at 17:4-9; Ex-1012 ¶ 196. It would have been obvious to a POSITA to include a CMOS imager in the combination of Orametrix, Faul, and Breton to achieve the increased sensitivity and facilitate real-time viewing of the three-dimensional model of the scanned object. Ex-1012 ¶ 196. Therefore, Orametrix, Faul, and Breton in combination with Durbin render this claim element obvious. *Id.*

X. INSTITUTION SHOULD NOT BE DISCRETIONARILY DENIED

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

Petitioner hereby stipulate that, should the Petition be granted, it 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). Under the June 21, 2022, Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation, the Director has stated “the PTAB will not discretionarily deny institution of on 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 pursuant to 35 U.S.C. § 314(a).

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

“In evaluating arguments under § 325(d), [the PTAB] use[s] a two-part framework: (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of the first part of the framework is satisfied, whether the petition has demonstrated that the Office erred in a manner material to the patentability of challenged claims.” *The Data Co. Techs., Inc. v. Bright Data Ltd.*, IPR2022-00135, Paper 12 at 15 (PTAB June 1, 2022) (citing *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020)).

Here, neither Breton, Faul, Orametrix, nor Durbin was presented to the Office during examination of the application that led to the ’146 patent. Nor were any other prior art or arguments substantially similar to those presented in this Petition presented to the Office. Thus, the *Advanced Bionics* framework does not apply because the first part is not satisfied. *Id.* at 17 (Where “the first part of the *Advanced Bionics* framework is not satisfied, [the Board] need not consider the second part of the framework.”).

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:

- Medit Corporation
- Medit USA
- Crown Jade Co., Ltd.
- Digital Dentistry Solution Holdings, Inc.

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 ’146 patent has been or is involved in the following cases:

- *Dental Imaging Technologies Corporation d/b/a/ DEXIS v. 3Shape A/S* IPR2023-00387 (PTAB). This case is no longer ongoing.
- *3Shape A/S v. Carestream Dental, LLC*, 1:22-cv-01829 (N.D. Ga.). This case is ongoing.
- *3Shape A/S v. Medit Corporation*, 6:22-cv-00443 (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.

Petitioner is not aware of any other matters involving the ’146 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 Bracewell-IP@bracewell.com.

XII. CONCLUSION

The prior art references cited herein demonstrate that the challenged claims of

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the '146 patent are obvious and therefore unpatentable. Petitioner thus requests that the PTAB grant this Petition, institute *inter partes* review, and cancel the challenged claims.

Respectfully Submitted,

Dated: August 18, 2023

/s/ Douglas F. Stewart

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Counsel for Petitioner

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned certifies that the foregoing Petition for *Inter Partes* Review contains 11,588 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.

Dated: August 18, 2023

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Counsel for Petitioner

CERTIFICATE OF SERVICE

I hereby certify that on August 18, 2023, 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
William C. Rowland Buchanan, Ingersoll & Rooney PC 1737 King Street, Suite 500 Alexandria, VA 22314-2727	Dustin N. Ferzacca TROUTMAN PEPPER HAMILTON SANDERS LLP 19th Floor, High Street Tower 125 High Street Boston, MA 02110-2736

I further certify that I served courtesy copies of the foregoing documents via electronic mail on August 18, 2023, upon Patent Owner's counsel of record as follows:

Patent Office Counsel of Record	Litigation Counsel of Record
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Dated: August 18, 2023

/s/Andrea Kato
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