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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

3SHAPE A/S and 3SHAPE INC.
Petitioners

v.

ALIGN TECHNOLOGY, INC.
Patent Owner

Case No. IPR2019-00153
Patent 6,334,853

PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 6,334,853 UNDER 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.100 *et seq*.

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I. INTRODUCTION

3Shape A/S and 3Shape Inc. ("3Shape" or "Petitioners") respectfully request *inter partes* review for claims 1-3, 5, 7, and 9-13 of U.S. Patent No. 6,334,853, issued on January 1, 2002 to Avi Kopelman ("the '853 Patent") (Ex.1001) in accordance with 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.100 *et seq*.

II. MANDATORY NOTICES PURSUANT TO 37 C.F.R. § 42.8(A)(1)

A. Real Party-In-Interest

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioners certify that 3Shape A/S, 3Shape Inc., 3Shape Holding A/S, 3Shape Trios A/S, and 3Shape Poland sp. z.o.o. are real parties-in-interest. Out of an abundance of caution, 3Shape Medical A/S, 3Shape Germany GmbH, 3Shape France SAS, 3Shape Italy SRL, 3Shape S.A.S., 3Shape (Shanghai) Co., Ltd., 3Shape Do Brasil Soluções Tecnologicas Para Saude Ltda, 3Shape Australia Pty Ltd., 3Shape Trios Sociedad Limitade, 3Shape Japan GK, 3Shape Ukraine Ltd., 3Shape (UK branch), SC Investment Company, LLC, FULLCONTOUR, LLC, Full Contour USA, FULLCONTOUR S.R.L., Full Contour Limitada, Full Contour Costa Rica Limitada, BOSQUES HUMEDOS DEL SUR S.A., FullContour Bosques, Full Contour Costa Rica Boscues, SHENZHEN FULLCONTOUR DESIGN COMPANY LTD., Full Contour China, DROPDENTAL LLC, 3Shape Medical Equipment Manufacture Shanghai Ltd., 3Shape Korea Ltd., 3Shape Manufacturing US LLC, Clausen Engineering APS, Tais Clausen, Deichmann Media APS, Nikolaj Hoffmann

Deichmann, and the individuals listed in Appendix B are also identified as real parties-in-interest, for purposes of compliance with 35 U.S.C. § 312(a)(2).

B. Identification of Related Matters Under 37 C.F.R. § 42.8(b)(2)

The following is a list of any judicial or administrative matters that would affect, or be affected by, a decision in this proceeding:

Align Technology, Inc. v. 3Shape A/S, Civil Action No. 1:17-cv-01648 (D. Del.) (Complaint filed November 14, 2017) (hereinafter "District Court Litigation" or "Delaware Litigation"); and

In the Matter of Certain Intraoral Scanners and Related Hardware and Software, Inv. No. 337-TA-1090 (U.S. International Trade Commission) (Complaint filed November 14, 2017) (hereinafter "ITC Proceeding" or "ITC Investigation").

C. Lead and Backup Counsel

Pursuant to 37 C.F.R. §§ 42.8(b)(3) and 42.10(a), Petitioners hereby identify its lead and backup counsel as follows:

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Powers of Attorney are being filed concurrently herewith in accordance with 37 C.F.R. § 42.10(b).

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

Petitioners consent to e-mail service at the addresses listed above.

III. PAYMENT OF FEES

The undersigned authorizes the Office to charge Deposit Account No. 02-4800 for the fees required by 37 C.F.R. § 42.15(a).

IV. REQUIREMENTS UNDER 37 C.F.R. § 42.104

A. Grounds for Standing

Pursuant to 37 C.F.R. § 42.104(a), Petitioners hereby certify that the '853 Patent is available for *inter partes* review in accordance with 37 C.F.R. § 42.102(a)(2), and that Petitioners are not barred or estopped from requesting *inter partes* review challenging the claims of the '853 Patent on the grounds identified in this Petition.

This Petition is filed within one year from the date on which Petitioners were served a Complaint by Patent Owner in the related litigation, *Align Technology, Inc. v. 3Shape A/S*, Civil Action No. 1:17-cv-17-cv-01648 (D. Del.), which asserted infringement of the '853 Patent.

Neither Petitioners nor any privies of Petitioners have received a final written decision under 35 U.S.C. § 318(a) with respect to any claim of the '853 Patent on any ground that was raised or could have been raised by Petitioners or privies of Petitioners in any *inter partes* review, post grant review, or covered business method patent review.

B. Identification of Challenges and Precise Relief Requested

Pursuant to 37 C.F.R. § 42.104(b), Petitioners challenge claims 1-3, 5, 7, 9-13 of the '853 Patent, and request that these claims be found unpatentable over the prior art for the reasons given herein. The following table provides Petitioners'

Grounds for challenging the patentabiliy of claims 1-3, 5, 7, and 9-13 of the '853 Patent.

Ground	References	Basis	Claims Challenged
1	Kunii, Tosiyasu L., Karol Myszkowski, Oleg Okunev, Hirobumi Nishida, Y. Shinagawa, and M. Ibusuki, "Evaluation of Human Jaw Articulation", In *Computer Animation '95 Proceedings,* edited by Demetri Terzopoulos and Daniel Thalmann (pp. 163-171), Los Alamitos, CA: IEEE Computer Society Press, 1995 ("Kunii") (Ex.1003)	35 U.S.C. § 102	1-3, 5, 7, 9-11
2	Kunii	35 U.S.C. § 103	1-3, 5, 7, 9-11
3	Kunii in view of Hayashi, Toyohiko, Michio Miyakawa, Akira Saitoh, Atsushi Watabe, and Syoji Kohno, "Three-Dimensional Analysis of Tooth Occlusion Using Distance Map", Edited by the Society of Biomechanisms Japan, *Baiomekanizumu*, vol. 12 (1994): 27-37 ("Hayashi") (Ex.1005)	35 U.S.C. § 103	3, 5, 7, 12, 13
4	Myszkowski, Karol, Jens Herder, Tosiyasu L. Kunii, and Masumi Ibusuki, "Visualization and analysis of occlusion for human jaws using a 'Functionally Generated Path,'" *Proceedings of SPIE 2656, Visual Data Exploration and Analysis III, 8 March 1996* (pp. 360-367), Bellingham, WA: Society of Photo-optical Instrumentation Engineers, 1996 ("Myszkowski") (Ex.1004)	35 U.S.C. § 102	1-3, 5, 9-11
5	Myszkowski in view of Hayashi	35 U.S.C. § 103	12, 13

In addition to the above prior art, Petitioners rely upon the evidence listed in the Exhibit List, including the Declaration and *Curriculum Vitae* of Parris Egbert, Ph.D. (Exs. 1006, 1007).

C. Prior Art Qualification of Asserted References

The '853 Patent was filed on June 12, 2000. For purposes of this Petition, Petitioners assume the earliest effective filing date of the '853 Patent is May 22, 1997—the filing date of priority Israel Foreign Application No. 120892.[1] Even if the '853 Patent receives its earliest possible priority date, all the applied references qualify as prior art.

Petitioners submit the Declaration and *Curriculum Vitae* of Dr. Sylvia D. Hall-Ellis (Exs.1013, 1014), an expert in the field of library cataloging and classification.

Kunii was published no later than November 14, 1994 and is thus prior art under 35 U.S.C. § 102(b). The testimony of Dr. Hall-Ellis demonstrates that Kunii was published and accessible to the public no later than November 14, 1994. Ex.1013. *See id.*, ¶¶45-54. Further, the Board has routinely held IEEE publications like Kunii are printed publications. "The Board has previously

[1] Petitioners do not concede that any challenged claim is, in fact, entitled to an effective filing date of May 22, 1997.

observed that 'IEEE is a well-known, reputable compiler and publisher of scientific and technical publications, and we take Official Notice that members in the scientific and technical communities who both publish and engage in research rely on the information published on the copyright line of IEEE publications.'" *Power Integrations, Inc., v. Semiconductor Components Industries, LLC*, IPR2018-00377, Paper No. 10 at 10 (PTAB Jul. 17, 2018) (quoting *Ericsson, Inc. v. Intellectual Ventures I LLC*, IPR2014-00527, Paper 41 at 11 (PTAB May 18, 2015)). *See also Coriant (USA) Inc. v. Oyster Optics, LLC*, IPR2018-00258, Paper 13 at 11 (PTAB Jun. 6, 2018); *Microsoft Corp. v. Bradium Technologies LLC*, IPR2016-00448, Paper 9 at 12-14 (PTAB Jul. 25, 2016). In *Ericsson*, the Board "accept[ed] the publication information on the IEEE copyright line on page 1 of [the IEEE reference] as evidence of its date of publication and public accessibility." *Ericsson*, IPR2014-00527, Paper 41 at 10-11. Here, Kunii has a copyright date of 1995. Ex.1003. For this additional reason, Kunii was published and accessible to the public no later than 1995.

Myszkowski was published no later than March 11, 1996, and is thus prior art under 35 U.S.C. § 102(b). Myszkowski is a Proceedings of SPIE publication. Ex.1004. Petitioners submit the Declaration of Eric Pepper (Ex.1012), the Director of Publications with SPIE. Ex.1012. The testimony of Eric Pepper demonstrates that Myszkowski was published and available for distribution and public

accessibility no later than March 11, 1996. *Id.* In addition, the testimony of Dr. Hall-Ellis demonstrates that Myszkowski was published and accessible to the public no later than May 8, 1996. Ex.1013. *See id.*, ¶¶55-63.

Hayashi was published no later than August 10, 1994, and is thus prior art under 35 U.S.C. § 102(b). The testimony of Dr. Hall-Ellis demonstrates that Hayashi was published and accessible to the public no later than August 10, 1994. Ex.1013. *See id.*, ¶¶64-79.

V. BACKGROUND

A. The '853 Patent and Technical Background

1. The '853 Patent

The '853 Patent is directed to a method for obtaining a dental occlusion map of a three-dimensional virtual computer model of teeth of upper and lower jaws of a mouth. Ex.1001, Abstract. An occlusion map is a "graphical representation of the distance between opposite points, or regions, on the surface of opposite teeth." *Id.*, 1:63-65. Ex.1006, ¶ 26.

The method of the '853 Patent includes determining the distances between opposite regions on opposite teeth of the upper and lower jaws of the mouth. Ex.1001, 8:3-5 (claim 1). The method also includes setting up a correspondence between the determined distances and regions on a mapping surface. *Id.*, 8:6-7 (claim 1). Examples of occlusion maps are shown in Figs. 4 and 5:

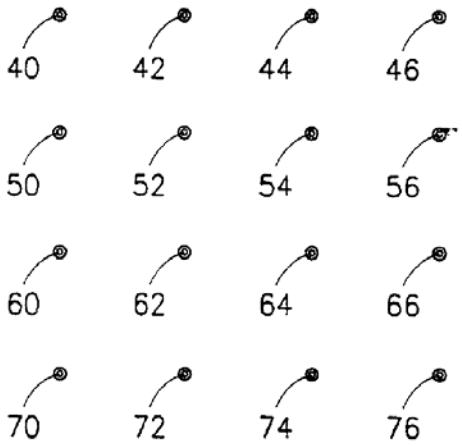


Fig. 4 of the '853 Patent

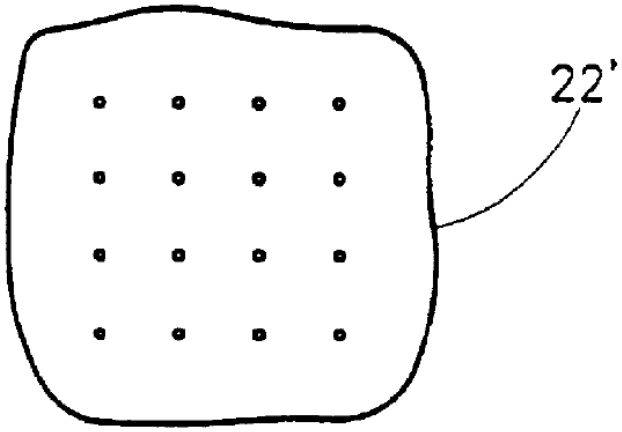


Fig. 5 of the '853 Patent

Ex.1001, 5:54-55 ("the occlusion map of FIG. 4"), 5:54-55 ("FIG. 5 shows the occlusion map"). The occlusion map can include colored regions (such as shades of grey), where each color corresponds to a given distance, or range of distances, between opposite points or regions on the surface of opposite teeth. *Id.*, 1:66-2:4, 2:4-7. Ex.1006, ¶¶ 27-29.

The ’853 Patent describes an embodiment where the mapping surface is a plane, whereby the dental occlusion map is a two-dimensional map of the distances between said opposite regions on said opposite teeth. Ex.1001, 2:19-22. The ’853 Patent describes an embodiment where the mapping surface is a facing surface of the facing surfaces of opposite teeth of the upper and lower jaws of the mouth. *Id.*, 2:23-25. Ex.1006, ¶ 30.

2. Dental occlusion maps and methods for obtaining same were well-known prior to the ’853 Patent.

The ’853 Patent purports to address the drawbacks of using plaster dental models to provide information about distances between teeth on opposite jaws. Ex.1001, 1:17-62. The ’853 Patent states that it would be expected that 3D virtual dental models “would help in alleviating the problems encountered with the plaster dental models.” *Id.*, 1:40-44. The ’853 Patent alleges that “none of the existing virtual computer dental models provide tools relating to the distance between opposite teeth on opposite jaws.” *Id.*, 1:50-53. However, it was well-known that “computer-aided diagnosis of occlusal disorders and design of dental restorations” provides advantages over “manually[] using hard models of teeth.” Ex.1003, 163 (left col.). The purported invention of the ’853 Patent—methods for obtaining a dental occlusion map of a three-dimensional virtual computer model of teeth of upper and lower jaws—were well-known before the priority date. *See, e.g.,* Ex.1003, 163, (right col.); Ex.1004, Abstract; Ex.1005, §1. Ex.1006, ¶ 33.

3. Summary of '853 Patent Prosecution History

U.S. Patent Application Serial No. 09/424,195 ("'195 Application") was filed with 13 claims on June 12, 2000. Ex.1002, 18-19. The Examiner did not reject any of the claims during prosecution of the '195 application. Ex.1002. On July 26, 2001, an interview was held with the examiner of record where Applicant agreed to amending claim 3 by adding a period (".") at the end of claim 3. Ex.1002, 67. In the Notice of Allowance, the Examiner stated that the closest prior art, Komatsu et al. (U.S. Patent No. 5,458,487) and Summer et al. (U.S. Patent No. 5,730,151), did not show the distance between the upper and lower teeth as claimed in the present application. Ex.1002, 65.

During prosecution, none of Kunii, Hayashi, and Myszkowski was made of record or substantively considered by the Patent Office. The prior art cited in this Petition differs from the art previously presented during prosecution (which the Examiner determined does not disclose showing distance between upper and lower teeth) because the prior art cited in this Petition discloses a map showing the distance between upper and lower teeth.

B. Overview of the Prior Art

1. Kunii (Ex.1003)

Kunii describes characterization of contacts between the surfaces of teeth for computer-aided diagnosis of occlusal disorders and design of dental restorations. Ex.1003, 163 (left col.).[2] Kunii discloses that the characteristics are "based on distance maps and topological structure of the contact zones." *Id.* Kunii discloses that its approaches are general and usable in applications where modeling of contact between objects with complex geometry is required. *Id.* Kunii discloses that the techniques for distance calculation and visualization to calculate a distance map for a model jaw make possible the use of distance maps for derivation of advanced characteristics of contact between teeth. *Id.*, 165 (right col.). Ex.1006, ¶ 34.

Kunii uses real data (scanned surfaces of the upper and lower jaw and three-dimensional lower jaw motion data). Ex.1003, 165 (right col.); *see also id.*, Figure

[2] Kunii (Ex.1003) does not contain color figures. Exhibit 1011, which is substantially identical to Kunii (Ex.1003), contains color figures. The color figures of Exhibit 1011 are reproduced herein, with the understanding that the color figures of Exhibit 1011 correspond to the black-and-white figures of Kunii (Ex.1003).

2 (below). Kunii discloses that the characteristics are "based on distance maps and topological structure of the contact zones." *Id.* Kunii discloses that its approaches are general and usable in applications where modeling of contact between objects with complex geometry is required. *Id.*

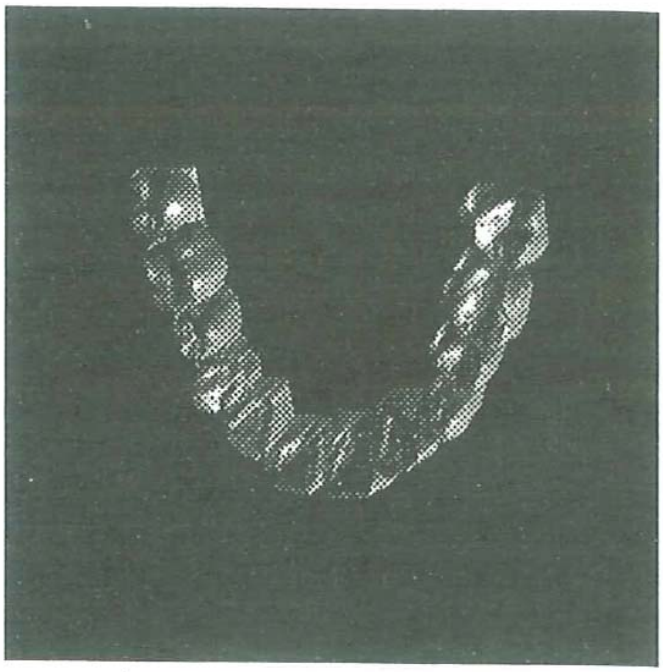


Figure 2: Occlusal surface of a jaw.

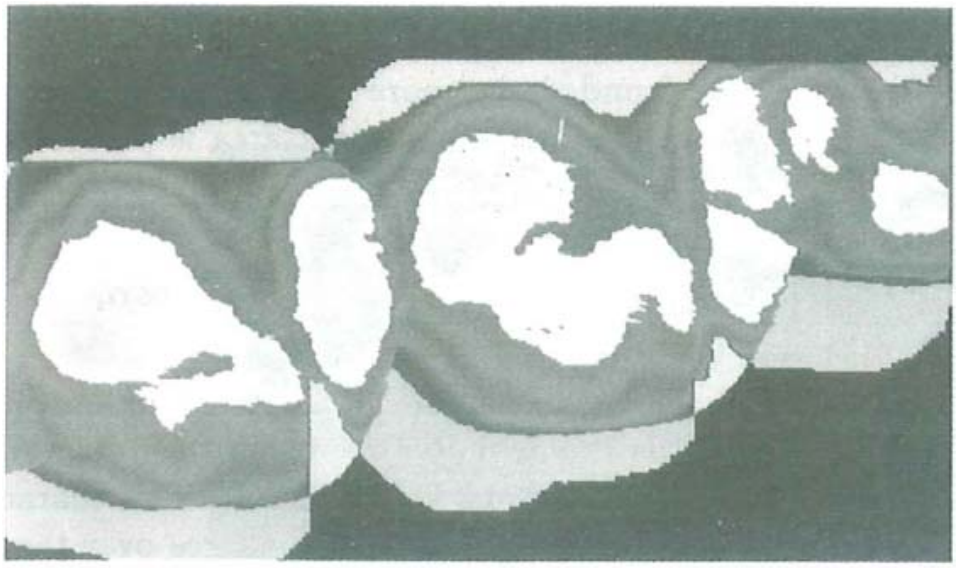
Fig. 2 of Kunii

Ex.1006, ¶ 35.

Kunii describes using distance maps in the evaluation of occlusion. Ex.1003, 163 (right col.). Kunii describes characteristics of contact between the surfaces of the upper and lower jaw (or in a more general context, any complex objects) may be found from distances between points on surfaces of these objects. *Id.*, 164 (left col.). Kunii discloses that when the distance is measured along a fixed projection

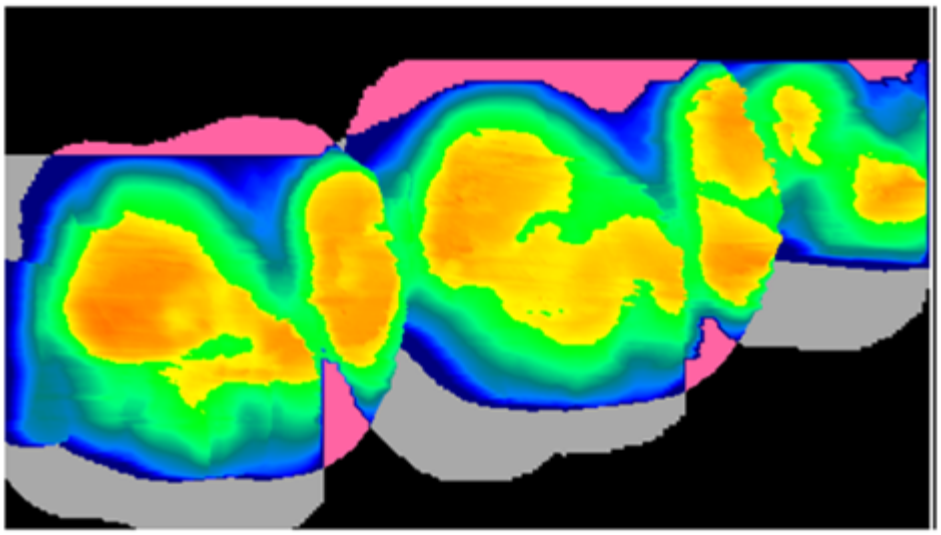
direction the results are strongly affected by the choice of direction, and that a more reliable distance measurement can be obtained when multiple directions are considered and the minimal or average distances are derived. *Id*. Ex.1006, ¶ 36.

Kunii describes the characteristics obtained by the distance maps are usually local, that is, relevant to a particular point or an area in a tooth, and as such, provide a convenient visualization in the form of color maps. Ex.1003, 163 (right col.). Kunii describes distance images result from distance values acquired for each projection direction resulting from hardware-supported depth calculations and these distance images can be displayed on a planar mapping surface in a graphical display such as shown in Figure 3a. *Id*., 164 (right col.).



a)

Fig. 3a of Kunii

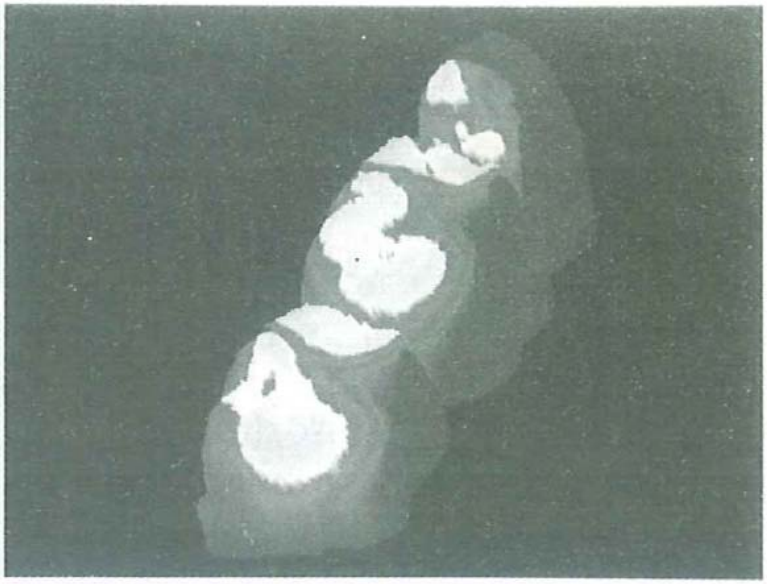


a)

Fig. 3a of Ex.1011

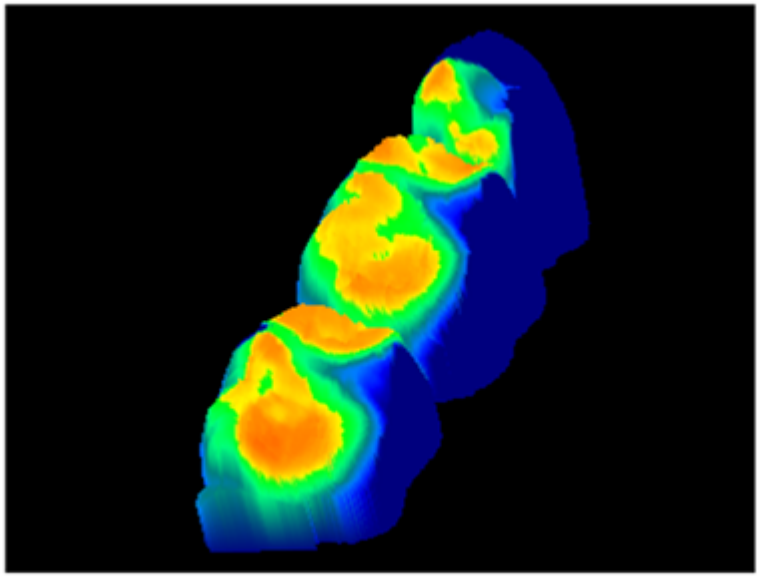
Ex.1006, ¶ 37.

Kunii describes projecting the distance image back into the object space, and that when multiple projections are used, distance images should be matched according to surface points to derive the distance characteristics at these points, e.g., minimal or average distance, to obtain a distance map. Ex.1003, 165 (left col.). Kunii describes a distance map having a mapping surface as the function on the surface of one of the objects (or a graphical representation of this function) whose value at a point on the surface is equal to the distance from the other surface. *Id*., 165 (right col.). Figure 3b of Kunii shows a distance map. *Id*.



b)

Fig. 3b of Kunii



b)

Fig. 3b of Ex.1011

Ex.1006, ¶ 38.

Kunii discloses using different colors in distance images and distance maps where the colors each correspond to given distances. Ex.1003, 165 (left col.). For

example, Fig. 3a shows an example of a distance image; pink and white regions correspond to areas in lower and upper jaws, respectively, that have no corresponding point in the opposite jaw in the direction of the current projection; regions marked by blue and green are those where the distance in the projection direction between the jaws exceeds 1 mm, and borders between green and yellow correspond to distances below 1 mm; colors between yellow and red correspond to distances below 1 mm; zero distance, i.e., contact between the surfaces, would be pure red. *Id*., 165 (left col.). The colors in Fig. 3b have the same meaning as the colors in Fig. 3a. *Id.*, 165 (right col.).

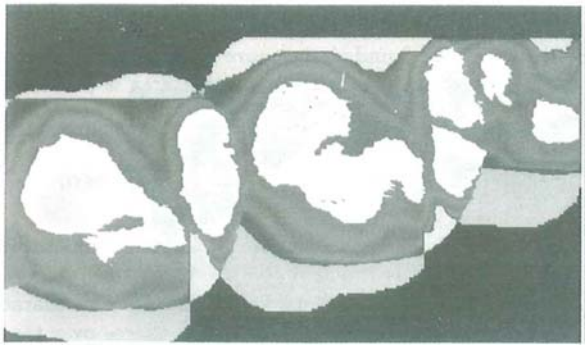


Fig. 3a of Kunii

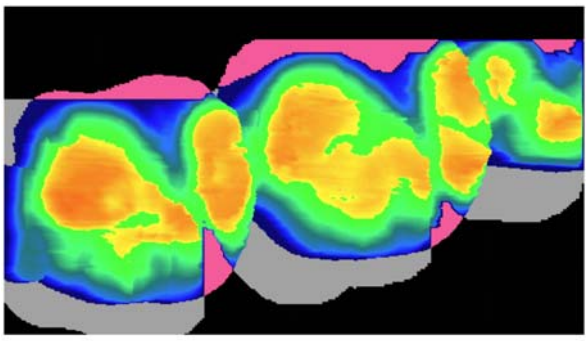


Fig. 3a of Ex.1011

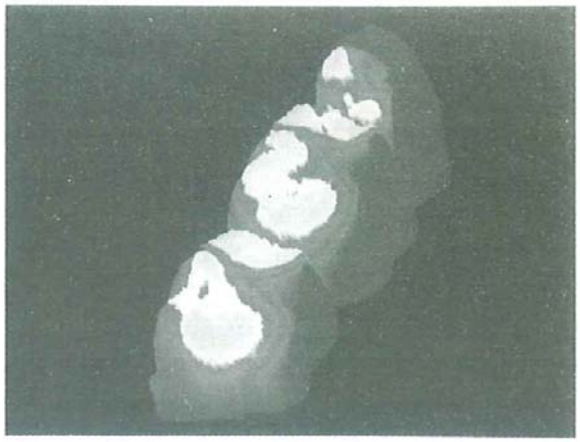


Fig. 3b of Kunii

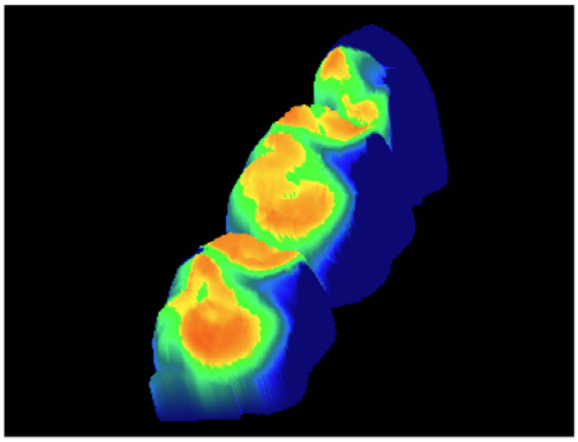


Fig. 3b of Ex.1011

Ex.1006, ¶ 39.

Figure 4 of Kunii shows distance maps found for the upper left first molar for two positions of the lower jaw. Ex.1003, 166 (left col.). Images on the left were obtained using single projection technique while the ones on the right were produced using 13 projection directions. *Id.*

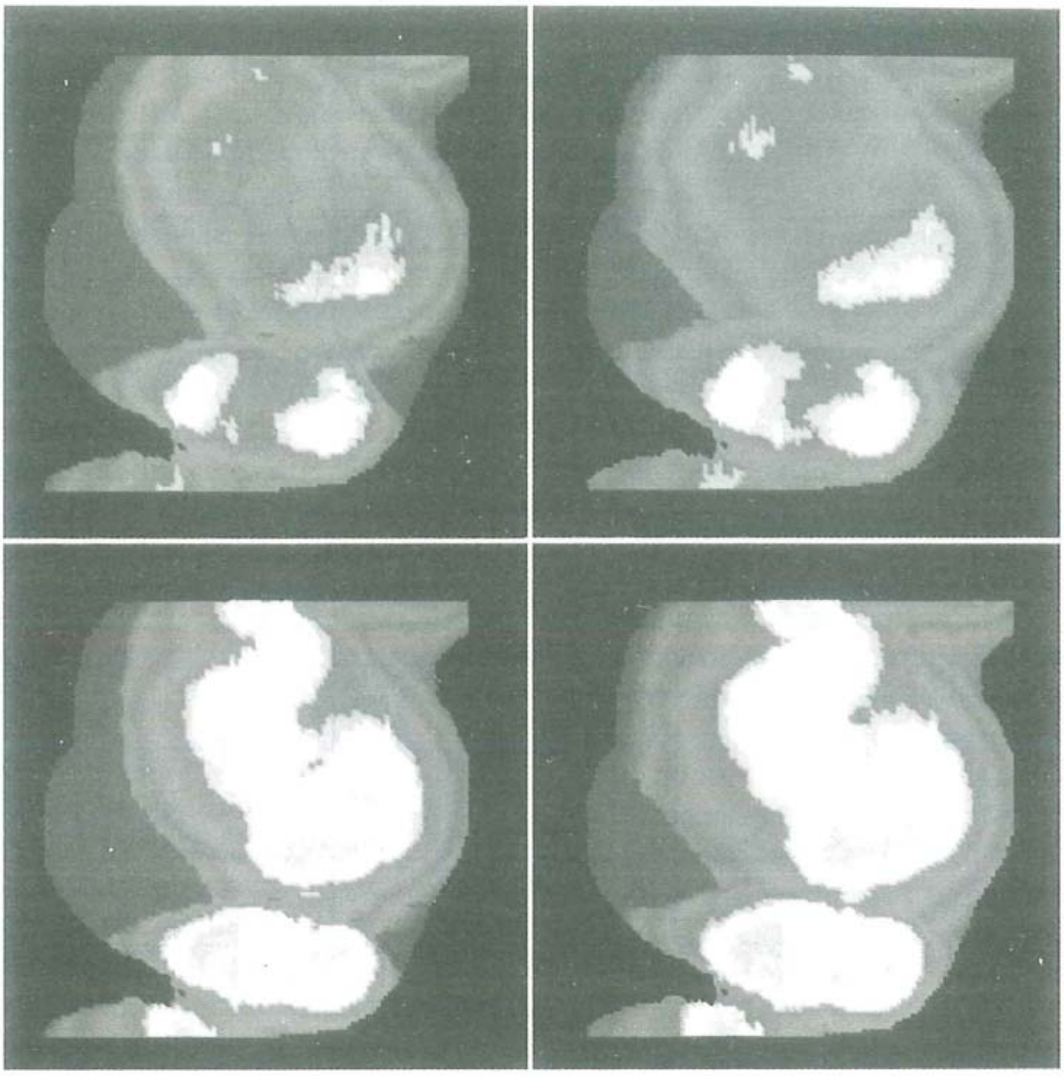


Figure 4: Distance map in the surface of a molar tooth.

Fig. 4 of Kunii

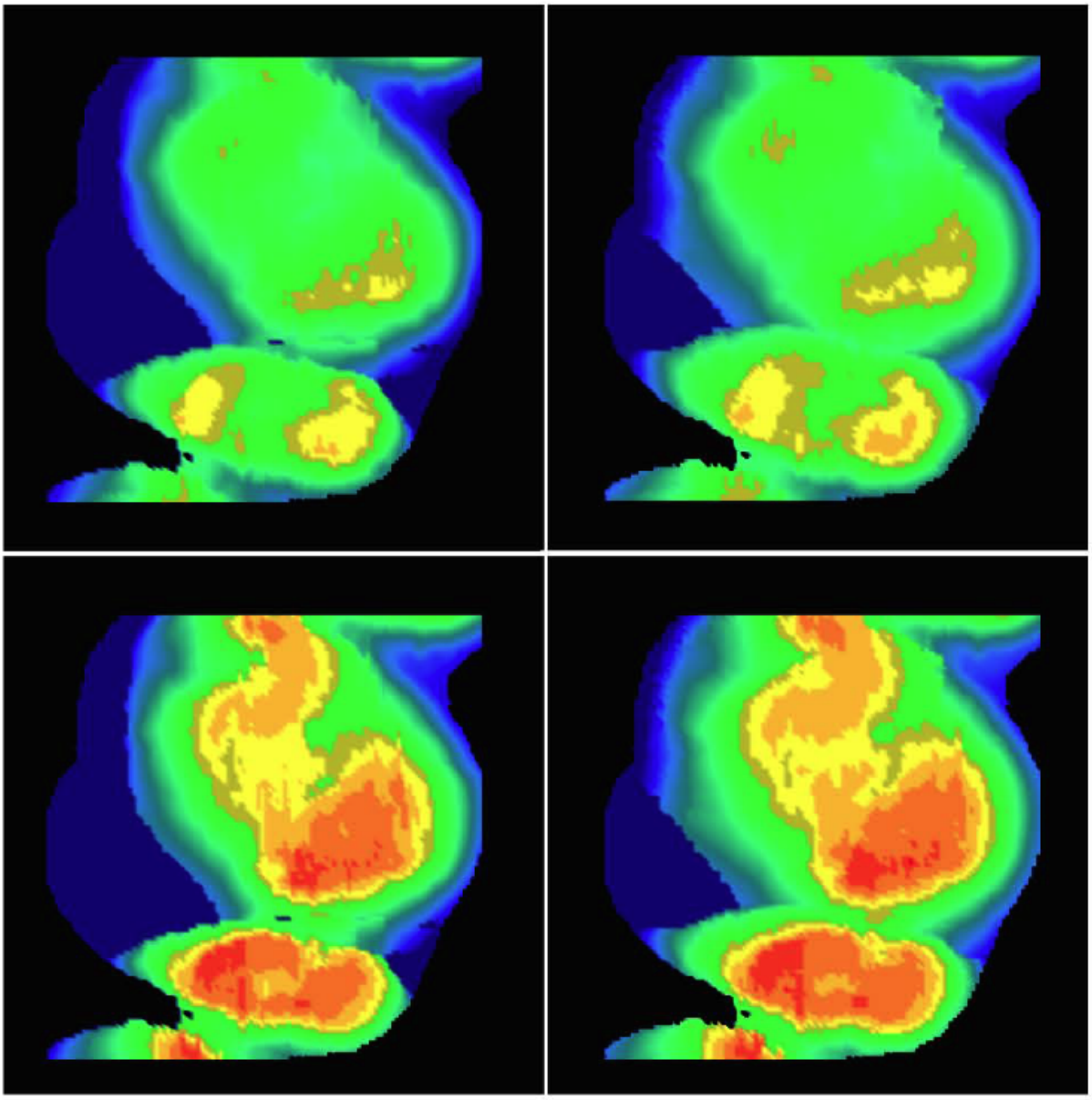


Figure 4: Distance map in the surface of a molar tooth.

FIG. 4 of Ex.1011

Ex.1006, ¶ 40.

2. Myszkowski (Ex.1004)

Myszkowski describes an efficient computerized technique for Functionally Generated Path ("FGP") reconstruction. Ex.1004, Abstract. Myszkowski discloses that the FGP is produced as a surface which envelops the actual occlusal surface of the moving opponent jaw. *Id*. Myszkowski describes the FGP surface is used as a compact representation of dynamic occlusal relations. *Id.*, Abstract; §2 (OCCLUSAL SURFACE DESIGN). Ex.1006, ¶ 41.

Myszkowski discloses that distance maps between occlusal surfaces of jaws, calculated for multiple projection directions and accumulated for mandibular motion, provide information for FGP computation. Ex.1004, Abstract. Rasterizing graphics hardware is used for fast calculation of the distance maps using "[r]eal-world data" including "the scanned shape of teeth and the measured motion of the lower jaw." *Id.* Myszkowski obtains the shape of actual teeth from measurements taken by a mechanical scanner and molds of the jaws, or by optical measurement directly in a patient's mouth. *Id.*, §2 (OCCLUSAL SURFACE DESIGN). Ex.1006, ¶ 42.

Myszkowski describes an FGP algorithm which uses the computational power of a hardware-implemented z-buffer for calculation of distance maps between the jaws, or a jaw and an opposing FGP. Ex.1004, §3 (FGP COMPUTATION ALGORITHM). Myszkowski discloses that the distance

information obtained from the distance maps can be used to accumulate the minimal distance to an opposing object (e.g., upper jaw) during motion of an object (e.g., lower jaw). *Id.*, §3 (FGP COMPUTATION ALGORITHM). Ex.1006, ¶ 43.

Myszkowski describes selecting a projection direction for z-buffer calculations such as a direction perpendicular to the occlusal plane, building a reference plane parallel to the occlusal plane in proximity of the occlusal surface of the teeth for which FGP is calculated. Ex.1004, §3 (FGP COMPUTATION ALGORITHM). Myszkowski discloses that for every step of motion, such as the motion of a lower jaw, distance maps are calculated between the jaw and the reference plane. *Id.* Map distances are extracted and compared to minimal distances stored at vertices of the reference plane mesh wherein the lower of the compared values are chosen for each of the vertices. *Id.* The vertices of the reference plane mesh are translated by minimal distances along the z-buffer projection direction to obtain an FGP surface. *Id.* Ex.1006, ¶ 44.

Myszkowski also describes using its distance maps techniques for occlusion evaluation between the jaws. Ex.1004, §4 (OCCLUSION EVALUATION WITH FGP). Myszkowski discloses that the distance maps can be multi-projection distance maps where the z-buffer calculations are performed for multiple projection directions and the obtained distance information is processed for

vertices of the restoration surface mesh. *Id.* The multiple-projection distance maps provide immediate information on the placement of collisions on the surface of the restoration, the map of the collision depths, and projection directions in which the minimal distance was registered. *Id.* Ex.1006, ¶ 45.

Figs. 7a and 7b of Myszkowski show corresponding multi-projection distance maps. Ex.1004, §5 (RESULTS). Fig. 7a shows the occlusion between the jaws for static conditions, and Fig. 7b shows a distance map for the FGP and an opposing restoration, which provides information on all possible contacts (collisions) during the entire simulated motion of a lower jaw. *Id.* Myszkowski describes regions of the distance maps where the distance to the opponent teeth (FGP) exceeds 1 mm are marked by blue and green colors; the colors between yellow and red correspond to distances below 1 mm; zero distance, *i.e.*, contact between jaws, is pure red. *Id.*

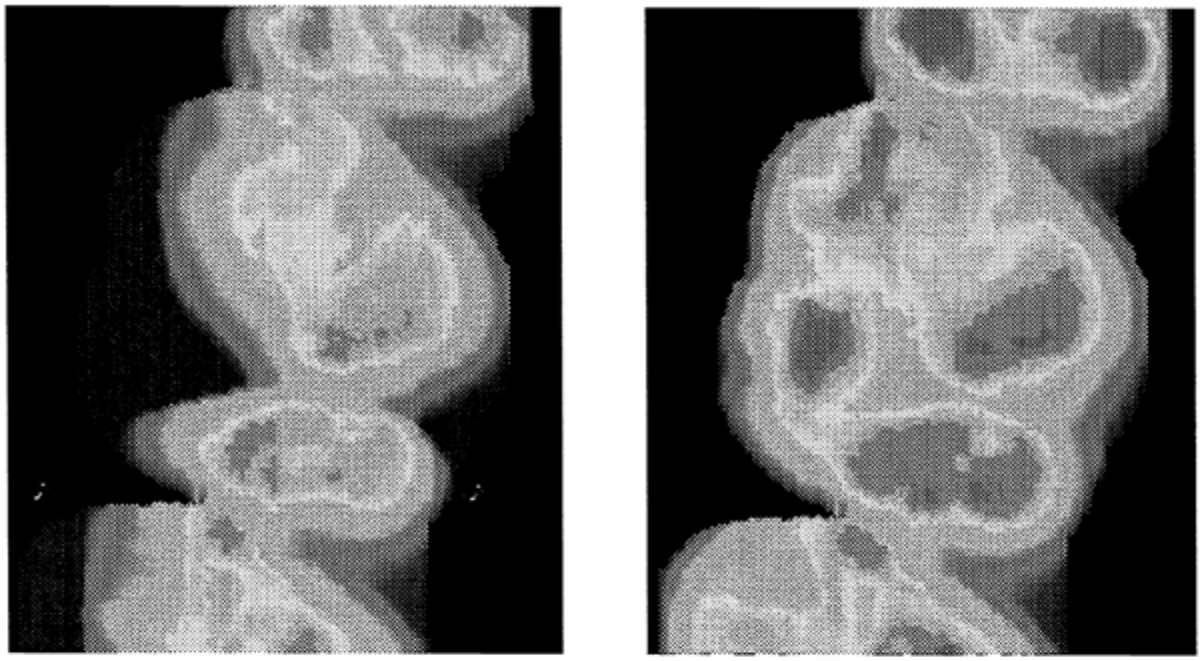


Figure 7: Distance maps between the occlusal surfaces of a) jaws, b) FGP and the opposite jaw

Fig. 7 of Myszkowski

Ex.1006, ¶ 46.

3. Hayashi (Ex.1005)

Hayashi describes methods of performing occlusion analysis using a computer and digital data obtained from methods including a laser scanning type three-dimensional digitizer method to quantitatively evaluate not only the contact sites, but also the pairing relationship of the entire tooth engagement surface (occlusion surface). Ex.1005, §1 (Introduction). Hayashi discloses the term "tooth occlusion" refers to the pairing relationship of the upper and lower jaw dentition. *Id*. Hayashi describes a method for quantification of the proximity relationship

using a distance map which may hierarchically represent the nearness of two surfaces, even including sites that are not in contact. *Id*. Ex.1006, ¶ 47.

Hayashi describes methods to evaluate the pairing relationship of dentition including methods to quantify the distance between an occlusion surface to an opposing occlusion surface at not only a contact site, but at all points on the occlusion surface. Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map). Hayashi describes two methods to measure distance between opposed occlusion surfaces, the first method measures distance in a certain direction and the second method determines the shortest distance of opposed occlusion surfaces. *Id.* Ex.1006, ¶ 48.

Hayashi describes the shortest distance between a point on the occlusion surface and the opposite occlusion surface as the interocclusal distance for that point. Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map). Hayashi describes determining the interocclusal distance for all of the points, to obtain the distribution of the shortest distances on the occlusion surface. *Id.* Hayashi describes this distribution of shortest distances as a distance map. *Id.* Ex.1006, ¶ 49.

Fig. 2 of Hayashi shows a distance map on the occlusion surface where the interocclusal distance on the upper jaw first molar occlusion surface is shown as a contour line. Ex.1005, §3.2 (Quantification of the pairing relationship using a

distance map). Hayashi describes using this distance map to easily determine which site of the occlusion surface is being touched, and which site is close without making any contact. *Id.*

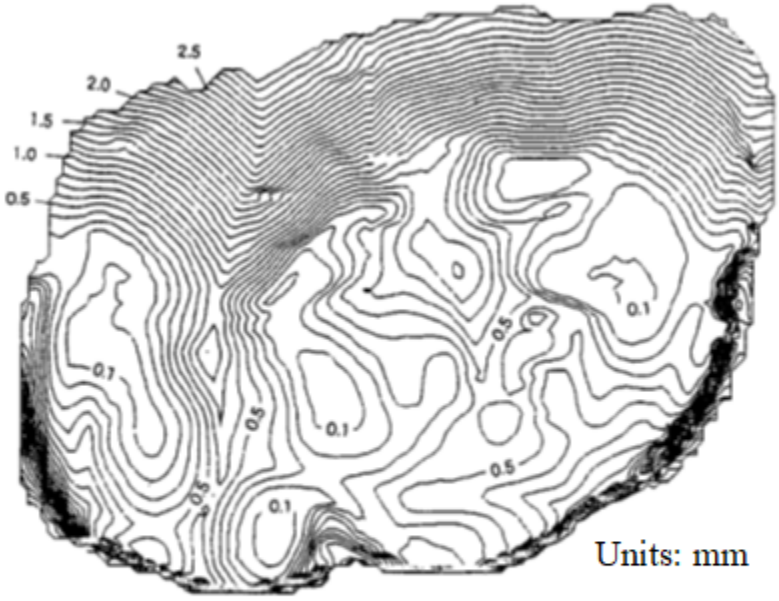
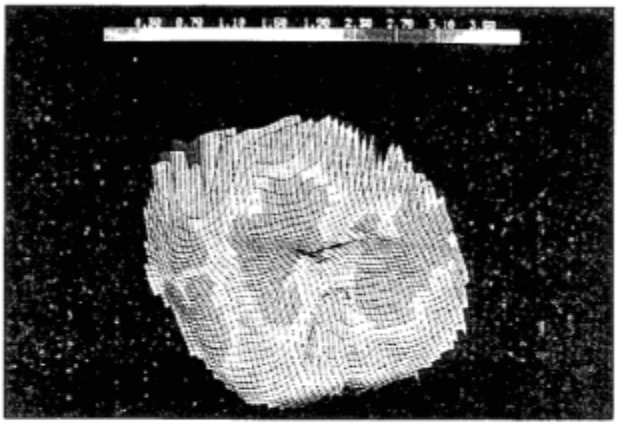


Figure 2 Distance map on the occlusion surface
The interocclusal distance on the upper jaw first molar occlusion surface is shown as a contour line.

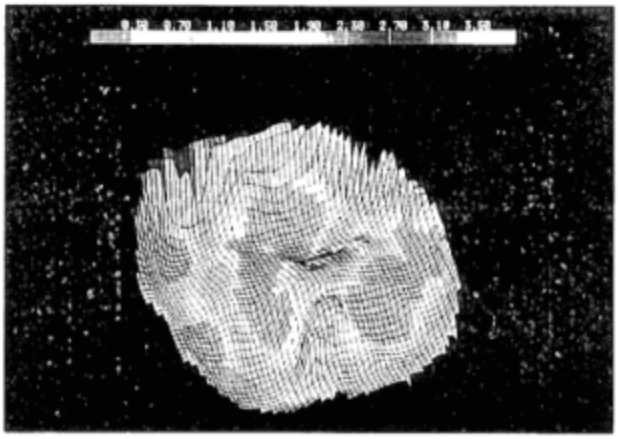
Fig. 2 of Hayashi

Ex.1006, ¶ 50.

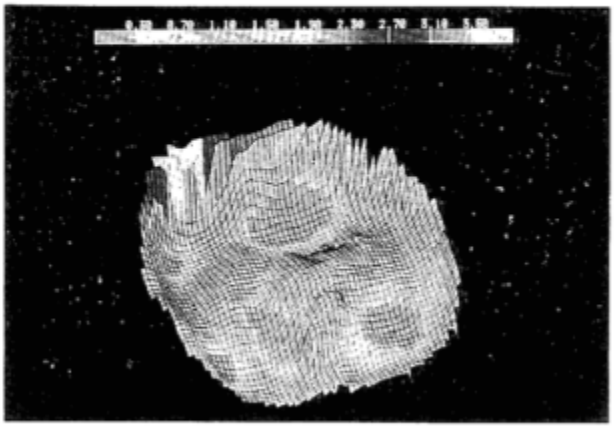
Figs. 11(a) to 11(c) of Hayashi show an example of the changes in the distance map accompanying lateral sliding movement. Ex.1005, §4.3 (Results and discussion). In Figs. 11(a) to 11(c), the "shape of the upper jaw first molar was represented using a wire frame, and the interocclusal distance d is shown using false colors." *Id.*



(a) Intercuspal position



(b) 0.5 mm lateral position (working side)



(c) 2.0 mm lateral position (working side)

Figure 11 Example of the changes in the distance map accompanying lateral sliding movement

Figs. 11(a)-(c) of Hayashi

Ex.1006, ¶ 51.

C. Person of Ordinary Skill in the Art ("POSITA")

A POSITA is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity. With respect to the '853 Patent, a POSITA would have at least (1) a bachelor's degree in computer science and/or computer engineering (or equivalent course work) and two to three years of work experience in computer modelling of physical structures or (2) a master's degree in computer engineering and/or computer science (or equivalent course work) with a focus in computer modelling of physical structures. Ex.1006, ¶ 24.

VI. HOW THE CHALLENGED CLAIMS ARE TO BE CONSTRUED

The '853 Patent claims priority to PCT Application No. PCT/IL98/00219 filed May 14, 1998.[3] Accordingly, the '853 Patent is currently expired. Claim terms of an expired patent, such as the '853 Patent, in an *inter partes* review are construed in accordance with the claim construction standard set forth in *Phillips v. AWH Corp*, 415 F.3d 1303 (Fed. Cir. 2005). *See* 37 C.F.R. § 42.100(b).

[3] "A patent granted on an international application filed on or after June 8, 1995 and which enters the national stage under 35 U.S.C. § 371 will have a term which ends twenty years from the filing date of the international application." M.P.E.P. § 270 at II. International Applications; *see also* 35 U.S.C. § 154.

Petitioners provide constructions for the following claim terms from the claims of the ’853 Patent. Any claim terms not addressed below should also be interpreted according to their plain and ordinary meaning. Ex.1006, ¶ 52.

A. “occlusion map” (claims 1-3, 5, 7, and 9-13)

The ’853 Patent specification defines the term “occlusion map” as a “graphical representation of the distance between opposite points, or regions, on the surface of opposite teeth.” Ex.1001, 1:63-65. The ’853 Patent specification discloses that the occlusion map can be “a two-dimensional map of the distances between said opposite regions on said opposite teeth.” *Id.*, 2:19-22. Accordingly, the term “occlusion map” should be construed as a “graphical representation of the distance between opposite points, or regions, on the surface of opposite teeth” and encompasses a two-dimensional graphical representation. Ex.1006, ¶¶ 53, 54.

B. “color” (claim 9)

The ’853 Patent specification states that the term “color” “includes not only all colors and shades of colors but also black and white and all shades of grey between black and white on a grey scale.” Ex.1001, 2:4-7. Accordingly, the term “color” should be construed as encompassing all colors and shades of colors and black and white and all shades of grey between black and white on a grey scale. Ex.1006, ¶¶ 55, 56.

VII. PETITIONERS HAVE A REASONABLE LIKELIHOOD OF PREVAILING

A claim is anticipated if each and every element as set forth in the claim is found, either expressly or inherently described, in a prior art reference. *See Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, *i.e.*, identity of terminology is not required. *See In re Bond*, 910 F.2d 831 (Fed. Cir. 1990).

Obviousness under 35 U.S.C. § 103 is determined by first evaluating several factual inquiries, namely the scope and content of the prior art, ascertaining the differences between the claimed invention and the prior art, and resolving the level of ordinary skill in the relevant art, as well as considering any objective evidence of "secondary considerations" relevant to obviousness. *Graham v. John Deere Co.*, 383 U.S. 1 (1966). The scope and content of the prior art is set forth below for the statutory ground of rejection upon which this Petition is based. Any differences between the prior art and the purported invention claimed in the '853 Patent are addressed below.

The following discussion explains why the claims of the '853 Patent are unpatentable over the prior art asserted in Grounds 1-5.

A. Claims 1-3, 5, 7, and 9-11 Are Anticipated by Kunii (Ground 1)

For the reasons set forth below, Kunii discloses every element of Claims 1-3, 5, 7, and 9-11. Thus, Kunii anticipates claims 1-3, 5, 7, and 9-11. Ex.1006, ¶ 58.

1. Claim 1 (preamble): A method for obtaining a dental occlusion map of a three-dimensional virtual computer model of teeth of upper and lower jaws of a mouth, said occlusion map indicative of distances between opposite regions on facing surfaces of opposite teeth of the upper and lower jaws of the mouth, said method comprising the steps of:

Kunii discloses the preamble of claim 1.[4] Ex.1006, ¶ 59.

"dental occlusion map"

Kunii discloses methods for "calculation of distance maps." Ex.1003, 163 (left col.). As discussed in Section VI.A., the term "occlusion map" should be construed as "a graphical representation of the distance between opposite points, or regions, on the surface of opposite teeth." Kunii's "distance image" and "distance map" are occlusion maps because they are graphical representations of distances "between the surfaces of the upper and lower jaw." Ex.1003, 164 (left col.). *See also* Fig. 3a ("Graphical display of a distance image"), Fig. 3b ("Graphical display of…a distance map"), Fig. 4 ("Distance map in the surface of a molar tooth").

[4] Petitioners do not concede that any preamble of the challenged claims is limiting.

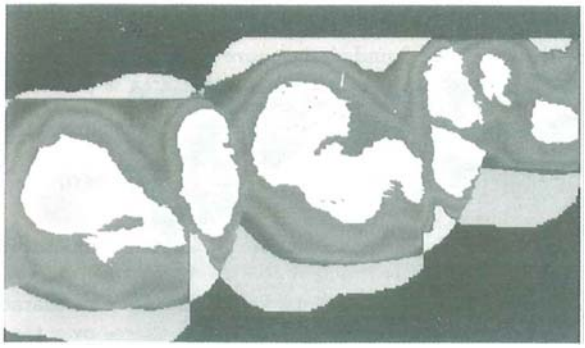


Fig. 3a of Kunii

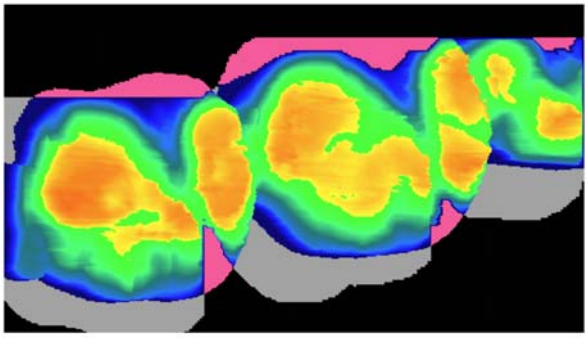


Fig. 3a of Ex.1011

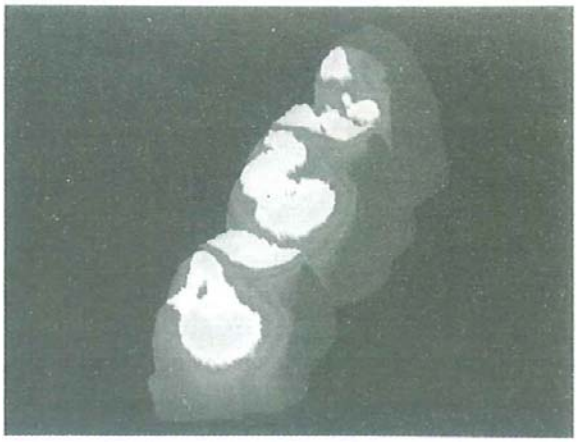


Fig. 3b of Kunii

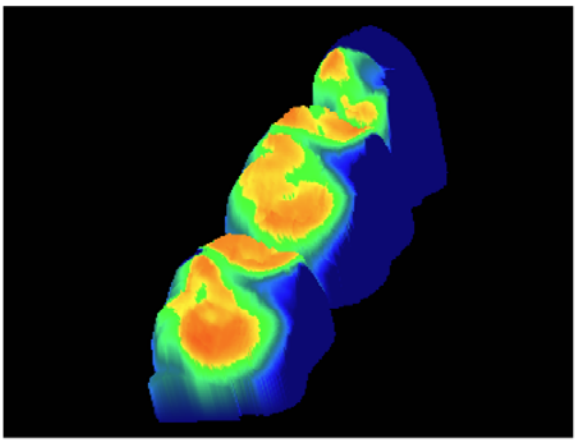


Fig. 3b of Ex.1011

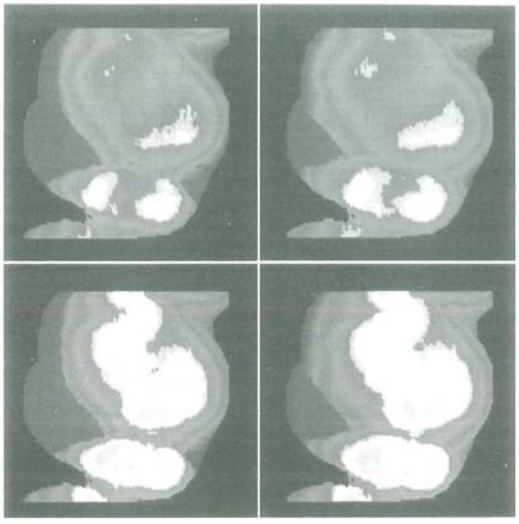


Fig. 4 of Kunii

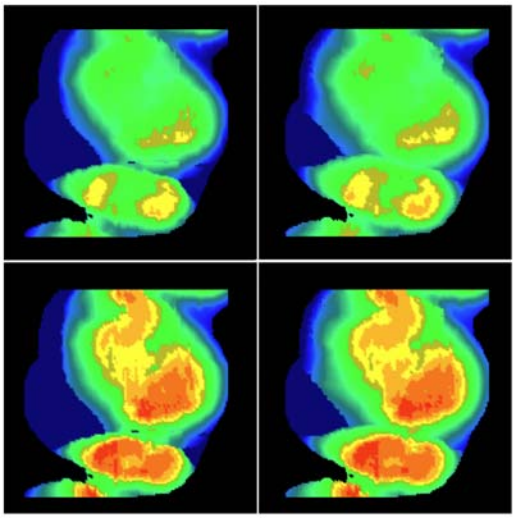


Fig. 4 of Ex.1011

Ex.1006, ¶ 60.

Kunii's distance map depicts "distances between points on surfaces," such surfaces being "of the upper and lower jaw." Ex.1003, 164 (left col.). Kunii discloses obtaining "the distance map of the surface S of a given tooth." *Id.*, 166 (left col.). Kunii discloses distance maps are used to obtain characteristics that "are usually *local*, that is, relevant to ***a particular point or an area in a tooth***." *Id.*, 163 (right col.) (emphasis added); *see also id.*, Fig. 2 (depicting a three-dimensional virtual computer model of teeth). Kunii discloses measuring distances ("$d = B_{min} - A_{max}$") between opposite points (e.g., B_{min}, A_{max}) of objects A and B along a projection direction:

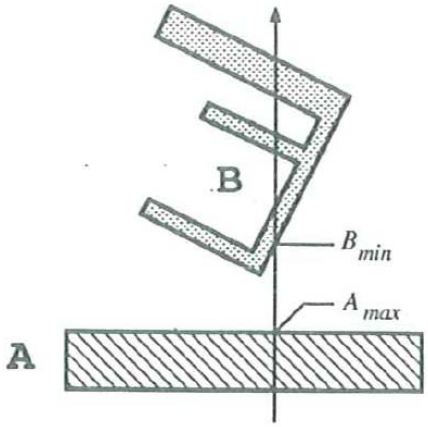


Fig. 1a of Kunii

Id., Fig. 1a (caption). Thus, the distances shown in Kunii's distance image and distance map are between opposite points, or regions, on the surface of opposite teeth. Ex.1006, ¶ 61.

Kunii's distance map is a "dental" occlusion map because the map pertains to teeth and the "design of dental restorations." Ex.1003, 163-64. In addition, Kunii discloses "distance maps found for the upper left first molar for two positions of the lower jaw." *Id.*, 166 (left col.). Kunii's distance map is of a three-dimensional virtual computer model of teeth of upper and lower jaws of a mouth because Kunii discloses that the distance map corresponds to "data [of] scanned surfaces of the upper and lower jaw and three-dimensional lower jaw motion data" and generally to "computer-aided diagnosis of occlusal disorders." *Id.*

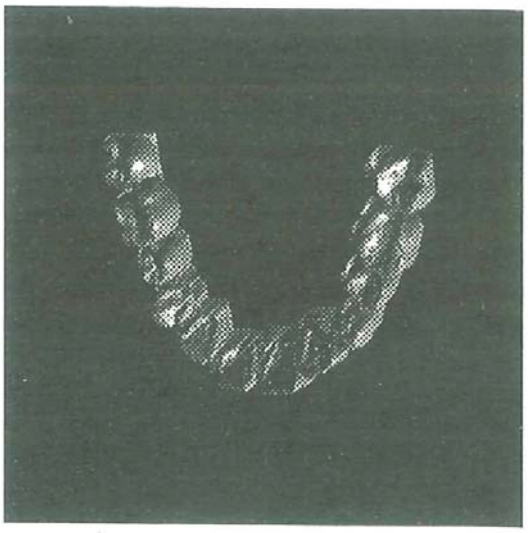


Figure 2: Occlusal surface of a jaw.

Fig. 2 of Kunii

Ex.1006, ¶ 62.

"said occlusion map indicative of distances between opposite regions on facing surfaces of opposite teeth of the upper and lower jaws of the mouth"

As discussed above, Kunii discloses that the distance image and distance map depicts "distances between points on surfaces," such surfaces being "of the upper and lower jaw." Ex.1003, 164 (left col.).

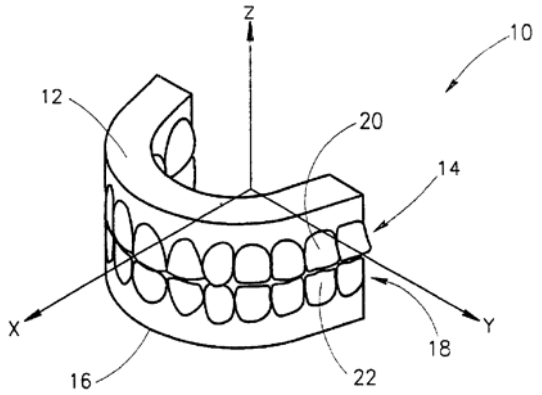


Fig. 1 of the '853 Patent

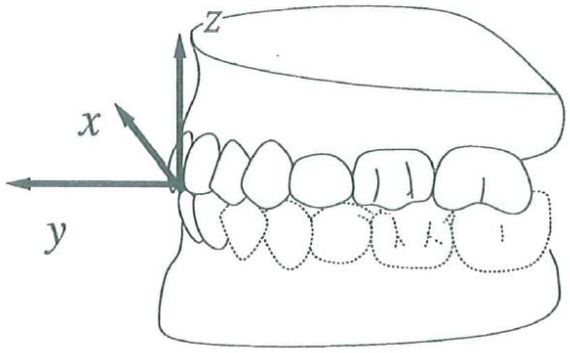


Fig. 6 of Kunii (Excerpt)

The '853 Patent discloses that Fig. 1 shows an upper jaw with upper teeth and a lower jaw with lower teeth, including "a pair of opposite teeth, namely upper tooth 20 and lower tooth 22." Ex.1001, 3:31-34. Fig. 6 of Kunii also discloses an upper jaw with upper teeth and a lower jaw with lower teeth, including a pair of opposite teeth. Ex.1003, Fig. 6. The "contact between teeth" (*id.*, 163) and "contact between the surfaces of the upper and lower jaw" (*id.*, 164) in Kunii involve contact between opposite teeth, where surfaces of the lower teeth face surfaces of the upper teeth. *Id.* In addition, Kunii discloses "distance maps found for the upper left first molar for two positions of the lower jaw." *Id.*, 166 (left col.). Ex.1006, ¶ 63.

Further, Kunii discloses measuring distances between opposite points (e.g., B_{min}, A_{max} in Fig. 1a) of objects A and B along a projection direction. Ex.1003, Fig. 1a and caption.

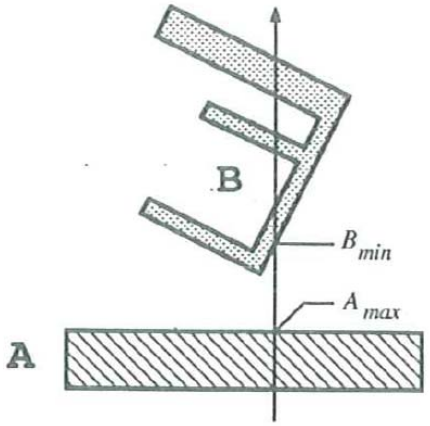


Fig. 1a of Kunii

Such objects can be facing surfaces of opposite teeth because Kunii discloses calculating distance maps for teeth. Ex.1003, 166 (left col.) ("the distance map of the surface S of a given tooth"), 163 (right col.) ("a particular point or an area in a tooth"). *See also id.*, 163 (right col.) ("evaluation of occlusion is to estimate interaction between teeth using distance maps; as soon as the distance map is known, we may estimate physical and geometric features of contact areas."). Kunii discloses using "real data (scanned surfaces of the upper and lower jaw and three-dimensional lower jaw motion data."). *Id.* The points disclosed by Kunii satisfy the claimed "opposite regions" because the '853 Patent discloses that the opposite regions can be points. Ex.1001, 2:39-40 ("If desired, said opposite

regions on said facing surfaces of opposite teeth are points"), claim 10. Ex.1006, ¶ 64.

Thus, Kunii's "distance image" and "distance map" show distance between opposite teeth. Kunii discloses an occlusion map indicative of distances between opposite regions on facing surfaces of opposite teeth of the upper and lower jaws of the mouth. Ex.1003, 164 (left col.) ("The characteristics of contact between the surfaces of the upper and lower jaw…may be found from distances between points on surfaces of these objects."). Ex.1006, ¶ 65.

a. Element [1.1.]: (i) determining said distances between opposite regions on opposite teeth of the upper and lower jaws of the mouth; and

Kunii discloses element [1.1] of claim 1. Ex.1006, ¶ 66.

Kunii discloses determining distances between opposite regions on opposite teeth because Kunii discloses determining "distances between points on surfaces of these objects" including "surfaces of the upper and lower jaw". Ex.1003, 164 (left col.)("The characteristics of contact between the surfaces of the upper and lower jaw . . . may be found from distances between points on surfaces of these objects."). *See also id.*, 164 (left col.)("We use approximate solutions and in the simplest case, the distance is measured along a fixed projection direction; in this case the results are strongly affected by the choice of this direction. A more reliable distance measurement can be obtained when multiple directions are considered and the

minimal or average distances are derived"), Ex.1003, 164 (right col.)("The distance between the objects is calculated as the difference d between the minimal depth B_{min} recorded when the first object is scan-converted, and the corresponding maximal depth A, for the second object (Fig. 1a).").

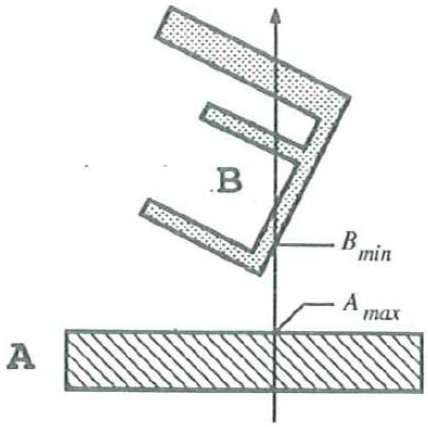


Fig. 1a of Kunii

In Fig. 1a, Kunii discloses measuring distances between opposite points (e.g., B_{min}, A_{max} in Fig. 1a) of objects A and B along a projection direction. *Id.*, Fig. 1a and caption. Ex.1006, ¶ 67.

Kunii discloses that the opposing surfaces of the upper and lower jaw (e.g., which contact each other) are surfaces of opposing teeth. Ex.1003, 164 (left col.) ("contact between teeth . . . for various positions of the jaws"), 165 (right col.) (distance maps pertain to "contact between teeth"), Fig. 6 (showing teeth of the upper jaw that are opposite teeth of the lower jaw).

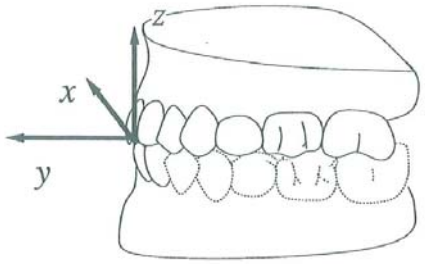


Fig. 6 of Kunii (Excerpt)

Kunii's distance map provides distance information concerning "surface S of a given ***tooth***. " [Emphasis added.] *Id.*, 166 (left col.). *See also* Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map) (determining "the shortest distance between a point on the occlusion surface and the opposite occlusion surface" of opposing teeth was desirable). Ex.1006, ¶ 68.

b. Element [1.2.] (ii) setting up a correspondence between said determined distances and regions on a mapping surface.

Kunii discloses element [1.2] of claim 1. Ex.1006, ¶ 69.

According to the '853 Patent, "setting up a correspondence between said determined distances and regions on a mapping surface" encompasses relating a distance to a "corresponding shade on a grey scale, or a corresponding color on a color scale." Ex.1001, 4:42-45 ("Each of the four values of distance so obtained is then related to a ***corresponding*** shade on a grey scale, or a ***corresponding*** color on a color scale. [Emphasis added.]"). *See also id.*, 2:32-39 (disclosing embodiments in which opposite regions "are colored in accordance with a given color scale and

wherein each color ***corresponds*** to a given distance" and "are shaded in accordance with a grey scale and wherein each shade ***corresponds*** to a given distance" (emphases added)). As explained below, Kunii discloses relating a distance to a corresponding color on a color scale. Ex.1006, ¶ 70.

Kunii discloses setting up a correspondence between the distances and regions on a mapping surface. Ex.1003, Fig. 3a, 3b. Kunii's "distance image" and "distance map" are visual representations of determined distances for selected regions ("areas" or "points"). *Id.*, 163 (right col.) (distance map shows "physical and geometric features of contact areas"), 166 (left col.) ("distance image" shows "the minimal distance between objects, calculated for selected points in their surfaces."). Kunii discloses "color maps" are a convenient means for visualization. Ex.1003, 164 (left col.); *see also id.*, 165. Ex.1006, ¶ 71.

The '853 Patent discloses setting up a correspondence in which "each color corresponds to a given distance, or range of distances." Ex.1001, 1:66-2:2; *see also id.*, 2:32-38. Kunii sets up a correspondence in the same manner as the '853 Patent. In this regard, Kunii discloses:

> Fig. 3a shows an example of a distance image: pink and white regions correspond to areas in lower and upper jaws, respectively, that have no corresponding point in the opposite jaw in the direction of the current projection; regions marked by blue and green are those where the distance in the projection direction between the jaws exceeds 1

> mm, and borders between green and yellow correspond to the distance below 1 mm, colors between yellow and red correspond to distances below 1 mm; zero distance, i.e., contact between the surfaces, would be pure red.

Id., 165 (left col.). In addition, Kunii discloses that the distance map of Fig. 3b sets up a correspondence of color to distance in the same manner as in Fig. 3a. *Id.,* 165 (right col.) ("Fig. 3b: the meaning of the colors is the same as in Fig. 3a"). Ex.1006, ¶ 72.

In addition, Kunii discloses that the distance map relates to "the function on the surface of one of the objects (or a graphical representation of this function) whose value at a point of the surface is equal to the distance from the other surface." Ex.1003, 165 (rt. col.). The "value" that is "equal to the distance" is also a correspondence between the distances and regions on a mapping surface. Ex.1006, ¶ 73.

From the above textual description of Kunii alone, it is apparent that Kunii discloses setting up a correspondence between determined distances and regions on a mapping surface. As noted above, Kunii depicts the distance image of Fig. 3a and distance maps of Figs. 3b and 4 in black-and-white. Exhibit 1011 provides color versions of Figs. 3a, 3b, and 4:

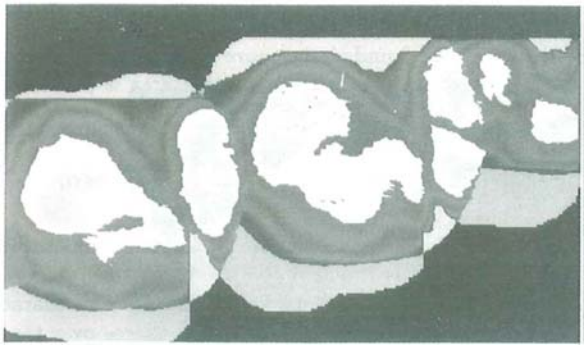


Fig. 3a of Kunii

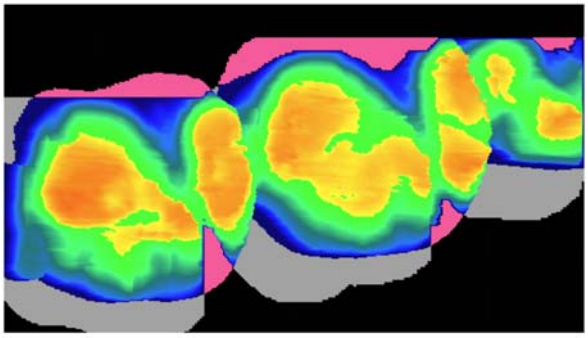


Fig. 3a of Ex.1011

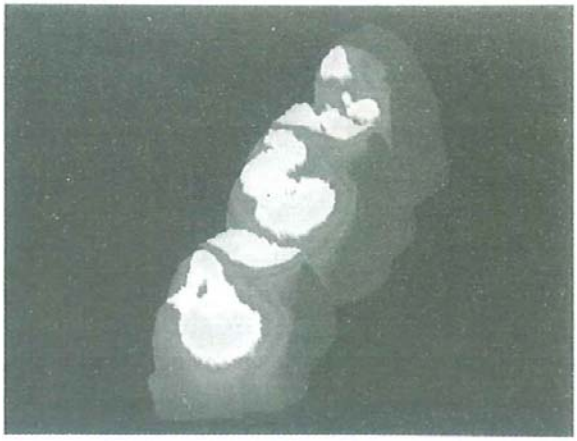


Fig. 3b of Kunii

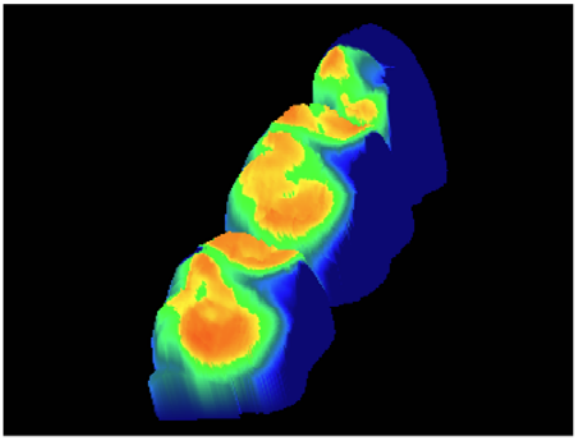


Fig. 3b of Ex.1011

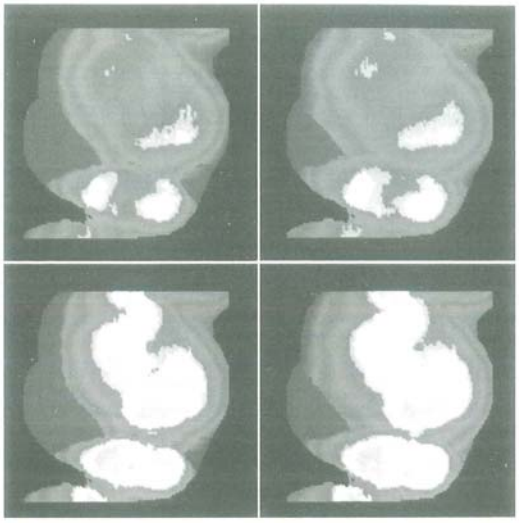


Fig. 4 of Kunii

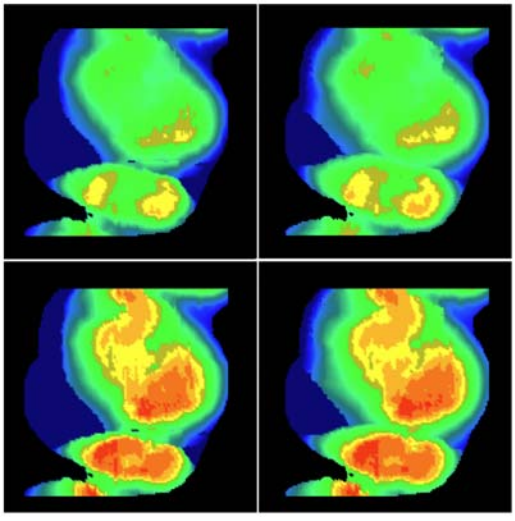


Fig. 4 of Ex.1011

Ex.1003, Figs. 3a, 3b, 4; Ex.1011, Figs. 3a, 3b, 4. Kunii further discloses that the "distance maps are view-independent and can be inspected by a dentist interactively." *Id.*, 165 (rt. col.). Kunii discloses graphically displaying the distance map. *Id.*; *see also id.*, 165 (left col.). Ex.1006, ¶ 74.

2. Claim 2: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said mapping surface is a plane, whereby said dental occlusion map is a two-dimensional map of the distances between said opposite regions on said opposite teeth.

Kunii discloses each element of claim 2. Kunii discloses each element of claim 1 from which claim 2 depends. Section VII.A.1. Ex.1006, ¶ 75.

Kunii discloses an occlusion map that is a two-dimensional map. Ex.1003, Fig. 3a. Fig. 3a of Kunii depicts a two-dimensional map:

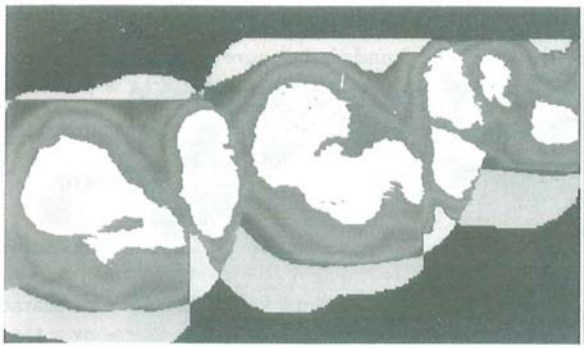


Fig. 3a of Kunii

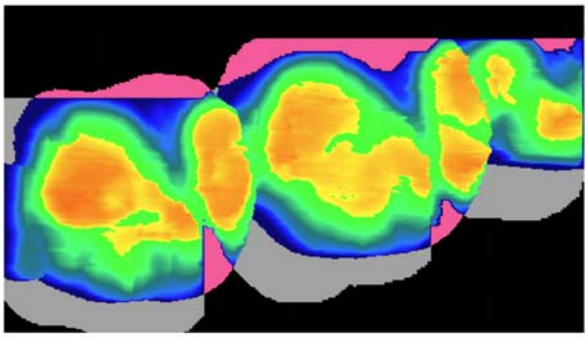


Fig. 3a of Ex.1011

In Fig. 3a of Kunii, the mapping surface is a plane because it is a two-dimensional map. The '853 Patent does not require the plane to be visible. Ex.1001, 2:60 ("FIG. 4 shows a map onto a plane", where Fig. 4 merely depicts colored dots). Thus, a plane according to the '853 Patent can be a two-dimensional space in

which the occlusion map resides (as in Fig. 4), and Kunii discloses such a two-dimensional space. *Id.* Ex.1006, ¶ 76.

3. Claim 3: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said mapping surface is a facing surface of said facing surfaces of opposite teeth of the upper and lower jaws of the mouth.

Kunii discloses each element of Claim 3. Kunii discloses each element of claim 1 from which claim 3 depends. Section VII.A.1. Ex.1006, ¶ 77.

According to the '853 Patent, a "mapping surface" is a surface on which a correspondence between determined distances and regions is set up. Ex.1001, 2:18-19, 8:6-7. While the '853 Patent requires the occlusion map to be a graphical representation (*Id.*, 1:63-65), the '853 Patent has no requirement that the mapping surface itself be graphically represented. Ex.1006, ¶ 78.

Claim 3 recites that the mapping surface (i.e., the surface on which a correspondence between said determined distances and regions is set up) is a facing surface of said facing surfaces of opposite teeth of the upper and lower jaws of the mouth. Kunii discloses such a mapping surface. Kunii discloses occlusion maps where the mapping surface is a facing surface of the facing surfaces of opposite teeth of the upper and lower jaw. Ex.1003, Figs. 3b, 4.

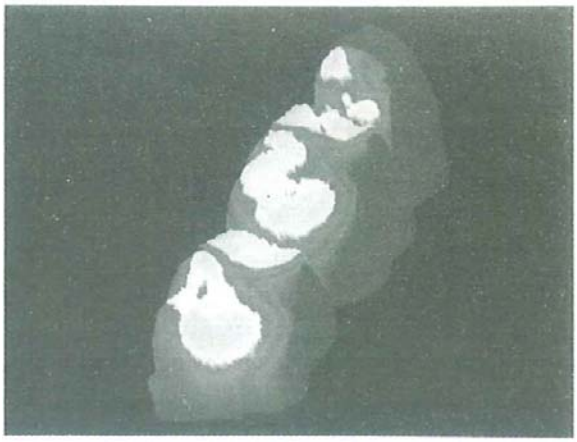


Fig. 3b of Kunii

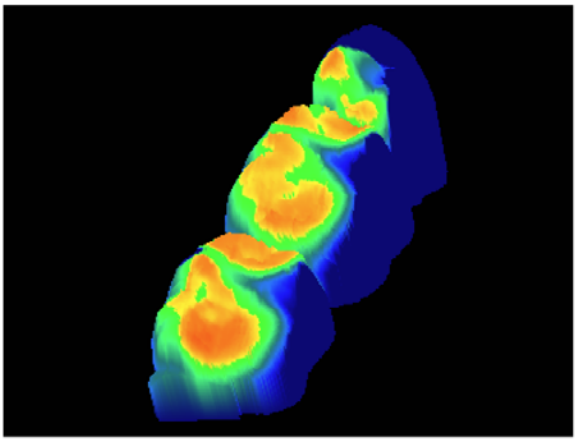


Fig. 3b of Ex.1011

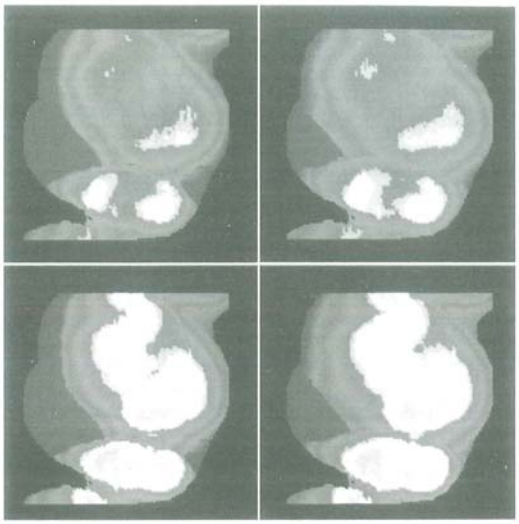


Fig. 4 of Kunii

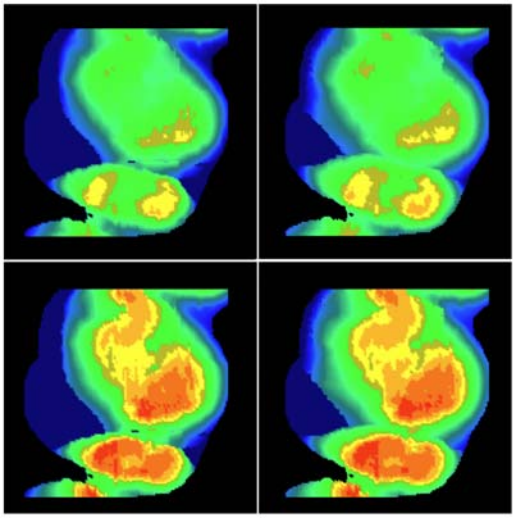


Fig. 4 of Ex.1011

Kunii discloses that in the occlusion map shown in Fig. 4, the surface on which a correspondence between distances and regions is set up (*i.e.*, the mapping surface) is a surface of "the upper left first molar." Ex.1003, 166 (left col.). Ex.1006, ¶ 79.

If the claimed "mapping surface" is somehow required to be graphically represented, claim 3 nevertheless would have been obvious as discussed in Section VII.C.1. Ex.1006, ¶ 80.

4. Claim 5: The method for obtaining a dental occlusion map in accordance with claim 3, wherein said facing surface belongs to the teeth of said upper jaw, and said lower teeth and lower jaw are not present.

Kunii discloses each element of claim 5. Kunii discloses each element of claim 1 from which claim 5 indirectly depends, as well as every element of claim 3 from which claim 5 directly depends. Sections VII.A.1., VII.A.3. Ex.1006, ¶ 81.

Fig. 4 of Kunii "shows distance maps found for the upper left first molar for two positions of the lower jaw." Ex.1003, 166 (left col.). In Fig. 4, the facing surface (surface of "the upper left first molar") belongs to the teeth of the upper jaw. *Id.* In Fig. 4, the lower teeth and lower jaw are not shown and therefore are not present.

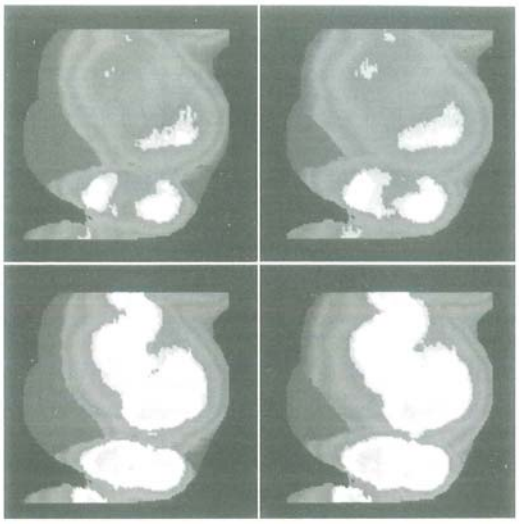


Fig. 4 of Kunii

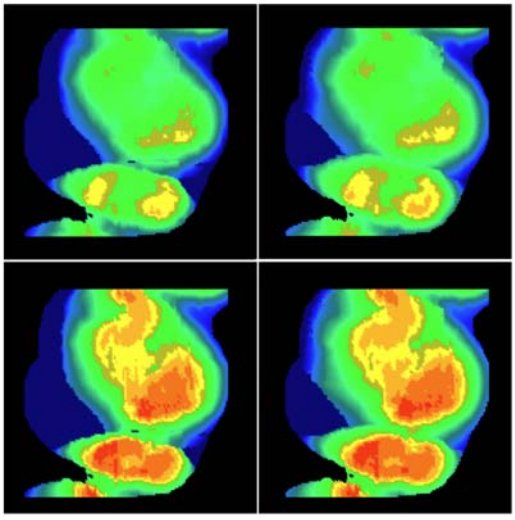


Fig. 4 of Ex.1011

Similarly, Figs. 3a and 3b of Kunii show a distance image and distance map relating to multiple teeth. Ex.1003, Figs. 3a, 3b. Ex.1006, ¶ 82.

5. Claim 7: The method for obtaining a dental occlusion map in accordance with claim 3, wherein said facing surface belongs to the teeth of said lower jaw, and said upper teeth and upper jaw are not present.

Kunii discloses each element of claim 7. Kunii discloses each element of claim 1 from which claim 7 indirectly depends, as well as every element of claim 3 from which claim 7 directly depends. Sections VII.A.1, VII.A.3. Ex.1006, ¶ 83.

As explained above in Section VII.A.4., in Fig. 4 of Kunii, the facing surface (surface of "the upper left first molar") belongs to the teeth of the upper jaw, and the lower teeth and lower jaw are not present. Ex.1003, 166 (left col.). Ex.1006, ¶ 84.

Kunii discloses that in the same manner the occlusion map is mapped onto the facing surface of the upper tooth, the occlusion map is also mapped onto the facing surface of the lower tooth. Kunii discloses that "characteristics of contact between the surfaces of the upper and lower jaw (or in a more general context, any complex objects) may be found from distances between points on ***surfaces of these objects*** (emphasis added)." Ex.1003, 164 (right col.). As explained above in Section VII.A.1.b., Kunii sets up a correspondence in the same manner as the '853 Patent where Fig. 3a shows a distance map where pink regions correspond to areas ***in the lower jaw*** and:

> regions marked by blue and green are those where the distance in the projection direction between the jaws exceeds 1 mm, and borders

> between green and yellow correspond to the distance below 1 mm, colors between yellow and red correspond to distances below 1 mm; zero distance, i.e., contact between the surfaces, would be pure red.

Id., 165 (left col.). Ex.1006, ¶ 85.

Kunii further discloses "project[ing] the distance image back into the object space." Ex.1003, 165 (left col.). Kunii discloses that "[a]s the result of back-projection the distance maps for ***every surface*** are produced (emphasis added)". *Id.*, 165 (right col.). "Every surface" includes a facing surface belonging to the teeth of the lower jaw. *Id.* When such occlusion map is mapped onto the facing surface of the lower tooth (in the same manner as the occlusion map is mapped onto the facing surface of the upper tooth), said upper teeth and upper jaw are not present. Ex.1006, ¶ 86.

Kunii discloses that the distance map is the function on the surface of ***one of the objects*** (or a graphical representation of this function) whose value at a point on the surface is equal to the distance from the other surface. (emphasis added)" *Id.* Kunii discloses that "[t]he distance maps are view-independent and can be inspected by a dentist interactively." *Id.* Ex.1006, ¶ 87.

Additionally, as explained in Section VII.B., it is a well-known technique to display dental information on a facing surface of a lower tooth. Ex.1006, ¶ 88.

6. Claim 9: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said opposite regions on said facing surfaces of opposite teeth are colored in accordance with a given color scale and wherein each color corresponds to a given distance.

Kunii discloses each element of claim 9. Kunii discloses each element of claim 1 from which claim 9 depends. Section VII.A.1. Ex.1006, ¶ 89.

Kunii discloses that opposite regions on said facing surfaces of opposite teeth are colored in accordance with a given color scale. Ex.1003, 165 (left col.). Kunii discloses:

> Fig. 3a shows an example of a distance image: pink and white regions correspond to areas in lower and upper jaws, respectively, that have no corresponding point in the opposite jaw in the direction of the current projection; regions marked by blue and green are those where the distance in the projection direction between the jaws exceeds 1 mm, and borders between green and yellow correspond to distances below 1 mm; zero distance, i.e., contact between the surfaces, would be pure red.

Id. As shown above, Kunii discloses that each color corresponds to a given distance. *Id.* Ex.1006, ¶ 90.

7. Claim 10: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said opposite regions on said facing surfaces of opposite teeth are points.

Kunii discloses each element of claim 10. Kunii discloses each element of claim 1 from which claim 10 depends. Section VII.A.1. Ex.1006, ¶ 91.

Kunii discloses determining "distances between ***points*** on surfaces of these objects (emphasis added)" including "surfaces of the upper and lower jaw". Ex.1003, 164 (left col.). Kunii discloses that the evaluation of occlusion using distance maps obtains characteristics that "are usually *local,* that is, relevant to ***a particular point*** or an area in a tooth. [Emphasis added.]" *Id.*, 163 (right col.). Kunii further discloses that "[t]he characteristics of contact between the surfaces of the upper and lower jaw (or in a more general context, any complex objects) may be found from distances between points on surfaces of these objects." *Id.*, 164 (left col.). Ex.1006, ¶ 92.

8. Claim 11: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said regions on said mapping surface comprise at least one pixel.

Kunii discloses each element of claim 11. Kunii discloses each element of claim 1 from which claim 11 depends. Section VII.A.1. Ex.1006, ¶ 93.

Fig. 3a of Kunii shows a graphical display of a distance image, the distance image of the graphical display includes at least one pixel because an image is made up of pixels. Kunii further discloses that the "measurement of depth is done independently for each object at discrete sample points (pixels) imposed by the raster of the depth buffer." Ex.1003, 164 (right col.). The pixels in Fig. 3a are colored according to the corresponding distances between the opposite jaws. *Id.,* 165 (left col.). Ex.1006, ¶ 94.

B. Claims 1-3, 5, 7, and 9-11 Would Have Been Obvious Over Kunii (Ground 2)

As discussed above in Section VII.A.1., Kunii discloses each element of claims 1-3, 5, 7, and 9-11. Ex.1006, ¶ 95.

Patent Owner may allege that the recitation "determining said distances between opposite regions on opposite teeth of the upper and lower jaws" of claim 1 of the '853 Patent requires that the distances are measured along a fixed projection direction, *e.g.*, as shown in Fig. 2 of the '853 Patent. Ex.1001, 2:55-57. Patent Owner may allege that Kunii does not anticipate claim 1 because Kunii does not disclose, in a single embodiment, that the distances are measured along a fixed projection direction, in combination with the other features of claim 1. However, claim 1 has no requirement that the distances of the occlusion map be measured in a fixed projection direction. If claim 1 is somehow interpreted to require that the distances of the occlusion map be measured in a fixed projection direction, it would have been obvious at the time of the purported invention to modify Kunii to measure distances along a fixed projection direction. Ex.1006, ¶ 96.

It would have been obvious at the time of the purported invention to modify Kunii to obtain a distance map that determines distances between opposite regions on opposite teeth of the upper and lower jaws in a single fixed projection direction and to set up a correspondence on a mapping surface of those distances. Kunii discloses that in the "simplest case" for calculation of occlusion maps, "the

distance is measured along a fixed projection direction." Ex.1003, 164 (left col.). Kunii recognizes that the most informative projection direction is close to the normal vector. *Id.*, 164 (right col.). Kunii further discloses that the "time of calculation of the distance map for a model jaw composed of 100,000 triangles using the single projection technique is 0.15 sec, and the multiprojection technique takes 0.9 sec per projection" and that the "efficiency of distance calculations makes possible the use of distance maps for derivation of some more advanced characteristics of contact between teeth… which can be used interactively." *Id.*, 165 (right col.). Ex.1006, ¶ 97.

As such, a POSITA would have been motivated to modify Kunii to determine distances in a fixed projection direction to obtain an occlusion map because a POSITA would have recognized that predictable benefits of such a modification would include simpler calculations for obtaining occlusion maps that may be obtained in less time. Ex.1003, 164-165. A POSITA would have had a reasonable expectation of success because Kunii discloses that the "simplest case" is to measure distance along a fixed projection direction. *Id.*, 164 (left col.). A POSITA would have recognized that the technique disclosed by Kunii would have readily been applicable to Kunii because Kunii discloses each of the techniques of determining distance along a fixed projection direction, a single projection

direction, and multiprojection directions for providing distance information of contact areas of opposing teeth. *Id.* Ex.1006, ¶ 98.

Further, modifying Kunii's occlusion map to reflect determined distances for a fixed projection direction merely would have been the obvious combination of known prior art elements (Kunii's occlusion map obtained using the single projection technique (*e.g.*, Fig. 4 left side)) modified to be obtained using a single projection direction according to known methods (Kunii's teaching of the "simplest case" for calculation of occlusion maps is to measure the distance along a fixed projection direction) to yield predictable results (efficiently carrying out distance calculations for occlusion maps). Such a modification merely would have been the use of a known technique (measuring along a fixed projection direction) to improve similar methods (Kunii's method of obtaining an occlusion map using a single projection technique) in the same way to yield predictable results (obtaining an occlusion map using a single, fixed projection direction). Ex.1006, ¶ 99.

Thus, a POSITA would have been motivated to modify the method of Kunii to arrive at determining distances for opposite points along a fixed projection direction to obtain an occlusion map that sets up a correspondence of those determined distances on a mapping surface. Ex.1006, ¶ 100.

Claims 2, 3, 5, 7, and 9-11 directly or indirectly depend from claim 1. Kunii discloses the subject matter of claims 2, 3, 5, 7, and 9-11. Sections VII.A.2.-

VII.A.8. The resulting obvious modification of Kunii would include the elements of claim 2, 3, 5, 7, and 9-11. Ex.1006, ¶ 101.

Patent Owner may allege that Kunii does not disclose that the facing surface belongs to the teeth of said upper jaw (claim 5) or lower jaw (claim 7). Patent Owner may allege that claims 5 and 7 require the facing surface to correspond to surfaces of multiple teeth. Claims 5 and 7 have no such requirement. Claims 5 and 7 merely recite that the facing surface "***belongs to*** the teeth of said upper/lower jaw." If Kunii is somehow found to not disclose the subject matter of claims 5 and 7, such subject matter nevertheless would have been obvious over Kunii. Ex.1006, ¶ 102.

In this regard, Kunii recognizes the desirability of providing additional information to assist with treatment of "occlusal orders" and "design of dental restorations." Ex.1003, 163 (left col.). Thus, while the examples of distance images and distance maps depicted in Kunii's figures relate to a specific tooth or teeth (and a specific jaw), a POSITA would have recognized that Kunii's techniques are equally applicable to any tooth or teeth of either jaw. This is because Kunii is concerned with "contacts between the surfaces of teeth" in general (not merely to a specific tooth or teeth or a specific jaw), and Kunii recognizes that the mouth includes teeth of an upper jaw and teeth of a lower jaw. *Id.*, Abstract, 163, Fig. 6. A POSITA would have been motivated to modify

Kunii's occlusion map to provide distance information of any tooth or all of the teeth of the upper jaw or lower jaw. A POSITA would have recognized that doing so would have provided the dentist with additional information that would assist in evaluation of the dental occlusion. Further, modifying Kunii's occlusion map to relate to any tooth or teeth of either jaw merely would have been the obvious combination of known prior art elements (any tooth or teeth of either the upper or lower jaw) according to known methods (Kunii's method of obtaining an occlusion map pertaining to a specific tooth or teeth of a specific jaw) to yield predictable results (obtaining an occlusion map pertaining to the selected tooth or teeth of either jaw). A POSITA would have had a reasonable expectation of success because Kunii teaches a method for obtaining an occlusion map for a particular tooth or teeth of a particular jaw. A POSITA would have recognized that the technique disclosed by Kunii would have readily been applied to any tooth or teeth of either the lower or upper jaw. Ex.1006, ¶ 103.

C. Claims 3, 5, 7, 12, and 13 Would Have Been Obvious Over Kunii in view of Hayashi (Ground 3)

1. Claims 3, 5, and 7 Would Have Been Obvious.

Claims 3, 5, and 7 would have been obvious over Kunii in view of Hayashi. As discussed above, Kunii alone discloses the subject matter of claim 3, 5, and 7. Sections VII.A.3.-VII.A.5. Ex.1006, ¶ 104.

Patent Owner may allege Kunii does not disclose that the mapping surface "is a facing surface of said facing surfaces of opposite teeth of the upper and lower jaws of the mouth" as recited in claim 3. If Kunii does not disclose this subject matter, it would have been obvious at the time of the purported invention to modify Kunii in view of Hayashi to arrive at such subject matter for the following reasons. Ex.1006, ¶ 105.

a. The claimed "facing surface of said facing surfaces of opposite teeth" is satisfied by an outline of a tooth.

The '853 Patent states that Fig. 4 shows an occlusion map, and "FIG. 5 shows the occlusion map of FIG. 4 superimposed on the outline 22' of the lower tooth 22." Ex.1001, 5:54-56. The '853 Patent discloses that Fig. 5 depicts "the points comprising the occlusion map [of Fig. 4] ***mapped onto the facing surface of lower tooth 22***." *Id.*, 5:56-58 (emphasis added).

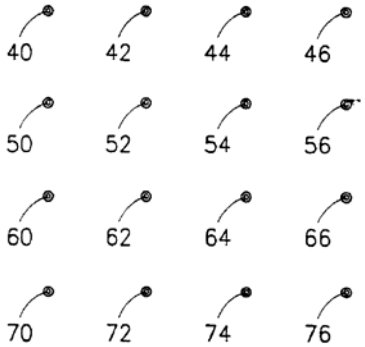


Fig. 4 of the '853 Patent

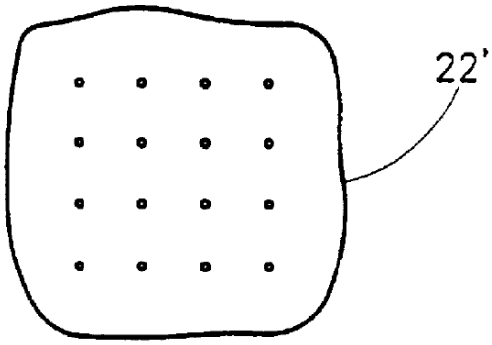


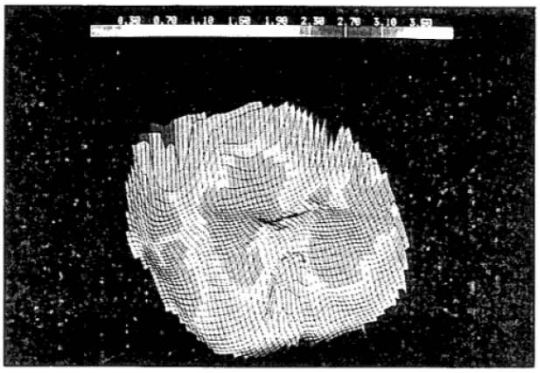
Fig. 5 of the '853 Patent

Ex.1001, Figs. 4, 5. The only difference between the occlusion map (shown in Fig. 4) and the occlusion map that is mapped onto the facing surface of the lower tooth (shown in Fig. 5) is the outline 22' of the lower tooth 22. *Id.* Thus, according to

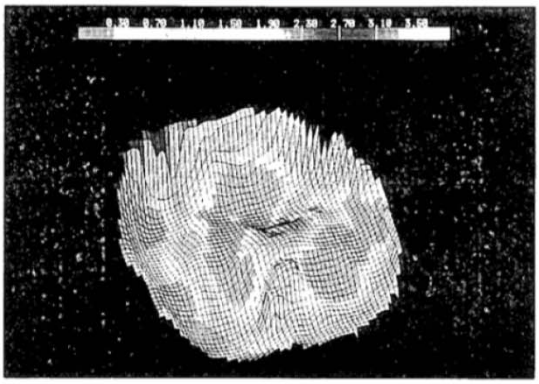
the ’853 Patent, the term “facing surface of said facing surfaces of opposite teeth” is satisfied by an outline of a tooth such as that shown in Fig. 5 (outline 22'). Ex.1006, ¶ 106.

b. Hayashi discloses providing distance information with an outline of a tooth.

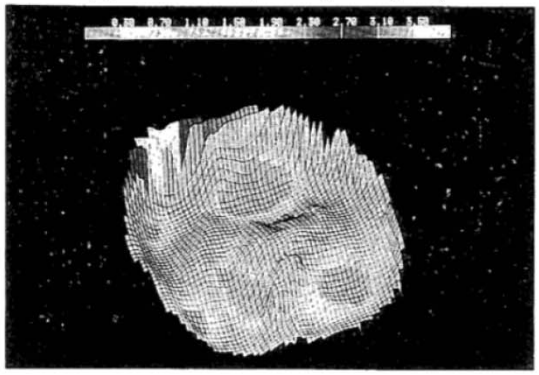
Hayashi discloses providing distance information with an outline of a tooth. Ex.1005, §4.3 (Results and discussion), Figs. 11(a)-(c). Hayashi discloses that Figs. 11(a)-(c) show “changes in the distance map accompanying lateral sliding movement.” *Id.*, 33 (rt. col.). Hayashi discloses that in such figures, the shape of the upper jaw first molar was represented using a wire frame. *Id.*



(a) Intercuspal position



(b) 0.5 mm lateral position (working side)



Figs. 11(a)-(c) of Hayashi

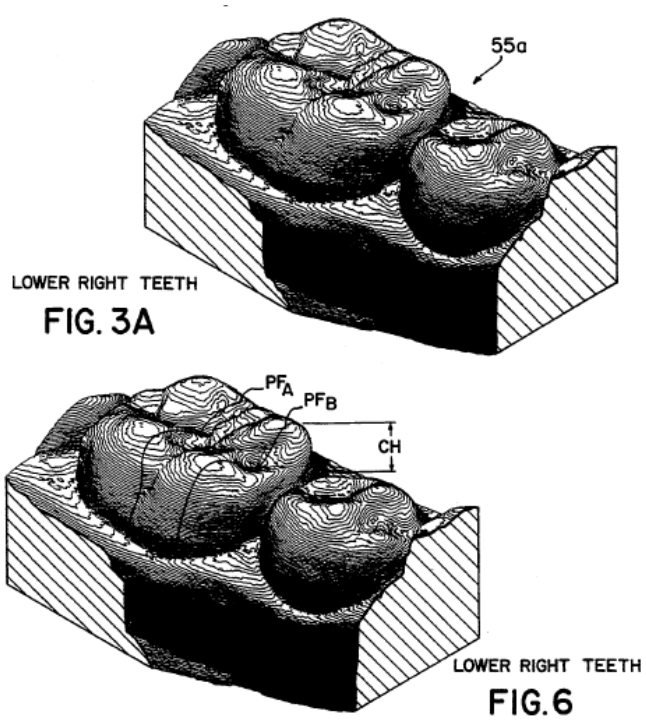
Thus, Hayashi discloses displaying distance information with an outline of a tooth ("wire frame" representing the "upper jaw first molar"). *Id.*, 33 (rt. col.). Ex.1006, ¶ 107.

Like Kunii, Hayashi discloses a distance map that is a graphical representation of the distance between opposite points, or regions, on the surface of

opposite teeth. Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map) (distance map shows distribution of the shortest distances "between a point on the occlusion surface and the opposite occlusion surface"), 30 ("contact relationship for opposing rows of teeth"). Thus, Hayashi's distance map is an occlusion map as claimed. Ex.1006, ¶ 108.

Further, displaying information on a facing surface of a three-dimensional model of a tooth, including a lower facing surface of a tooth, is a well-known and conventional technique. Ex.1010, Fig. 3A, Fig. 6, 24:64-67, and 9:58-61 ("The tooth profile information can be generated using computer analysis or interactive computer imaging from three-dimensional images, if employed, as illustrated in FIG. 3A", "FIG. 6 is an isometric image of a three-dimensional computerized representation, similar to FIG. 2B, of a molar showing the locations of alternative vertical labial-lingual profile planes and tooth profiles.").[5]

[5] Exhibit 1010 (U.S. Patent No. 5,368,478 to Andreiko *et al*) has an issue date of Nov. 29 1994, and therefore constitutes prior art under 35 U.S.C. § 102(b).



Figs. 3A and 6 of Ex.1010

Ex.1006, ¶ 109.

c. It would have been obvious to combine Kunii and Hayashi.

Hayashi, like Kunii, uses distance maps as a means for providing information concerning distances between surfaces of opposing teeth. Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map); Ex.1003, 163 (rt. col.). It would have been obvious to a POSITA at the time of the purported invention to modify Kunii's occlusion map to have an outline of a tooth as disclosed by Hayashi. Kunii recognizes the desirability of providing dentists with "additional information" to assist with treatment of "occlusal orders" and "design of dental restorations." Ex.1003, 163 (left col.). Kunii recognizes that, in

comparison with manual use of hard models of teeth, use of "computer-aided diagnosis" enables dentists to receive "additional information" to assist in "evaluation of dental occlusion." *Id.* Hayashi provides an example of additional information that would be useful to a dentist: an outline of the tooth. A POSITA would have been motivated to modify Kunii's occlusion map to have such additional information (outline of the tooth) because doing so would have provided the dentist with additional information that would assist in evaluation of the dental occlusion. Ex.1006, ¶ 110.

Further, modifying Kunii's occlusion map to have an outline of a tooth merely would have been the obvious combination of known prior art elements (Kunii's occlusion map modified to have an outline of a tooth as disclosed by Hayashi) according to known methods (Hayashi's teaching of displaying distance information with an outline of a tooth) to yield predictable results (displaying the occlusion map with an outline of a tooth). Such a modification merely would have been the use of a known technique (including a "wire frame" of a tooth disclosed by Hayashi) to improve similar methods (Kunii's method of providing an occlusion map) in the same way (the wire frame would be used in Kunii's method in the same way disclosed by Hayashi). A POSITA would have had a reasonable expectation of success because Hayashi discloses that providing distance information with an outline of a tooth is a viable approach to displaying distance

information. A POSITA would have recognized that the technique disclosed by Hayashi would have readily been applied to Kunii because both Hayashi and Kunii relate to techniques for providing distance information of contact areas of opposing teeth. Ex.1006, ¶ 111.

Claim 5 and 7 directly depend from claim 3. The subject matter of claim 3 is satisfied by Hayashi, which would have been obvious to combine with Kunii as discussed above for Claim 3. The resulting combination would include the elements of claim 5 and 7. Ex.1006, ¶ 112.

2. Claims 12 and 13 Would Have Been Obvious.

Claims 12 and 13 would have been obvious over Kunii in view of Hayashi. Kunii discloses each element of claim 1 from which claims 12 and 13 directly depend. Section VII.A.1. As discussed in Section VII.C.2.a. below, the prior art discloses each feature of claim 12. As discussed in Section VII.C.2.b. below, the prior art discloses each feature of claim 13. Ex.1006, ¶ 113.

a. Claim 12: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said occlusion map only shows those distances that are less than one tenth of a millimeter.

Hayashi discloses or suggests the subject matter of claim 12. Hayashi discloses displaying a "Region of 0.3 mm or less" and a "Region of 0.5 mm or less." Ex.1005, §3.2 (Quantification of the pairing relationship using a distance

map) ("Figure 4 shows region R (0.3) of 0.3 mm or less and region R (0.5) of 0.5 mm or less on a certain occlusion surface using diagonal lines.")

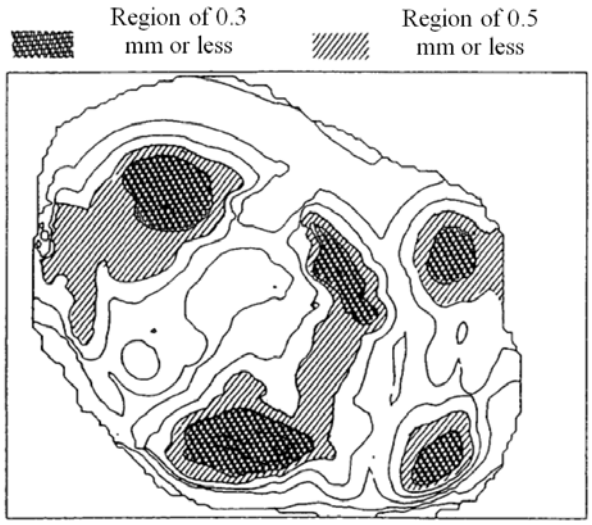


Figure 4 Region R (x) of x mm or less on the occlusion surface R (0.3) and R (0.5) are shown using diagonal lines.

Fig. 4 of Hayashi

See also Ex.1005, §3.3 (Evaluation of the pairing relationship using the proximity) ("The contact region on a certain occlusion surface S will be the region in which the interocclusal distance d on the occlusion surface will be zero. In this case, if the interocclusal distance d is not zero, but is equal to or less than a certain value x mm, it will be possible to target a broader region that includes the contact region."). Ex.1006, ¶ 114.

b. Claim 13: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said occlusion map only shows those distances that are zero in value.

Hayashi discloses or suggests the subject matter of claim 13. As discussed above regarding claim 12, Hayashi discloses displaying a "Region of 0.3 mm or less" and a "Region of 0.5 mm or less." Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map) ("Figure 4 shows region R (0.3) of 0.3 mm or less and region R (0.5) of 0.5 mm or less on a certain occlusion surface using diagonal lines."), Fig. 4. Ex.1006, ¶ 115.

c. Explanation of Why Claims 12 and 13 Would Have Been Obvious

Kunii discloses calculating and graphically displaying occlusion maps ("distance maps" and "distance images") which show distances of various lengths. Ex.1003, 164 (left col.), Fig. 3a, Fig. 3b. Kunii does not explicitly disclose that the occlusion map "only" shows those distances that are less than one tenth of a millimeter (claim 12) and the occlusion map "only" shows those distances that are zero in value (claim 13). Such subject matter would have been obvious in view of Hayashi. Ex.1006, ¶ 116.

As explained above, Hayashi discloses an occlusion map (Fig. 4) that only shows regions of "0.5 mm or less" of which the regions of "0.3 mm or less" are a part:

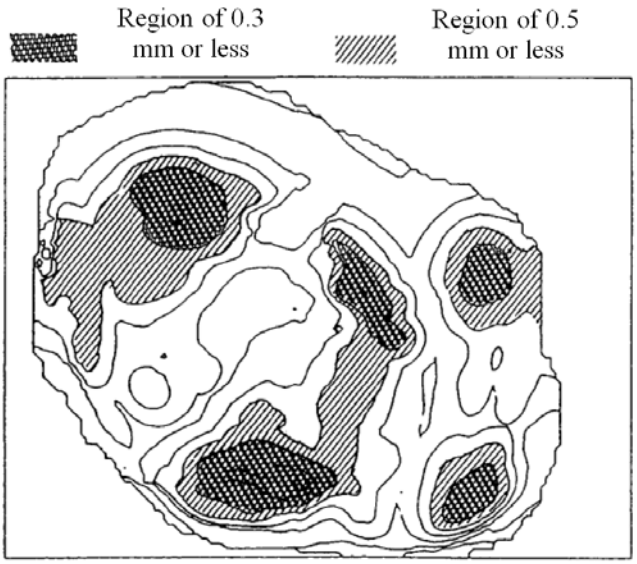


Figure 4 Region R (x) of x mm or less on the occlusion surface R (0.3) and R (0.5) are shown using diagonal lines.

Fig. 4 of Hayashi

Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map). Fig. 4 of Hayashi ***only*** shows regions of "0.5 mm or less" because the regions of "0.3 mm or less" are included in the regions "0.5 mm or less". *Id.* The range of "0.5 mm or less" disclosed by Hayashi encompasses or overlaps the claimed "less than one tenth of a millimeter" and "zero in value." In cases where claimed ranges "overlap or lie inside ranges disclosed by the prior art," a *prima facie* case of obviousness exists. *See In re Wertheim,* 541 F.2d 257 (CCPA 1976). *See also E.I. duPont de Nemours & Co. v. Synvina C.V.*, No. 2017-1977, 2018 U.S. App. LEXIS 26194 (Fed. Cir. Sep. 17, 2018). It therefore would have been obvious to modify Kunii such that the occlusion map only shows those distances that are either less

than one tenth of a millimeter or zero in value, in view of the disclosures of Hayashi. Ex.1006, ¶ 117.

D. Claims 1-3, 5, and 9-11 Are Anticipated By Myszkowski (Ground 4)

For the reasons set forth below, Myszkowski discloses every element of Claims 1-3, 5, and 9-11. Thus, Myszkowski anticipates claims 1-3, 5, and 9-11. Ex.1006, ¶ 118.

1. Claim 1 (preamble): A method for obtaining a dental occlusion map of a three-dimensional virtual computer model of teeth of upper and lower jaws of a mouth, said occlusion map indicative of distances between opposite regions on facing surfaces of opposite teeth of the upper and lower jaws of the mouth, said method comprising the steps of:

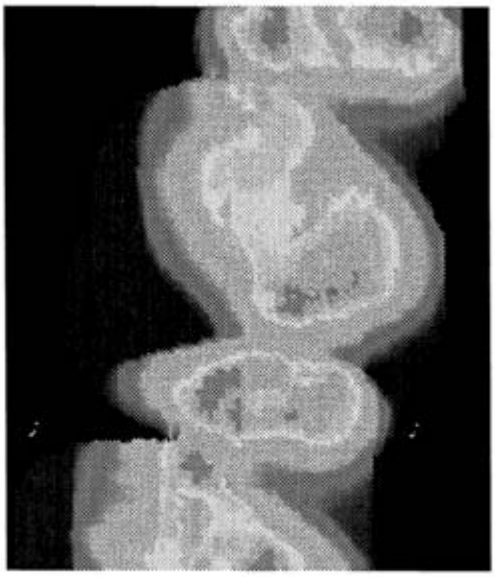
Myszkowski discloses the subject matter of the preamble of Claim 1. Ex.1006, ¶ 119. [6]

"dental occlusion map"

The term "occlusion map" should be construed as "a graphical representation of the distance between opposite points, or regions, on the surface of opposite teeth." *See* Section VI.A. Myszkowski discloses "distance maps between occlusal surfaces of jaws". Ex.1004, Abstract. Myszkowski discloses that "[t]he

[6] Petitioners do not concede that any preamble of the challenged claims is limiting.

distance maps technique is also used for occlusion evaluation between the jaws". *Id.*, §4 (OCCLUSION EVALUATION WITH FGP). Myszkowski's "distance maps" are occlusion maps because they are graphical representations of distances between occlusal surfaces of opposite teeth. Ex.1004, §5 (RESULTS) ("Fig. 7a shows the occlusion between the jaws for static conditions.").



a)

Fig. 7(a) of Myszkowski

Ex.1006, ¶ 120.

"three-dimensional virtual computer model of teeth of upper and lower jaws of a mouth"

Myszkowski relates to "computer-aided design/manufacture of teeth restorations" and "computerized techniques." Ex.1004, ABSTRACT. Myszkowski discloses "distance maps between occlusal surfaces of jaws" are obtained using

"[r]eal-world data" including "the scanned shape of teeth" where "[r]asterizing graphics hardware is used for fast calculation of the distance maps." *Id.*; *see also id.*, §3 (FGP COMPUTATION ALGORITHM) ("In our application we deal with extremely complex surfaces of jaws, approximated by 100,000-500,000 triangles."). A POSITA would have understood that, given that Myszkowski relates to scanned surfaces of physical objects having extremely complex surfaces, the distance maps are of a three-dimensional virtual computer model of teeth of upper and lower jaws of a mouth. *Id.* Ex.1006, ¶ 121.

"said occlusion map indicative of distances between opposite regions on facing surfaces of opposite teeth of the upper and lower jaws of the mouth"

Myszkowski discloses "the computational power of a hardware-implemented z-buffer for calculation of distance maps between the jaws". Ex.1004, §3 (FGP COMPUTATION ALGORITHM). Myszkowski discloses that the "distance maps technique is also used for occlusion evaluation between the jaws". Ex.1004, §4 (OCCLUSION EVALUATION WITH FGP). Ex.1006, ¶ 122.

Myszkowski discloses that a "multi-projection distance map provides immediate information on the placement of collisions on the surface of the restoration, the map of the collision depths, and projection directions in which the minimal distance was registered." Ex.1004, §4 (OCCLUSION EVALUATION WITH FGP). Thus, Myszkowski discloses that the occlusion map is indicative of

distances between opposite regions on facing surfaces of opposite teeth of the upper and lower jaws of the mouth. Ex.1006, ¶ 123.

a. Element [1.1.] (i) determining said distances between opposite regions on opposite teeth of the upper and lower jaws of the mouth; and

Myszkowski discloses the subject matter of [1.1] of Claim 1. Ex.1006, ¶ 124.

Fig. 7a shows of Myszkowski "shows the occlusion between the jaws for static conditions." Ex.1004, §4 (OCCLUSION EVALUATION WITH FGP). Myszkowski discloses that "processing includes the distance map computation and calculation of the minimal distance for every vertex of the reference plane mesh." *Id.* Myszkowski discloses that "[r]egions where the distance to the opponent teeth (FGP) exceeds 1 mm are marked by blue and green colors; the colors between yellow and red correspond to distances below 1 mm; zero distance, i.e., contact between jaws, is pure red. We do not use color interpolation in the contact area here; borders between different tones of yellow and orange correspond to 0.2 mm intervals in distance. *Id.* Ex.1006, ¶ 125.

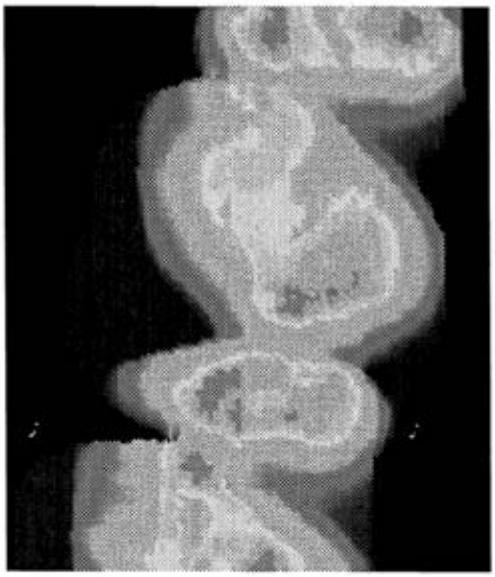
FIG. 7a of Myszkowski is a dental map between occlusal surface of jaws showing determined distances between opposite regions on opposite teeth of the upper and lower jaws of the mouth. Ex.1006, ¶ 126.

b. Element [1.2.] (ii) setting up a correspondence between said determined distances and regions on a mapping surface.

Myszkowski discloses the subject matter of [1.2] of Claim 1. Ex.1006, ¶ 127.

As discussed above in Section VII.A.1.b., according to the '853 Patent, "setting up a correspondence between said determined distances and regions on a mapping surface" encompasses relating a distance to a "corresponding shade on a grey scale, or a corresponding color on a color scale." Ex.1001, 4:42-45, 2:32-39. As explained below, Myszkowski discloses relating a distance to a corresponding color on a color scale. Ex.1006, ¶ 128.

Myszkowski discloses setting up a correspondence between said determined distances and regions on a mapping surface. Ex.1004, §3 (FGP COMPUTATION ALGORITHM) ("Extract from the map distances ***corresponding*** to the vertices of the reference plane mesh."), §5 (RESULTS) ("Fig. 7 presents ***corresponding*** multi-projection distance maps. Regions where the distance to the opponent teeth (FGP) exceeds 1 mm are marked by blue and green colors; the colors between yellow and red ***correspond*** to distances below 1 mm; zero distance, i.e., contact between jaws, is pure red."). Thus, Myszkowski discloses relating a distance to a corresponding color on a color scale.



a)

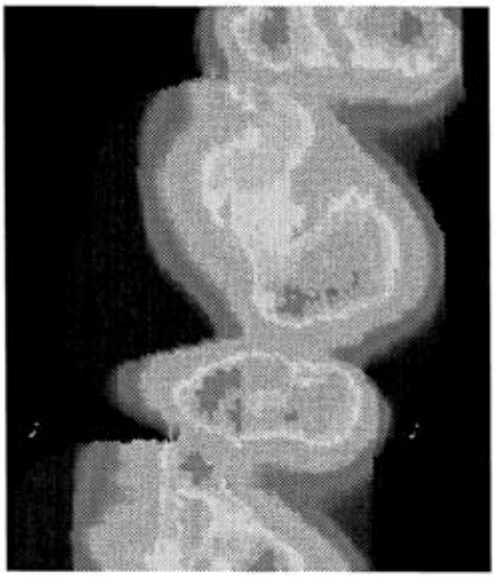
Fig. 7(a) of Myszkowski

Ex.1006, ¶ 129.

2. Claim 2: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said mapping surface is a plane, whereby said dental occlusion map is a two-dimensional map of the distances between said opposite regions on said opposite teeth.

Myszkowski discloses each element of claim 2. Myszkowski discloses each element of claim 1 from which claim 2 depends. Section VII.D.1. Ex.1006, ¶ 130.

Fig. 7a of Myszkowski shows an occlusion map that is a two-dimensional map. Ex.1004. The mapping surface of Fig. 7a is a plane because it is a two-dimensional map.



a)

Fig. 7(a) of Myszkowski

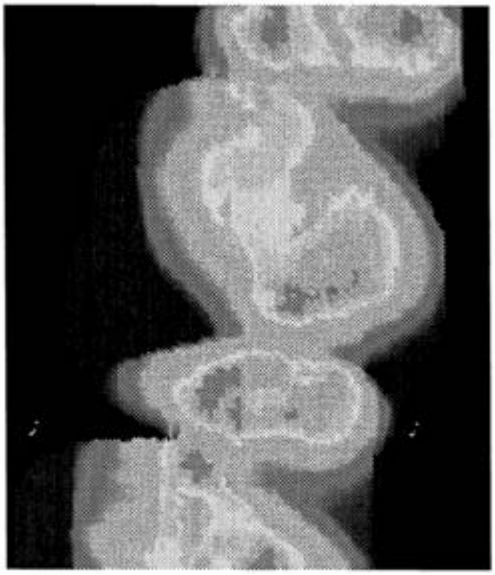
Ex.1006, ¶ 131.

The ’853 Patent does not require the plane to be visible. Ex.1001, 2:60 (“FIG. 4 shows a map onto a plane”, where Fig. 4 merely depicts colored dots). Thus, a plane according to the ’853 Patent can be a two-dimensional space in which the occlusion map resides (as in Fig. 4), and Myszkowski discloses such a two-dimensional space. Ex.1004, Fig. 7a (“Fig. 7a shows the occlusion between the jaws for static conditions.”). Ex.1006, ¶ 132.

3. Claim 3: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said mapping surface is a facing surface of said facing surfaces of opposite teeth of the upper and lower jaws of the mouth.

Myszkowski discloses each element of claim 3. Myszkowski discloses each element of claim 1 from which claim 3 depends. Section VII.D.1. Ex.1006, ¶133.

Myszkowski discloses "occlusion evaluation for the upper left first molar tooth (Fig. 6b) which simulates a dental restoration of the crown. Fig. 7 presents corresponding multi-projection distance maps." Ex.1004, §5 (RESULTS). Fig. 7a of Myszkowski is an occlusion distance map for occlusion evaluation for the upper left first molar tooth. *See id*. Accordingly, the mapping surface of Fig. 7a is a facing surface of the upper left first molar tooth. The upper left first molar tooth is a tooth of the upper jaw of the mouth. *Id.*



a)

Fig. 7(a) of Myszkowski

Ex.1006, ¶ 134.

4. Claim 5: The method for obtaining a dental occlusion map in accordance with claim 3, wherein said facing surface belongs to the teeth of said upper jaw, and said lower teeth and lower jaw are not present.

Myszkowski discloses each element of claim 5. Myszkowski discloses each element of claim 1 from which claim 3 depends, as well as every element of claim 3 from which claim 5 depends. Sections VII.D.1. and VII.D.3 Ex.1006, ¶135.

As explained with respect to claim 3 above, the mapping surface of Fig. 7a of Myszkowski is a facing surface of the upper left first molar tooth. Ex.1004,, §5 (RESULTS). In Fig. 7a, the lower teeth and lower jaw are not present. Accordingly, Fig. 7a of Myszkowski is an occlusion map having a mapping surface that is a facing surface of the teeth of the upper jaw, and the lower teeth and lower jaw are not present. Ex.1006, ¶ 136.

5. Claim 9: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said opposite regions on said facing surfaces of opposite teeth are colored in accordance with a given color scale and wherein each color corresponds to a given distance.

Myszkowski discloses each element of claim 9. Myszkowski discloses each element of claim 1 from which claim 9 depends. Section VII.D.1. Ex.1006, ¶ 137.

Fig. 7 of Myszkowski presents corresponding multi-projection distance maps where "[r]egions where the distance to the opponent teeth (FGP) exceeds 1 mm are marked by blue and green colors; the colors between yellow and red

correspond to distances below 1 mm; zero distance, i.e., contact between jaws, is pure red." Ex.1004, §5 (RESULTS). Accordingly, Myszkowski discloses said opposite regions on said facing surfaces of opposite teeth are colored in accordance with a given color scale and wherein each color corresponds to a given distance. Ex.1006, ¶ 138.

6. Claim 10: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said opposite regions on said facing surfaces of opposite teeth are points.

Myszkowski discloses each element of claim 10. Myszkowski discloses each element of claim 1 from which claim 10 depends. Section VII.D.1. Ex.1006, ¶ 139.

Myszkowski discloses "us[ing] the computational power of a hardware-implemented z-buffer for calculation of distance maps between the jaws" and "[s]elect[ing] the projection direction for z-buffer calculations (the orthographic parallel projection is used as the method of rendering). Ex.1004, §3 (FGP COMPUTATION ALGORITHM). Myszkowski discloses "the direction perpendicular to the occlusal plane is usually chosen." *Id.* Ex.1006, ¶ 140.

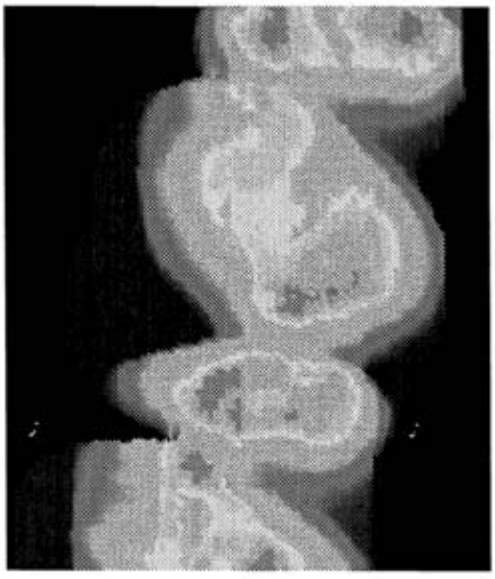
Choosing the perpendicular direction to the occlusal plane for z-buffer calculations will result in determining distances between points of opposite teeth. Ex.1006, ¶ 141.

7. Claim 11: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said regions on said mapping surface comprise at least one pixel.

Myszkowski discloses each element of claim 11. Myszkowski discloses each element of claim 1 from which claim 11 depends. Section VII.D.1. Ex.1006, ¶ 142.

Fig. 7 of Myszkowski presents corresponding multi-projection distance maps where "[r]egions where the distance to the opponent teeth (FGP) exceeds 1 mm are marked by blue and green colors; the colors between yellow and red correspond to distances below 1 mm; zero distance, i.e., contact between jaws, is pure red." Ex.1004, §5 (RESULTS). An image is made up of pixels. Ex.1006, ¶ 143.

The regions shown in Fig. 7a of Myszkowski comprise at least one pixel.



a)

Fig. 7(a) of Myszkowski

Ex.1006, ¶ 144.

E. Claims 12 and 13 Would Have Been Obvious Over Myszkowski in View of Hayashi (Ground 5)

Claims 12 and 13 would have been obvious over Myszkowski in view of Hayashi. Myszkowski discloses each element of claim 1 from which claims 12 and 13 directly depend. Section VII.D.1. As discussed below, Hayashi discloses or suggests each feature of claims 12 and 13. Ex.1006, ¶ 145.

1. Claim 12: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said occlusion map only shows those distances that are less than one tenth of a millimeter.

Hayashi discloses or suggests the subject matter of claim 12. Hayashi discloses displaying a "Region of 0.3 mm or less" and a "Region of 0.5 mm or less." Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map) ("Figure 4 shows region R (0.3) of 0.3 mm or less and region R (0.5) of 0.5 mm or less on a certain occlusion surface using diagonal lines.")

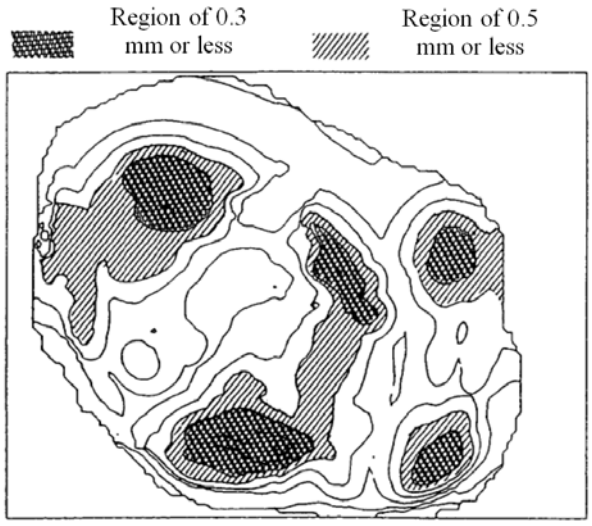


Figure 4 Region R (*x*) of *x* mm or less on the occlusion surface R (0.3) and R (0.5) are shown using diagonal lines.

Fig. 4 of Hayashi

See also Ex.1005, §3.3 (Evaluation of the pairing relationship using the proximity)("The contact region on a certain occlusion surface S will be the region in which the interocclusal distance d on the occlusion surface will be zero. In this case, if the interocclusal distance d is not zero, but is equal to or less than a certain value x mm, it will be possible to target a broader region that includes the contact region."). Ex.1006, ¶ 146.

2. Claim 13: The method for obtaining a dental occlusion map in accordance with claim 1, wherein said occlusion map only shows those distances that are zero in value.

Hayashi discloses or suggests the subject matter of claim 13. As discussed above regarding claim 12, Hayashi discloses displaying a "Region of 0.3 mm or less" and a "Region of 0.5 mm or less." Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map) ("Figure 4 shows region R (0.3) of 0.3

mm or less and region R (0.5) of 0.5 mm or less on a certain occlusion surface using diagonal lines."), Fig. 4. Ex.1006, ¶ 147.

3. Explanation of Why Claims 12 and 13 Would Have Been Obvious

Myszkowski does not explicitly disclose that the occlusion map "only" shows those distances that are less than one tenth of a millimeter (claim 12) and the occlusion map "only" shows those distances that are zero in value (claim 13). Such subject matter would have been obvious in view of Hayashi. Ex.1006, ¶ 148.

As explained above, Hayashi discloses an occlusion map (Fig. 4) that only shows regions of "0.5 mm or less" of which the regions of "0.3 mm or less" are a part:

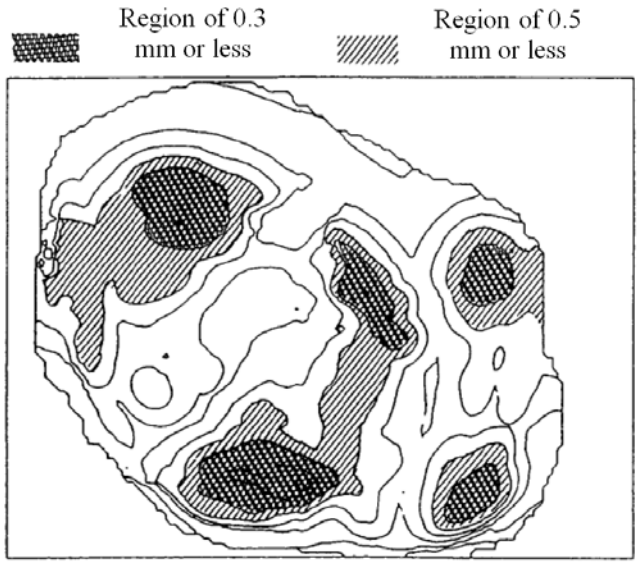


Figure 4 Region R (x) of x mm or less on the occlusion surface R (0.3) and R (0.5) are shown using diagonal lines.

Fig. 4 of Hayashi

Ex.1005, §3.2 (Quantification of the pairing relationship using a distance map). Fig. 4 of Hayashi ***only*** shows regions of "0.5 mm or less" because the regions of "0.3 mm or less" are included in the regions "0.5 mm or less". *Id.* The range of "0.5 mm or less" disclosed by Hayashi encompasses or overlaps the claimed "less than one tenth of a millimeter" and "zero in value." In cases where claimed ranges "overlap or lie inside ranges disclosed by the prior art," a *prima facie* case of obviousness exists. *See In re Wertheim,* 541 F.2d 257 (CCPA 1976). *See also E.I. duPont de Nemours & Co. v. Synvina C.V.*, No. 2017-1977, 2018 U.S. App. LEXIS 26194 (Fed. Cir. Sep. 17, 2018). It therefore would have been obvious to modify Kunii such that the occlusion map only shows those distances that are either less than one tenth of a millimeter or zero in value, in view of the disclosures of Hayashi. Ex.1006, ¶ 149.

VIII. OTHER CONSIDERATIONS

A. Any Purported Secondary Considerations Evidence Does Not Overcome the Strong Evidence of the Obviousness

Petitioners are not aware of any secondary considerations evidence that Patent Owner may assert. As illustrated above, all the elements of the challenged claims are known in the art, and any differences between the claims of the '853 Patent and Kunii and Myszkowski would have been obvious to a POSITA based on the disclosures of the applied references and the knowledge in the art. Any secondary considerations evidence Patent Owner may offer in this proceeding

would be insufficient to overcome the strong evidence of obviousness of the challenged claims. Ex.1006, ¶ 150.

B. Discretion to Institute

The PTAB should not deny this Petition under § 314(a) for two reasons. First, Petitioners have not challenged the '853 Patent in any prior AIA trial proceeding. Based on a review of Docket Navigator® data, the '853 Patent has not been challenged in any prior AIA trial proceeding. This Petition is not a "follow-on" petition as was the case in *General Plastic*.

Second, events in the District Court Litigation and ITC Investigation do not warrant denial. The District Court Litigation is stayed. Exs. 1008, 1009. Discovery and trial have not yet occurred in the District Court Litigation. Further, parties are not awaiting any disposition concerning the '853 Patent in the ITC Investigation. While Patent Owner initially asserted the '853 Patent in the ITC Investigation, Patent Owner filed a motion for partial termination with respect to the '853 Patent, and the ITC granted the motion. Ex.1015, 2. *See also* Ex.1016, 1 ("The investigation was terminated as to the '853 and '175 patents…based on the withdrawal of Align's allegations"). Thus, the economy, the integrity of the patent system, and the efficient administration of the Office do not warrant denial.

The PTAB should not deny this Petition under § 325(d). The same or substantially the same prior art or arguments were not previously presented to the

Office. None of the applied references (Kunii, Hayashi, Myszkowski) was made of record during any PTO proceeding involving the '195 application (which issued as the '853 patent) or in any application related to the '853 patent. Nor were the combinations of references presented in this Petition previously considered by the Office. Thus, denial under § 325(d) is not warranted.

IX. CONCLUSION

For at least the reasons given above, claims 1-3, 5, 7, and 9-13 of the '853 Patent are unpatentable. Petitioners have shown a likelihood of success on the merits. Therefore, this Petition should be granted and the Board should institute trial.

Respectfully submitted,

Date: November 12, 2018

By: /Todd R. Walters/

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Counsel for Petitioners

APPENDIX A - LIST OF EXHIBITS

EXHIBIT	DESCRIPTION
1001	U.S. Patent No. 6,334,853, issued on January 1, 2002 to Avi Kopelman *et al.* ("the '853 Patent")
1002	File History of U.S. Patent Application No. 09/424,195, filed on November 19, 1999 (U.S. Patent No. 6,334,853)
1003	Tosiyasu Kunii *et al.*, "*Evaluation of Human Jaw Articulation*", in COMPUTER ANIMATION '95 PROCEEDINGS, edited by Demetri Terzopoulos and Daniel Thalmann (pp. 163-171), Los Alamitos, CA: IEEE Computer Society Press, 1995 ("Kunii")
1004	Karol Myszkowski *et al.*, "*Visualization and analysis of occlusion for human jaws using a 'Functionally Generated Path*," PROCEEDINGS OF SPIE 2656, VISUAL DATA EXPLORATION AND ANALYSIS III, 8 March 1996 (pp. 360-367), Bellingham, WA: Society of Photo-optical Instrumentation Engineers, 1996 ("Myszkowski")
1005	Toyohiko Hayashi *et al.*, "*Three-Dimensional Analysis of Tooth Occlusion Using Distance Map*", Edited by the Society of Biomechanisms Japan, BAIOMEKANIZUMU, vol. 12 (1994): 27-37 ("Hayashi")
1006	Declaration of Parris Egbert, Ph.D.
1007	*Curriculum Vitae* of Parris Egbert, Ph.D.
1008	Stipulation and [Proposed] Order for Stay [Doc 19] filed on January 23, 2018 in *Align v. 3Shape*, Civ. Action No. 1:17-cv-01648
1009	PACER Docket Sheet, *Align v. 3Shape*, Civ. Action No. 1:17-cv-01648 (downloaded on October 12, 2018)
1010	U.S. Patent No. 5,368,478 to Andreiko *et al* ("Andreiko")

EXHIBIT	DESCRIPTION
1011	Tosiyasu Kunii *et al.*, "*Evaluation of Human Jaw Articulation*", Repository of The University of Aizu (pp. 1-13) ("Kunii-color" or "color version of Kunii")
1012	Declaration of Eric Pepper
1013	Declaration of Sylvia D. Hall-Ellis, Ph.D.
1014	*Curriculum Vitae* of Sylvia D. Hall-Ellis, Ph.D.
1015	Order No. 7, Initial Determination Terminating Investigation as to U.S. Patent No. 6,334,853, ITC Inv. No. 337-TA-1090, Mar. 7, 2018
1016	Order No. 32, Markman Order, ITC Inv. No. 337-TA-1090, Sep. 25, 2018

APPENDIX B – ADDITIONAL REAL PARTIES-IN-INTEREST

Allan Junge Hyldal	Lars Henrik Jakobsen
Anders Gaarde	Lars Henriksen
Anders Kjær-Nielsen	Lei Zhang
Anja Engblad	Lene Nørgaard
Birk Plönnings	Lise Thorning Christensen
Bo Esbech	Mads Brøkner Christiansen
Bruce Frederic Mendel	Martin Baltzer
Carsten Nørrevang Mogensen	Michael Bing
Casper Rasmussen	Michael Pedersen
Christian Lysholdt Dünweber	Michael Vinther
Christian Pejrup	Miguel Dovalo
Christophe Barthe	Mikael Toxværd Petersen
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Daniel Grest	Mikkel Ninn-Grønne
David Fischer	Morten Bonding Granlund
Deichmann Media ApS	Morten Nordsted Jacobsen
Dorota Lebiedowicz	Morten Rudkjær Schrøder
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Esben Rosenlund Hansen	Morten Trouplin Nørholm
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Herman Scherling	Rasmus Kjær
Iain McLeod	Remek Nalecz
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Jens Paldam	Rune Fisker
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Jesper Simonsen	Sophie Ellersgaard
Jesper Østerbye	Steen Frost Tofthøj
Joaquin Londono	Stefan Elmsted Jensen
Karl Josef Hollenbeck	Sven Nonboe
Kasper Egdø	Søren Greve Jensen
Kasper Kabell Kristensen	Søren Maagaard Olsen
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Klaus Rudbæk Høj	Thomas Geoffrey Moon
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Kristian Worziger Nielsen	Tim Trækjær
Kristine Slot	Tommy Sanddal Poulsen
Krzysztof Christopher Adamus	Ye Jin
Lars Christian Lund	Zhengjie Li

CERTIFICATE OF COMPLIANCE WITH 37 C.F.R. § 42.24

I hereby certify that the word count for the foregoing Petition totals 13,295 words, excluding the parts which are exempted by 37 C.F.R. § 42.24(a)(1).

Date: November 12, 2018

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CERTIFICATE OF FILING AND SERVICE

The undersigned hereby certifies that on this 12th day of November, 2018, a true and correct copy of the foregoing **PETITION FOR *INTER PARTES* REVIEW FOR U.S. PATENT NO. 6,334,853 PURSUANT TO 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42.100 *et seq.*** and **EXHIBITS 1001-1016** were filed via PTAB E2E and served by UPS on the correspondence address of record for **U.S. Patent No. 6,334,853** as follows:

Fitch, Even, Tabin, and Flannery
120 South LaSalle Street, Suite 1600
Chicago, IL 60603

and courtesy copies are being served by UPS to litigation counsel as follows:

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