

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

ALIGN TECHNOLOGY, INC.,
Patent Owner.

IPR2019-00151
Patent 8,638,448 B2

Before BRIAN J. McNAMARA, NEIL T. POWELL, and
ELIZABETH M. ROESEL, *Administrative Patent Judges*.

POWELL, *Administrative Patent Judge*.

DECISION
Final Written Decision
Determining No Challenged Claim Unpatentable
Dismissing in Part and Denying in Part Petitioner's Motion to Exclude
35 U.S.C. § 318(a) and 37 C.F.R. § 42.4(a)

I. INTRODUCTION

Petitioner filed a Petition (Paper 3, “Pet.”) requesting an *inter partes* review of claims 15–30 of U.S. Patent No. 8,638,448 B2 (Ex. 1001, “the ’448 patent”). Patent Owner filed a Preliminary Response. Paper 9 (“Prelim. Resp.”). In view of those submissions, we instituted an *inter partes* review of claims 15–30 of the ’448 patent. Paper 10 (“Institution Decision” or “Inst. Dec.”). Subsequent filings include a Patent Owner Response (Paper 20, “PO Resp.”), a Petitioner Reply (Paper 25, “Pet. Reply”), and a Patent Owner Sur-reply (Paper 29, “Sur-reply”). Additionally, Petitioner filed a Motion to Exclude Evidence (Paper 34, “Mot.”), Patent Owner filed an Opposition to Petitioner’s Motion to Exclude Evidence (Paper 35, “Opp.”), and Petitioner filed a Reply in Support of Motion to Exclude Evidence (Paper 37, “Mot. Reply”). An oral hearing was held on April 15, 2020, and a copy of the transcript was entered into the record. Paper 41.

We have jurisdiction over this proceeding under 35 U.S.C. § 6(b). After considering the evidence and arguments of the parties, we determine that Petitioner has not proven by a preponderance of the evidence that claims 15–30 of the ’448 patent are unpatentable. *See* 35 U.S.C. § 316(e). We issue this Final Written Decision pursuant to 35 U.S.C. § 318(a).

II. BACKGROUND

A. Related Matters

The parties identify the following civil action and investigation:

Align Technology, Inc. v. 3Shape A/S, Civil Action No. 1:17-cv-01648 (D. Del., filed Nov. 14, 2017); and

*In the Matter of Certain Intraoral Scanners and Related
Hardware and Software*, Inv. No. 337-TA-1090 (U.S. Int'l Trade
Comm'n, complaint filed Nov. 14, 2017).

Pet. 2; Paper 5, 1.

B. The Asserted Grounds of Unpatentability

Petitioner contends that claims 15–30 of the '448 patent are
unpatentable based on the following grounds:

Claims Challenged	35 U.S.C. §	References/Basis
15–18	103(a) ¹	Picard ² , Ishihara ³
15–19, 21	103(a)	Tiziani ⁴ , Gmitro ⁵ , Ishihara, Kino ⁶

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287 (2011), amended 35 U.S.C. § 103. Because the application from which the '448 patent issued was filed before March 16, 2013, the effective date of the relevant amendment, the pre-AIA version of § 103 applies.

² French Patent Application No. FR 2707018 B1, pub. Dec. 30, 1994 (Ex. 1003).

³ U.S. Patent No. 5,737,084, iss. Apr. 7, 1998 (Ex. 1007).

⁴ H.J. Tiziani et al., *Theoretical analysis of confocal microscopy with microlenses*, 35 APPLIED OPTICS 120–25 (1996) (Ex. 1004).

⁵ Arthur F. Gmitro & David Aziz, *Confocal microscopy through a fiber-optic imaging bundle*, 18 OPTICS LETTERS 565–67 (1993) (Ex. 1005).

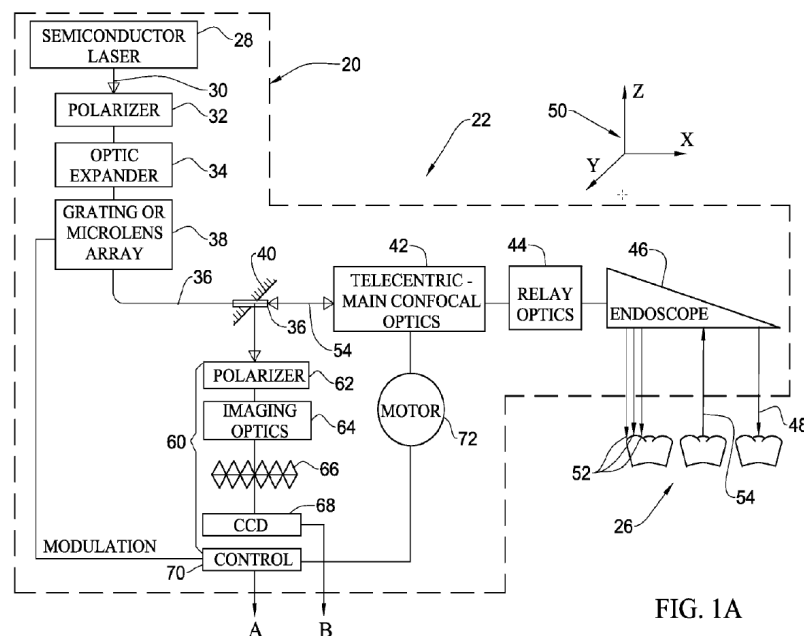
⁶ Kino et al., WO 88/07695 A1, pub. Oct. 6, 1988 (Ex. 1006).

Claims Challenged	35 U.S.C. §	References/Basis
20, 22–30	103(a)	Tiziani, Gmitro, Ishihara, Kino, Watson ⁷

Petitioner also relies on Declarations of Alexander Sergienko, Ph.D. Exs. 1008, 1037. Patent Owner relies on the Declaration of David Aikens. Ex. 2019.

C. The '448 Patent

The '448 patent relates to an apparatus and method for imaging three-dimensional structures like teeth without contact. Ex. 1001, 1:34–37. Figures 1A and 1B of the '448 patent are reproduced below.



⁷ T. F. Watson et al., *In vivo confocal microscopy in clinical dental research: an initial appraisal*, 20 J. DENT. 352–58 (1992) (Ex. 1010).

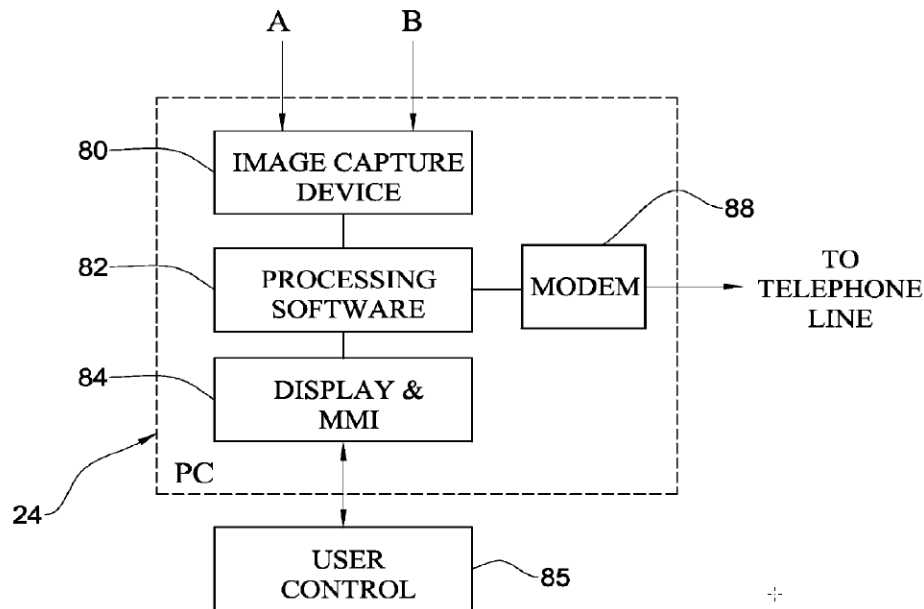


FIG. 1B

Figures 1A and 1B show apparatus 20, which includes optical device 22 (shown in Figure 1A) and processor 24 (shown in Figure 1B). *Id.* at 5:16–19.

Optical device 22 includes semiconductor laser unit 28, polarizer 32, optic expander 34, module 38, partially transparent mirror 40, confocal optics 42, relay optics 44, and endoscopic probing member 46, detection optics 60, control module 70, and motor 72. *Id.* at 5:32–64, 6:40–42, 6:56–58, Fig. 1A. Detection optics 60 include polarizer 62, imaging optic 64, matrix 66, and CCD camera 68. *Id.* at 6:40–50, Fig. 1A. The '448 patent discloses that “[m]otor 72 is linked to telecentric confocal optics 42 for changing the relative location of the focal plane of the optics 42 along the Z-axis.” *Id.* at 6:58–60.

Processor 24 includes imaging capture module 80, CPU 82, display 84, and modem 88. *Id.* at 6:56–7:22, Fig. 1B. Modem 88 may transmit data through telephone line 90. *Id.* at 7:17–22.

Apparatus 20 “is particularly useful for determining the three-dimensional structure of a teeth segment 26.” *Id.* at 5:16–21. Semiconductor laser unit 28 emits “laser light, as represented by arrow 30.” *Id.* at 5:32–34. The light travels through polarizer 32, optic expander 34, and module 38. *Id.* at 5:34–39. Module 38 “may, for example, be a grating or a micro lens array which splits the parent beam 30 into a plurality of incident light beams 36, represented here, for ease of illustration, by a single line.” *Id.* at 5:39–44. Partially transparent mirror 40 includes a small central aperture and permits transmission of the laser light through downstream optics. *Id.* at 5:45–47.

Endoscopic probing member 46 typically includes a light-transmitting medium, as well as a mirror that sends the light beams toward teeth segment 26. *Id.* at 6:5–12. “[E]ndoscope 46 thus emits a plurality of incident light beams 48 impinging on to the surface of the teeth section.” *Id.* at 6:13–14. “Incident light beams 48 form an array of light beams arranged in an X-Y plane, in the Cartesian frame 50, propagating along the Z axis.” *Id.* at 6:15–17. Light beams 48 illuminate spots 52 “at different (X_i , Y_i) locations.” *Id.* at 6:15–20.

From each illuminated spot 52, light reflects in a direction opposite incident light beams 48 in the Z direction. *Id.* at 6:36–39. “Given the unsymmetrical properties of mirror 40, the returned light beams are reflected in the direction of the detection optics generally designated 60.” *Id.* at 6:40–

42. After polarization in polarizer 62, returned light beams 54 travel through imaging optic 64, “typically a lens or a plurality of lenses, and then through a matrix 66 comprising an array of pinholes. CCD camera has a matrix [of] sensing elements each representing a pixel of the image and each one corresponding to one pinhole in the array 66.” *Id.* at 6:40–50. “[E]ach light intensity measured in each of the sensing elements of the CCD camera, is then grabbed and analyzed . . . by processor 24.” *Id.* at 6:52–55.

Because of the uneven surface of teeth segment 26, different spots 52 where different light beams 48 contact teeth segment 26 will be in different positions along the Z axis. *Id.* at 6:16–19. Therefore, the light at one spot 52 may be in focus, while the light at other spots 52 may be out of focus. *Id.* at 6:19–21. “[T]he light intensity of the returned light beams . . . of the focused spots will be at its peak, while the light intensity at other spots will be off peak.” *Id.* at 6:21–24.

Using this effect, the ’448 patent discloses determining the three-dimensional shape of teeth segment 26. Control unit 70 cause motor 72 to move optical element 42 to move the focal plane location. *Id.* at 6:60–62. Subsequently, control unit 70 causes laser 28 to produce a pulse of light while “synchroniz[ing] image-capturing module 80 to grab data representative of the light intensity from each of the sensing elements.” *Id.* at 6:63–67. “Then in subsequent sequences the focal plane will change in the same manner and the data capturing will continue over a wide focal range of optics 44.” *Id.* at 6:67–7:3. Therefore, “by determining the Z_i , corresponding to the maximal light intensity or by determining the maximum displacement derivative of the light intensity, for each pixel, the

relative position of each light spot along the Z axis can be determined.” *Id.* at 7:8–12. This allows obtaining data representative of the three-dimensional shape of teeth segment 26. *Id.* at 7:12–14.

D. Illustrative Claim

Claims 15 and 23 are independent. Each of claims 16–22 and 24–30 depends, directly or indirectly, from one of independent claims 15 and 23. Claim 15 is illustrative and recites:

15. An apparatus for determining surface topology of at least a portion of a three-dimensional structure, the apparatus comprising:

a probing member comprising a probing end;

an illumination unit configured to generate a plurality of incident light beams for illuminating the portion of the three-dimensional structure;

an optical system configured to focus the plurality of incident light beams at a plurality of focal planes forward of the probing end;

a detector unit configured to measure intensities of a plurality of returned light beams that are generated from illuminating the portion of the three-dimensional structure with the plurality of incident light beams; and

a processor coupled to the detector unit and configured to determine a surface topology of the three-dimensional structure based at least in part on the measured intensities of the plurality of returned light beams.

Ex. 1001, 10:3–21.

III. ANALYSIS

A. Claim Construction

In an *inter partes* review filed before November 13, 2018, generally, claim terms in an unexpired patent are given their broadest reasonable

construction in light of the specification of the patent. 37 C.F.R. § 42.100(b) (2016). In this proceeding, however, pursuant to our authorization, Patent Owner filed an unopposed Motion & Certification for District Court (*Phillips*) Claim Construction, certifying that the challenged patent will expire within eighteen months of the entry of the Notice of Filing Date Accorded to Petition. Paper 6 (“Motion”). We granted Patent Owner’s Motion. Paper 8.

Therefore, we construe the challenged claims under the framework set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–19 (Fed. Cir. 2005) (en banc). Under this framework, claim terms are given their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art, at the time of the invention, in light of the language of the claims, the specification, and the prosecution history of record. *Id.* Only those terms that are in controversy need be construed, and only to the extent necessary to resolve the controversy. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

The Petition proposes constructions for certain claim language. Pet. 10–16. Petitioner’s claim construction positions include assertions that certain claim language invokes 35 U.S.C. § 112, sixth paragraph. *Id.* at 11–13, 15–16. Patent Owner argues Petitioner has not supported adequately certain of the proposed claim constructions. PO Resp. 6–11.

In view of our analysis below, we need not construe expressly any claim language to resolve the parties’ patentability dispute. The Petition’s first challenge asserts obviousness of claims 15–18 over Picard and Ishihara.

Pet. 16–38. As explained in greater detail below in Section III.B.3, this challenge rests on a contention that it would have been obvious to modify Picard to use telecentric optics like those taught in Ishihara. *Id.* at 31–38. With respect to the challenge of claims 15–18 over Picard and Ishihara, the Petition does not explain any theory of unpatentability that does not rely on the assertion that it would have been obvious to modify Picard with telecentric optics based on Ishihara. *Id.* at 16–38. Thus, the merits of this challenge inextricably depend on whether Petitioner has demonstrated adequately that it would have been obvious to modify Picard with telecentric optics based on Ishihara. For the reasons explained below in Section III.B.3, Petitioner has not done so. Therefore, Petitioner’s challenge of claims 15–18 over Picard and Ishihara fails for reasons unrelated to claim construction.

The Petition’s second challenge asserts obviousness of claims 15–19 and 21 over Tiziani, Ishihara, Gmitro, and Kino. Pet. 38–62. As explained in greater detail below in Section III.C.4, this challenge rests on a contention that it would have been obvious to modify Tiziani to use a fiber-optic bundle like that taught in Gmitro. *Id.* at 52–54. With respect to the challenge of claims 15–19 and 21 over Tiziani, Ishihara, Gmitro, and Kino the Petition does not explain any theory of unpatentability that does not rely on the assertion that it would have been obvious to modify Tiziani with Gmitro’s fiber-optic bundle. *Id.* at 38–62. Thus, the merits of this challenge inextricably depend on whether Petitioner has demonstrated adequately that it would have been obvious to modify Tiziani with Gmitro’s fiber-optic bundle. For the reasons explained below in Section III.C.4, Petitioner has not done so. Therefore, Petitioner’s challenge of claims 15–19 and 21 over

Tiziani, Ishihara, Gmitro, and Kino fails for reasons unrelated to claim construction.

The Petition's fourth challenge asserts obviousness of claims 20 and 22–30. Pet. 63–76. This challenge builds from the Petition's third challenge and also fails for reasons unrelated to claim construction, specifically the same reasons the Petition's third challenge fails. *See id.; infra* Section III.D.2.

For these reasons, we need not construe expressly any language in the challenged claims to resolve the parties' patentability disputes.

B. Alleged Obviousness over Picard and Ishihara

1. Overview of Picard

Picard discloses an apparatus for acquiring three-dimensional images. Ex. 1003, 1:4–5.⁸ Picard uses confocal imaging. *Id.* at 2:15. Picard discusses a confocal imaging device that uses a Nipkow disk for scanning, as illustrated in Figure 2. *Id.* at 5:12–17, 11:18–19. Figure 2 is reproduced below.

⁸ Picard has two sets of page numbers, including original page numbers (appearing at the tops of the pages) and added page numbers (appearing at the bottoms of the pages). Our citations use the original page numbers.

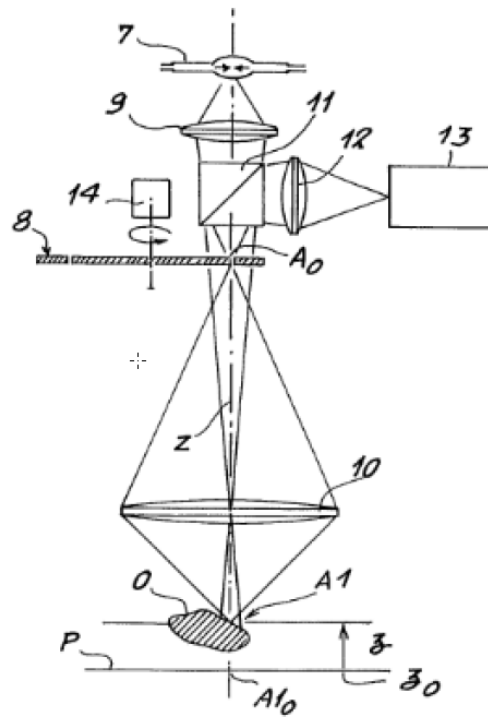


FIG. 2

Figure 2 shows a confocal imaging device that includes arc lamp 7, Nipkow disk 8, focusing lens 9, objective lens 10, separator cube 11, focusing lens 12, and CCD video camera 13. *Id.* at 6:1–8. Figure 2 also shows object O, which is to be observed. *Id.* at 6:4.

Light source 7 lights Nipkow disk 8 through focusing lens 9. *Id.* at 6:1–2. Objective lens 10 casts the image from Nipkow disk 8 onto object O. *Id.* at 6:3–4. Object O reflects light, which passes back through Nipkow disk 8. *Id.* at 6:5. Separator cube 11 allows light passed by Nipkow disk 8 to be directed toward focusing lens 12, which casts the image from Nipkow disk 8 onto CCD video camera 13. *Id.* at 6:6–8. When Nipkow disk 8 is rotated, object O is scanned, and a two-dimensional image is generated at camera 13. *Id.* at 6:9–13.

Picard notes that “the intensity of the image is maximal when the points of the object to be observed are located in the focal plane P of the objective lens 10.” *Id.* at 6:17–18. Picard discusses using this effect to obtain three-dimensional images. *Id.* at 6:19–7:11. Picard explains that the process includes acquiring multiple images of the object at different heights and searching for the maximum light intensity from each of the object’s points to determine the Z position of each of the object’s points. *Id.* at 6:21–7:11 (noting that “the object is moved vertically to do this”).

Picard notes that the number N “represents the number of images necessary to cover the topography of the object” and “the number of acquisitions N can currently reach one hundred, or even one thousand in certain applications.” *Id.* at 7:14–19. Picard explains that “[t]he present invention makes it possible to obtain the three-dimensional image of the object in a single acquisition.” *Id.* at 7:16–17. Picard asserts that “the benefit the present invention can represent is obvious.” *Id.* at 7:19–20.

Picard notes that “four elements make it possible to obtain a three-dimensional image of the observed object, in a single acquisition.” *Id.* at 8:1–6. Those elements include “a polychromatic light source, i.e., one having at least two different wavelengths,” “a confocal imaging system,” “an objective lens having longitudinal chromatism or axial chromatism,” and “a spectral analysis of the light.” *Id.*

Figure 3 of Picard “is a schematic view of a particular embodiment of the device according to the invention.” *Id.* at 11:20–21. Figure 3 is reproduced below.

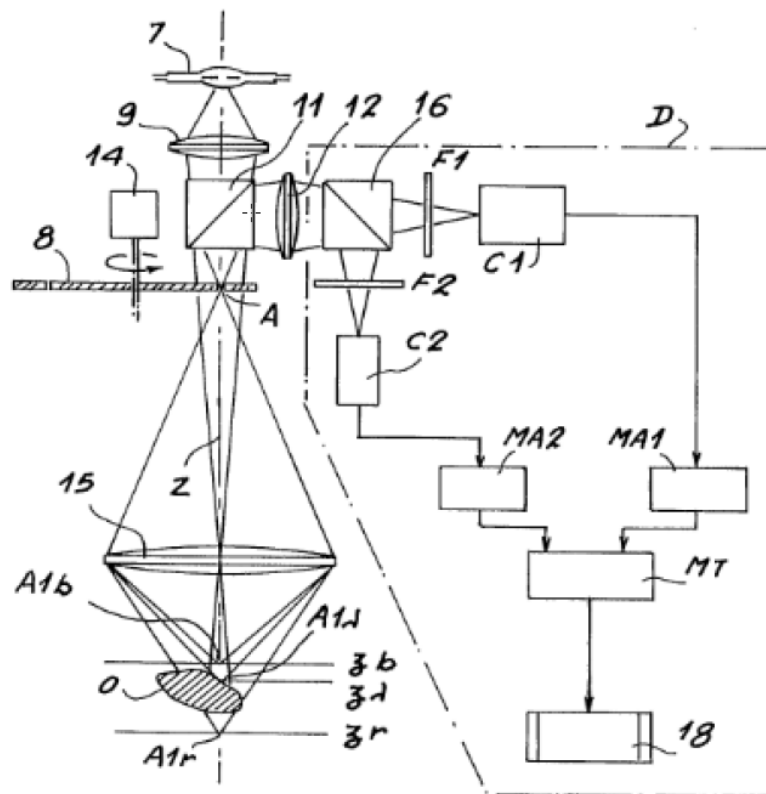


FIG. 3

Figure 3 shows a device that includes broad-spectrum light source 7, Nipkow disk 8, means of rotation 14, lens 9, separator cube 11, focusing lens 12, and objective lens 15. *Id.* at 12:11–22. The device also includes decoding module D, which includes separator cube 16, CCD camera C1, chromatic filter F1, CCD camera C2, chromatic filter F2, electronic card MA1, electronic card MA2, and electronic processing module MT. *Id.* at 15:5–25.

The device shown in Figure 3 is similar to the device shown in Figure 2, but replaces objective lens 10 with objective lens 15, which has an axial chromatism. *Id.* at 12:11–22, Figs. 2, 3. As a result of this axial

chromatism, objective lens 15 “has as many different focal planes as there are wavelengths present in the incident light beam.” *Id.* at 13:8–12.

Figure 8 of Picard “is a schematic and partial view of another device according to the invention utilizing an ordered fiber-optic bundle.” *Id.* at 12:9–10. Figure 8 is reproduced below.

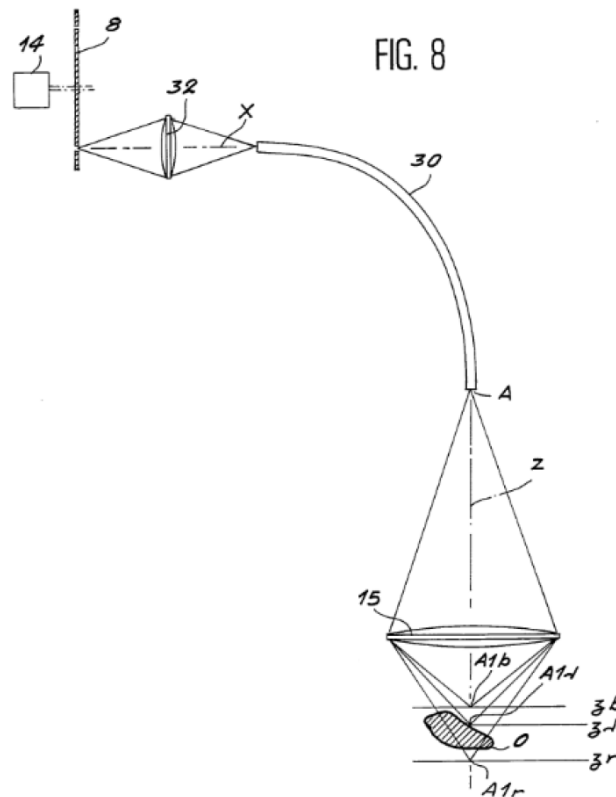


Figure 8 shows a device that “differs from that which is represented in figure 3 by the fact that it further comprises an ordered fiber-optic bundle 30, which can be a pliable endoscope, between the objective lens 15 and the Nipkow disk 8.” *Id.* at 24:10–12.

2. Overview of Ishihara

Ishihara discloses “an arrayed confocal imaging system.” Ex. 1007, 8:8–10. One embodiment of such a system is shown in Figure 5, which is reproduced below. *Id.*

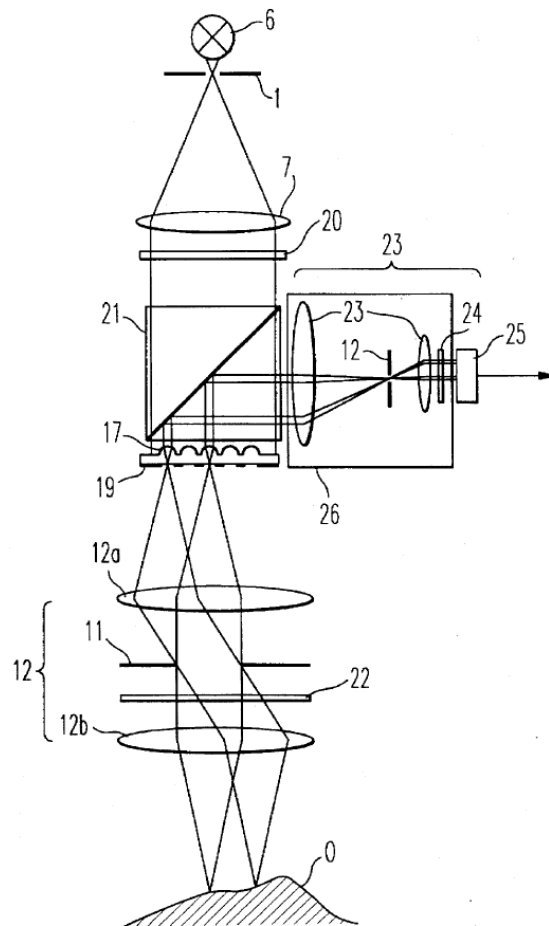


FIG. 5

Figure 5 shows a confocal imaging system that includes light source 6, pinhole 1, collimator lens 7, polarizer 20, light path diverging element 21, microlens array 17, pinhole array 19, objective lens 12, and image forming section 26. *Id.* at 8:10–27, 51–54.

The light from light source 6 travels through the confocal imaging device as follows. The light passes through pinhole 1, collimator lens 7, polarizer 20, light path diverging optical element 21, microlens array 17, pinhole array 19, and objective lens 12. *Id.* at 8:10–43. Light reflected from object O passes through objective lens 12, converges toward pinhole

array 19, gets refracted by microlens array 17, deflects off light path diverging optical element 21, and enters image forming section 26. *Id.* at 8:44–54.

Objective lens 12 includes lenses 12a and 12b, telecentric diaphragm 11, and plate 22. *Id.* at 8:27–29. “[T]he lenses 12a and 12b on each side of the telecentric diaphragm 11 and the telecentric diaphragm 11 make up a telecentric lens which prevents the magnification from being changed if an object O or the imaging system is moved in the direction of the optical axis.” *Id.* at 8:29–34.

Ishihara discusses alternate ways of adjusting focus in the Z direction. Ishihara discusses a “conventional three-dimensional shape measuring apparatus which uses the object stage to change the distance in the Z direction between the object and the object-position-in-focus.” *Id.* at 6:21–24. Ishihara also discusses using “refraction means for changing the object-position-in-focus, instead of the object stage being moved in the Z direction, to change the distance between the object and the object-position-in-focus in the Z direction.” *Id.* at 6:29–34. Ishihara discloses an example of the refraction approach in connection with Figure 11, which is reproduced below.

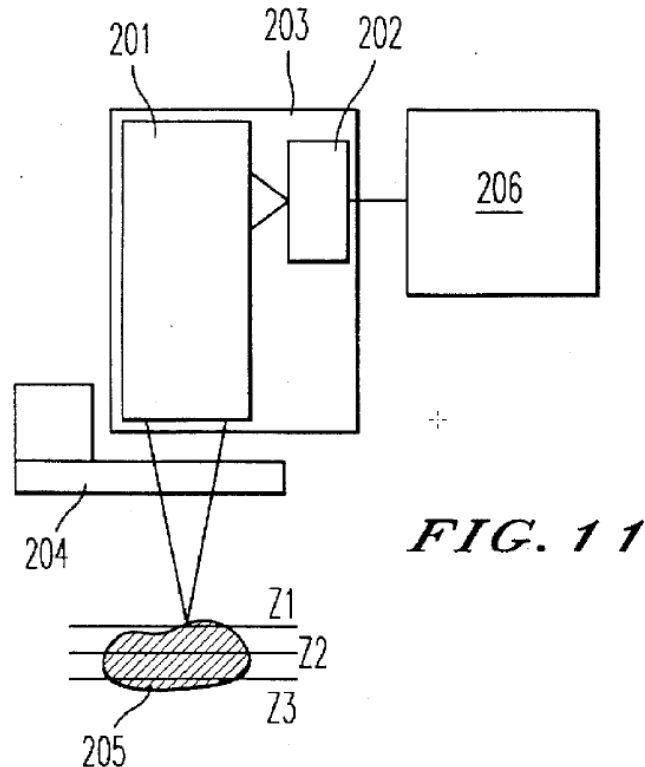


Figure 11 shows confocal imaging system 203 used with refraction means 204. *Id.* at 13:1–15. Refraction means 204 “changes the relative position between the object and the object-position-in-focus in the Z direction, or the position of an object point so that the intensity of the reflected light detected by the confocal imaging system 203 becomes maximum.” *Id.* at 13:10–15.

3. Discussion

The Petition asserts that Picard teaches a device for determining surface topology that meets most of the limitations of claims 15–18. Pet. 16–31. The Petition cites Ishihara when addressing claim 15’s limitation of an “optical system configured to focus the plurality of incident light beams.” *Id.* at 22–24. The Petition asserts that this claim language invokes § 112, sixth paragraph and requires, *inter alia*, “confocal optics

operating in a telecentric mode.”⁹ *Id.* at 22. The Petition notes that “Picard teaches a confocal imaging apparatus (Ex. 1003, Fig. 3), but does not explicitly disclose confocal optics which operate in telecentric mode.” *Id.* at 31. The Petition asserts that Ishihara teaches such confocal optics. *Id.* at 22–23, 31.

The Petition asserts that a person of ordinary skill in the art would have been motivated to modify Picard’s optical system to have confocal optics that operate in telecentric mode. *Id.* at 32–38. The Petition notes that Picard and Ishihara teach similar confocal imaging systems for determining surface topology of a three-dimensional structure. *Id.* at 32. The Petition cites Ishihara and Dobson¹⁰ as evidence that Picard’s confocal imaging system would have been recognized as suffering from “the magnification problem,” which could be addressed with telecentric optics. *Id.* at 33. Accordingly, the Petition argues that a person of ordinary skill in the art “would have been motivated to incorporate such telecentric optics into Picard’s system as a known technique to improve its confocal imaging

⁹ Claim 15 does not recite explicitly that the confocal optics operate in a telecentric mode. However, the Petition does not present any theory of obviousness other than its assertion that it would have been obvious to combine Ishihara’s telecentric mode with Picard’s system. *See* Pet. 16–38; Inst. Dec. 8–10. Therefore, we express no opinion on the issue of whether claim 15 requires telecentric optics, and we limit our analysis to the merits of the obviousness theory advanced in the Petition and addressed by Patent Owner.

¹⁰ Sarah L. Dobson, *et al.*, “Diffractive lenses for chromatic confocal imaging,” Optical Society of America, 1997 (Ex. 1011).

capabilities in the same way such telecentric optics improve the similar system of Ishihara.” *Id.* at 33–34.

The Petition contends that a person of ordinary skill in the art would have had a reasonable expectation of success in modifying Picard’s apparatus to use telecentric optics. *Id.* at 34–38. The Petition explains that Picard and Ishihara both teach apparatuses that determine surface topology of an object using a source, a beam splitter, and focusing optics arranged in similar manners to produce light at different focal planes. *Id.* According to the Petition, a person of ordinary skill in the art

would have therefore appreciated that modifying Picard with Ishihara’s telecentric confocal optics by replacing Picard’s lens 15 with such optics (or adding such optics between Picard’s Nipkow disk 8 and lens 15) would have been a matter of mere substitution or addition in view of the close similarities of Picard’s and Ishihara’s systems, and would have been simple to accomplish with a reasonable expectation of success.

Id. at 38 (citing Ex. 1008 ¶ 137).

The parties’ arguments raise a number of different disputes regarding Petitioner’s contention that claims 15–18 would have been obvious over Picard and Ishihara. One of these disputes is whether Petitioner has shown adequately that a person of ordinary skill in the art would have had reason to modify Picard’s system to use Ishihara’s telecentric operation. PO Resp. 27–37.

In support of its position, the Petition asserts that Picard’s lens 15 focuses polychromatic light at different planes, which results in undesirable differences in magnification. Pet. 32. The Petition explains that “Ishihara discloses a confocal imaging apparatus with telecentric confocal optics, which is designed to prevent undesirable magnification when changing the

focal plane of light during confocal imaging.” *Id.* at 33. The Petition adds that “Dobson, which, like Picard, discloses a chromatic scanning confocal imaging system, also teaches that a telecentric system addresses the magnification problem.” *Id.* The Petition concludes that

Thus, a [person of ordinary skill in the art] would have recognized that the problem of undesirable magnification associated with changing the focal plane by moving the imaging system as described in Ishihara is present in Picard’s system which changes the focal plane by using light beams of different wavelengths. Here, a POSITA would have appreciated that incorporation of telecentric confocal optics – such as those disclosed in Ishihara – would have benefited Picard’s system by preventing undesirable magnification when changing the focal plane of light during confocal imaging in Picard. Thus, a POSITA would have been motivated to incorporate such telecentric optics into Picard’s system as a known technique to improve its confocal imaging capabilities in the same way such telecentric optics improve the similar system of Ishihara.

Id. at 33–34 (citing Ex. 1008 ¶¶ 133–134).

Patent Owner argues that a person of ordinary skill in the art would not have combined Ishihara’s telecentric optics with Picard’s system. PO Resp. 27–48. Patent Owner asserts that the magnification problem discussed in Ishihara does not apply to Picard’s system. *Id.* at 27–29. Patent Owner argues that Ishihara focuses light on a single plane, either optically moving the focal plane relative to the object, or moving the object relative to the focal plane. *Id.* at 28. Patent Owner elaborates that Ishihara’s telecentric optics prevent magnification changes resulting from relative movement between the single focal plane and the object. *Id.* In contrast, Patent Owner argues, Picard does not move the focal plane and the object relative to one another, but performs depth encoding by relying on multiple stationary focal

planes for different wavelengths of light. *Id.* at 29. Therefore, Patent Owner argues, unlike in Ishihara, “[t]he magnification in Picard does not change during operation.” *Id.*

Patent Owner also argues that the axial chromatism of Picard’s lens 15, which focuses different wavelengths on different planes, constitutes “Picard’s basic principle of operation, and purported point of novelty.” *Id.* at 27. Patent Owner asserts that Picard “exploits the aberration to encode the distance along the z-axis.” *Id.* at 30. Patent Owner elaborates that Picard explains different wavelengths of light are transmitted with different degrees of intensity, depending upon the positional relationship between the different wavelengths’ focal planes and the surface of the object. *Id.* at 30–31. According to Patent Owner, “[a]s Dr. Sergienko admitted in his deposition, Picard’s system *requires* chromatism to determine the surface topology of an object.” *Id.* at 31. Indeed, Patent Owner argues, “the very definition of telecentricity is contrary to the main feature of Picard’s invention.” *Id.* at 33.

Patent Owner adds that “Picard’s systems already include structures to accommodate any difference in magnification versus color.” *Id.* at 34. Patent Owner asserts that a number of approaches simpler than telecentric optics could have been used to accommodate different magnifications of different colors. *Id.* at 36. Patent Owner further argues that Picard requires no modification to address magnification differences “because Picard’s algorithm easily accounts for any difference in magnification by allowing for lateral chromatic aberration.” *Id.* at 36.

In its Reply, Petitioner maintains that “[i]t would have been obvious to combine Picard and Ishihara.”¹¹ Pet. Reply 13. Petitioner contends that the ’448 patent acknowledges that it was well-known to operate confocal optics in telecentric mode. *Id.* (citing Ex. 1001, 5:62–65). Noting that Patent Owner “asserts that telecentricity is incompatible with a chromatic confocal system like the one disclosed by Picard,” Petitioner disagrees. *Id.* at 14. Petitioner argues that Dobson “demonstrates that it was known that (1) chromatic confocal systems suffer from magnification problems and (2) telecentric systems were used to address such magnification problems.” *Id.* Arguing that Dr. Sergienko testified Picard’s lens 15 creates magnification issues, Petitioner contends that Patent Owner’s “assertion that Picard does not suffer from magnification issues (POR, 27-29) is untenable.” *Id.* at 15. Petitioner asserts that Patent Owner’s admission that “Picard was quite aware of the difference in the magnification for the various wavelengths” (PO Resp. 36) contradicts Patent Owner’s position that Picard

¹¹ Petitioner also argues that “[t]here is no need for Ishihara if the Board agrees with [Patent Owner] that the claims do not require telecentric mode.” Pet. Reply 13. Because the Petition did not assert that the claims are unpatentable over Picard separately from Ishihara, we do not address Petitioner’s new argument to this effect. 37 C.F.R. § 42.22(a)(2) (requiring a petition to include “[a] full statement of the reasons for the relief requested, including a detailed explanation of the significance of evidence including material facts, and the governing law, rules, and precedent”); 37 C.F.R. § 42.104(b)(4) (requiring that a petition must identify “[h]ow the construed claim is unpatentable under the statutory grounds identified in paragraph (b)(2) of this section. The petition must specify where each element of the claim is found in the prior art patents or printed publications relied upon.”).

does not have a magnification problem (*id.* at 27). Pet. Reply 15. Petitioner also argues that the '448 patent teaches performing chromatic confocal imaging with telecentricity. *Id.* at 16–20.

In response, Patent Owner maintains that Petitioner has not demonstrated it would have been obvious to modify Picard with Ishihara's telecentric optics. Sur-reply 12–20. Patent Owner again emphasizes that the axial chromatism of Picard's lens 15 constitutes an important feature of its system, not a problem. *Id.* at 14–16. Patent Owner also argues that Petitioner's Reply improperly relies on Dobson as a bridge between Picard and Ishihara, when the Petition did not rely on Dobson in this manner. *Id.* at 16–20. Additionally, Patent Owner argues that, in citing the '448 patent itself as teaching the combination of telecentric optics with a chromatic confocal system, Petitioner resorts to improper hindsight. *Id.* at 15–16.

Petitioner's obviousness assertion rests on its contention that a person of ordinary skill in the art would have viewed the axial chromatism of Picard's lens 15, which focuses different wavelengths on different planes, as “the magnification problem” that would have motivated modification to operate in a telecentric mode. Pet. 32–33. We find that Petitioner's contention is not supported by a preponderance of the evidence.

Patent Owner persuades us that, in Picard, the axial chromatism of lens 15 constitutes a key feature of its system, not a problem. PO Resp. 27–31. We credit the unrebutted testimony of Mr. Aikens that Picard's “basic principle of operation, and purported point of novelty, requires focusing light at different planes via axial chromatic aberration,” provided by lens 15. Ex. 2019 ¶ 107. Mr. Aikens explains that Picard leverages the axial

chromatism of lens 15 to ascertain the position of an object along the z-axis. *Id.* ¶¶ 68–70, 107–116. Consistent with this, Dr. Sergienko testifies that “[t]he axial chromatism in Picard is the main feature to achieve this section,” elaborating that “[t]hey’re arranging the device to provide the longitudinal dynamics, because longitudinal dynamics, it’s information about position of the focal planes along the axis longitudinally.” Ex. 2012, 85:21–86:10.

Patent Owner shows persuasively that Picard discloses an architecture that already addresses any effects of magnification differences. PO Resp. 34–37; Ex. 1003, Fig. 4, 28:8–13; Ex. 2019 ¶¶ 121–127. Patent Owner persuades us that a person of ordinary skill in the art would have understood Picard as disclosing an architecture that accommodates effectively any differences in magnification for the reasons discussed below. PO Resp. 34–37; Ex. 2019 ¶¶ 121–127.

Petitioner does not dispute, much less discredit this contention. *See generally* Pet. Reply. Instead, Petitioner responds to Patent Owner’s assertion that telecentric operation was not the best way to address any effects of magnification. *Id.* at 15. Petitioner explains that “Ishihara’s telecentric mode need not be the most preferred/desirable solution.” *Id.*

We agree that the law does not require Petitioner to show a person of ordinary skill in the art would have viewed the proposed modification as the most preferred or desirable approach. The law does, however, require Petitioner to show not only that a person of ordinary skill in the art could have combined the references in the proposed manner, but that a person of ordinary skill in the art would have had a reason to combine the references’ teachings in the proposed manner. *See Belden Inc. v. Berk-Tek LLC*, 805

F.3d 1064, 1073 (Fed. Cir. 2015) (emphasis added) (citation omitted) (“[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention”). Here, Petitioner does not do so.

Petitioner does not persuade us that a person of ordinary skill in the art would have viewed Ishihara’s discussion of magnification problems as applicable to Picard’s system. Patent Owner persuades us that Ishihara teaches magnification problems stem from moving the object relative to the system’s focal plane or moving the focal plane relative to the object. PO Resp. 27–28; Ex. 2019 ¶¶ 109–111. Patent Owner also persuades us that Picard teaches a stationary relationship between its focal planes and the object, such that a person of ordinary skill in the art would have viewed Ishihara’s discussion of problems stemming from moving the object/focal plane as inapplicable to Picard’s system. PO Resp. 29; Ex. 2019 ¶¶ 68–70, 111.

Additionally, Petitioner does not persuade us that Dobson would have conveyed to a person of ordinary skill in the art that axial chromatism creates a problem motivating the use of telecentric optics. *See* Pet. 33; Pet. Reply 14–16. Dobson says nothing about a problem with magnification stemming from axial chromatism. Instead, Dobson says “[t]he telecentric system serves to image and demagnify the focus spot from the diffractive lens onto the object plane of the microscope objective, where the position of the focus is determined by the wavelength of the source.” Ex. 1011, 4746. Additionally, Dobson says that “[t]he demagnification enables a fine change

of the focus position in depth by wavelength tuning, which can be characterized by a wavelength-to-depth coding.” *Id.* To the extent a person of ordinary skill in the art might have perceived from Dobson that those advantages correspond to addressing certain perceived problems, Petitioner does not provide persuasive evidence that a person of ordinary skill in the art would have believed that those problems generally apply to all chromatic confocal microscopy or specifically apply to Picard’s disclosure. Petitioner cites Dr. Sergienko’s deposition testimony that Picard’s lens 15 creates a magnification problem because it is “[t]he device that focuses at different depths.” Pet. Reply 15 (citing Ex. 2012, 82:7–13, 84:13–17). We find more credible Mr. Aikens’ testimony that different magnification of different wavelengths is not a problem, but a key feature of Picard’s system.

Ex. 2019 ¶¶ 107–116, 121–127. Dr. Sergienko does not dispute Mr. Aikens’ testimony that Picard exploits the different magnifications caused by lens 15’s axial chromatism. Ex. 2019 ¶¶ 107–116; *see generally*, Ex. 2012; Ex. 1037. Additionally, Dr. Sergienko does not dispute, much less provide persuasive evidence to refute Mr. Aikens’ testimony that Picard’s architecture already addresses any effects of magnification. Ex. 2019 ¶¶ 121–127; *see generally*, Ex. 2012; Ex. 1037. For example, Dr. Sergienko does not refute Mr. Aikens’ testimony that “Picard’s algorithm easily accounts for any difference in magnification.” Ex. 2019 ¶ 126; *see generally*, Ex. 2012; Ex. 1037. Weighing the declarants’ testimony, and keeping in mind that Petitioner bears the burden of proof, we are not persuaded that a person of ordinary skill in the art would have ascertained

from Ishihara or Dobson that Picard suffers from a magnification problem needing correction.

We also find persuasive Patent Owner’s argument that Petitioner’s Reply improperly relies on Dobson to bridge the teachings of Picard and Ishihara, whereas the Petition did not rely on Dobson for this. Sur-reply 16–20. As Patent Owner explains, the Reply relies on Dobson for its discussion of “wavelength-to-depth coding” as an element that a person of ordinary skill in the art would combine with the teachings of Picard and Ishihara in order to allow them to work together. *Id.* at 16–19; Pet. Reply 22. Patent Owner cites evidence, including the deposition testimony of Dr. Sergienko, persuading us that the combination of Picard and Ishihara would not work without further modifying the combination to include elements from Dobson to serve as a bridge between the elements taught by Picard and Ishihara. Sur-reply 17–18. In contrast, as Patent Owner notes, the Petition relied on Dobson only as providing motivation for combining the elements of Picard and Ishihara. *Id.* at 19–20; Pet. 33.

We also find unavailing Petitioner’s reliance on the disclosures of the ’448 patent itself. Petitioner does not persuade us that the ’448 patent admits it was known to use telecentric operation with a chromatic confocal system. *See* Pet. Reply 19. In support of this assertion, Petitioner cites the ’448 patent’s disclosure that “[t]he unit further comprises a confocal optics 42, typically operating in a telecentric mode, a relay optics 44, and an endoscopic probing member 46. Elements 42, 44, and 46 are generally as known per se.” Ex. 1001, 5:62–65; Pet. Reply 20. This disclosure conveys that each of confocal optics 42, relay optics 44, endoscopic probing member

46, individually was known in the art. Facially, the disclosure does not convey that the individually known elements previously had been combined. And Petitioner does not present persuasive evidence that we should read the disclosure as conveying more than its plain meaning, i.e., that the elements separately were known in the art. Having failed to persuade us that the '448 patent admits the combination of the elements was known in the art, Petitioner's assertions that the '448 patent discloses using the claimed elements together amounts to improper hindsight reasoning.

For the foregoing reasons, Petitioner fails to persuade us that a person of ordinary skill in the art would have had a reason to modify Picard's system to use telecentric operation from Ishihara. Consequently, Petitioner has not carried its burden of showing that claims 15–18 would have been obvious over Picard and Ishihara.

C. Alleged Obviousness over Tiziani, Gmitro, Ishihara, and Kino

1. Overview of Tiziani

Tiziani discusses using optical scanning confocal microscopy to generate three dimensional images. Ex. 1004, 120. According to Tiziani, “a recently developed approach using microlenses is analyzed; a microlens array generates many light spots onto the object to be detected simultaneously on a CCD array camera system.” *Id.* Tiziani shows an exemplary system in Figure 2, which is reproduced below.

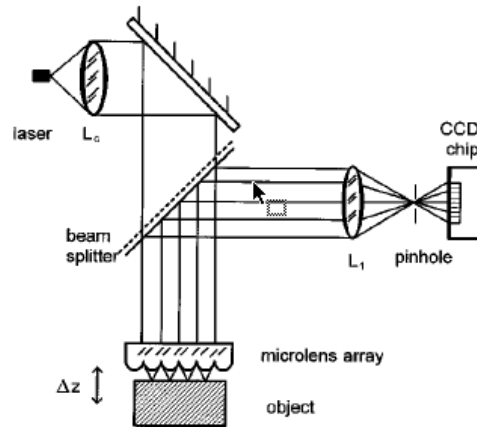


Fig. 2. Arrangement for confocal three-dimensional analysis with a microlens array.

Id. at 123. Figure 2 shows a system for “three-dimensional analysis with a microlens array.” *Id.* at 123.

Light from the diode laser gets collimated by lens L_c . *Id.* The microlens array focuses the parallel beam to “a two-dimensional, diffraction-limited spot array.” *Id.* The same microlenses collect the reflected light, which is focused by lens L_1 to the pinhole. *Id.* After travelling through the pinhole, the light goes to the CCD camera, at which the object is imaged. *Id.* Moving the object in steps in the axial direction allows measuring the three-dimensional topology of an object. *Id.* “For topography measurement the brightest intensity must be searched for each camera pixel to determine the z values of the whole object.” *Id.* at 124.

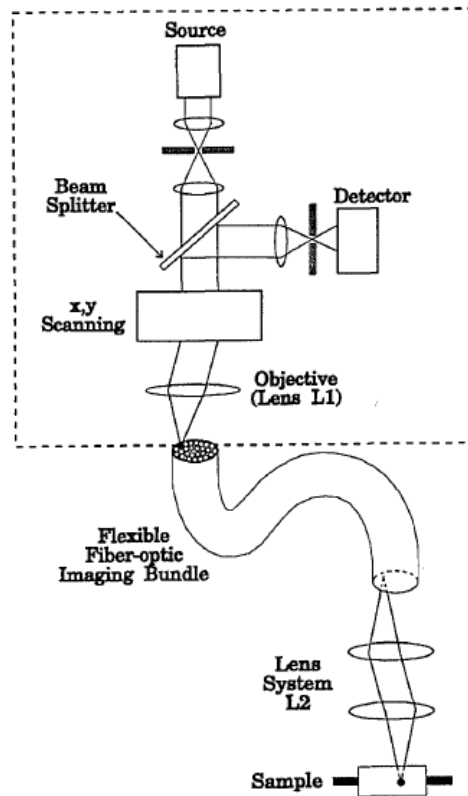
2. Overview of Gmitro

Gmitro discusses optical scanning confocal microscopy. Ex. 1005, 565. Gmitro notes that confocal microscopes “typically consist of one or more laser sources, confocal source and collection pinholes, an x - y scanning mechanism, an optical detector, and a computer system for capturing and displaying the images.” *Id.* According to Gmitro, using confocal

microscopes generally involves placing the object to be imaged on a stage, as with other microscopes. *Id.* Gmitro laments that “this requirement greatly limits the flexibility of the system and the types of imaging applications for which confocal microscopes can be used.” *Id.*

Gmitro discloses using a fiber-optic imaging bundle to extend the use of a confocal microscope “to image samples that are not easily accessible or easily placed on a microscope stage. Confocal imaging of *in vivo* rather than *in vitro* biological specimens is one of the exciting prospects for this type of system.” *Id.*

Gmitro provides an example of a confocal microscope used with a fiber-optic bundle in Figure 1, which is reproduced below.



Id. Figure 1 shows a “[c]onfocal microscope equipped with a fiber-optic imaging bundle. The components shown within the dotted line are those of a standard confocal microscope.” *Id.*

3. Overview of Kino

Kino discloses a confocal optical microscope. Ex. 1006, code (57). Kino describes certain perceived problems with “[c]onventional confocal optical microscopes.” *Id.* at 1:5–12. According to Kino, “[t]he main drawback with conventional confocal scanning optical microscopes is that they illuminate only one point on the object at a time.” *Id.* at 1:7–9. Figure 2 of Kino is reproduced below.

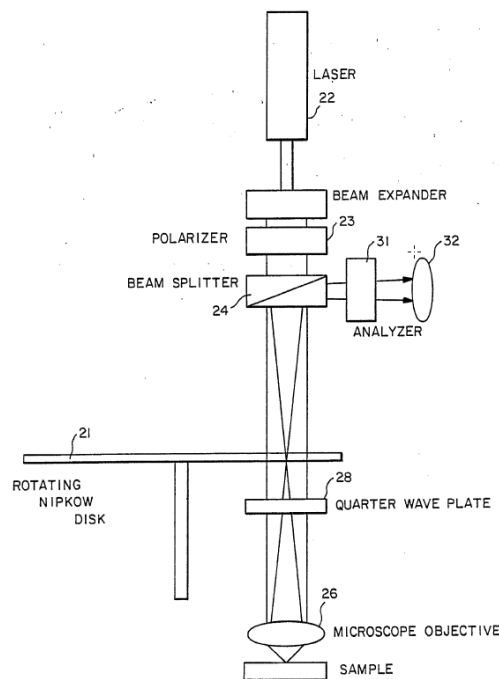


FIG. -2

Figure 2 shows a confocal optical microscope with circular disc 21, “known as a Nipkow disc.” *Id.* at 4:3–10.

Kino teaches illuminating 4,000 points on an object simultaneously. *Id.* at 4:30–31. Circular disc 21 includes holes arranged in numerous

interleaved spirals, each having several turns. *Id.* at 4:9–12. Laser 22 illuminates “an area of 1.8 centimeters by 1.8 centimeters containing about 4,000 holes.” *Id.* at 4:22–24. “The holes diffract the impinging light and the incident beam converges on objective lens 26. For example, the incident beam converges to a five millimeter diameter on the back of the objective lens 26 so that 4,000 points on the object 27 are simultaneously illuminated.” *Id.* at 4:26–31. Before the light impinges on disc 21, the light is polarized by polarizer 23. *Id.* at 4:23–26.

Kino teaches alternate ways to focus on different planes in an object. *Id.* at 6:19–22. Specifically, Kino teaches that “[t]he object or the objective lens can be moved up or down in order to focus on various planes in a translucent object such as a biological material like bone, or at various levels of a sample such as an integrated circuit.” *Id.*

4. Discussion

The Petition asserts that, in combination, Tiziani, Gmitro, Ishihara, and Kino teach every limitation of claims 15–19 and 21. Pet. 38–50. The Petition asserts that Tiziani teaches most of the claims’ limitations (*id.*), but does not expressly disclose certain things (*id.* at 51). Specifically, the Petition concedes that Tiziani does not expressly teach a probing member, confocal optics that operate in telecentric mode, “an optical system configured to focus the plurality of incident light beams at a plurality of focal planes forward of the probing end” (Claim 15), or “a translation mechanism configured to change the focal plane of the plurality of incident light beams over a range of focal plane positions” (Claim 19). *Id.*

Asserting that Gmitro teaches a probing member, the Petition argues that it would have been obvious to modify Tiziani to include a probing member. *Id.* at 52–54. The Petition contends that “Tiziani and Gmitro are in the same field of endeavor—confocal microscopy.” *Id.* at 52. The Petition argues that Gmitro teaches that the approach of imaging a specimen on a stage restricts the system’s flexibility, as well as the applications for the system. *Id.* at 52–54. The Petition notes that Gmitro teaches combining a confocal imaging system with a fiber-optic imaging bundle, such that “the confocal microscope can be extended to image samples that are not easily accessible or easily placed on a microscope stage.” *Id.* at 52 (quoting Ex. 1005, 565). The Petition further notes that Gmitro explains “[t]he small size and flexibility of the fiber-optic imaging bundle could even allow confocal imaging of objects that would otherwise be completely inaccessible, such as inside the human body.” *Id.* at 52–53 (quoting Ex. 1005, 565). Accordingly, the Petition argues that a person of ordinary skill in the art

would have been motivated to modify Tiziani’s confocal imaging system to use a probing member—such as that disclosed in Gmitro—because a [person of ordinary skill in the art] would have recognized that use of such [a] probing member provides greater flexibility and applicability of the confocal imaging system to various types of imaging applications in the same way that probing member improves the similar system of Gmitro.

Id. at 53 (citing Ex. 1008 ¶ 194).

The Petition also argues that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Gmitro’s fiber optic bundle with Tiziani. *Id.* at 53–54. In support of this, the Petition asserts that Tiziani and Gmitro both relate to confocal imaging devices. *Id.*

at 53. The Petition contends that a person of ordinary skill in the art would have had a reasonable expectation of success “because the objective lens of Gmitro serves a similar purpose as Tiziani’s microlens array by generating multiple light spots onto the object to be detected.” *Id.* at 54.

Asserting that Ishihara teaches confocal optics that operate in telecentric mode, the Petition argues that it would have been obvious to modify Tiziani to include such optics. *Id.* at 51, 54–59. The Petition explains that Tiziani and Ishihara both teach confocal imaging systems for determining surface topology of a three-dimensional object. *Id.* at 54. The Petition argues that a person of ordinary skill in the art would have understood, “[a]s taught in Ishihara,” that Tiziani’s system of focusing light beams at different focal planes would have caused undesirable variation in the “magnifications of the light at the *different* focal planes.” *Id.* at 55 (emphasis in original). The Petition argues that

a [person of ordinary skill in the art] would have appreciated that incorporation of telecentric confocal optics – such as those disclosed in Ishihara – would have benefited Tiziani’s system by preventing undesirable magnification when changing the focal plane of light during confocal imaging in Tiziani. Thus, the [person of ordinary skill in the art] would have been motivated to incorporate such telecentric optics into Tiziani’s system as a known technique to improve its confocal imaging capabilities in the same way such telecentric optics improve the similar system of Ishihara.

Id. at 56 (citing Ex. 1008 ¶ 199).

The Petition asserts that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Ishihara with Tiziani in the proposed manner. *Id.* at 56–59. The Petition explains that the references disclose similar confocal imaging systems that rely on shifting

focal planes, each system including a light source, a beam splitter, and focusing optics. *Id.* The Petition argues that a person of ordinary skill in the art “would have therefore appreciated that modifying Tiziani with Ishihara’s telecentric confocal optics by placing such optics between Tiziani’s microlens array and the object would have been a matter of mere substitution or addition, and would have been simple to accomplish with reasonable expectation of success.” *Id.* at 59 (citing Ex. 1008 ¶ 203).

Asserting that it would have been obvious in view of Kino to modify Tiziani’s device “to include an optical system which focuses the plurality of incident light beams at a plurality of focal planes forward of the probing end, and a translation mechanism.” *Id.* at 59–60. Petitioner explains that Tiziani and Kino both teach a confocal imaging system for imaging a three-dimensional object. *Id.* at 60. Asserting that Kino discloses interchangeability between moving an object and moving an objective lens, Petitioner argues that adding Kino’s translation mechanism to Tiziani “would have amounted to merely combining prior art elements (Tiziani’s confocal microscopy and Kino’s movable objective lens) according to known methods (interchangeability of moving either the object *or* the objective lens up or down to focus on various planes) to yield predictable results (a translation mechanism within Tiziani’s system).” *Id.* Petitioner asserts that a person of ordinary skill in the art would have had a reasonable expectation of success in implementing such a change. *Id.* at 62.

Patent Owner asserts multiple reasons that Petitioner has not demonstrated obviousness of claims 15–19 and 21 over Tiziani, Gmitro, Ishihara, and Kino. PO Resp. 48–59. Patent Owner argues that

“[m]odifying Tiziani with Ishihara’s telecentric confocal optics by placing such optics between Tiziani’s microlens array and the object would render Tiziani’s fixed focal plane system, with associated equations, unsuitable for its intended purpose.” *Id.* at 49. Patent Owner also argues that it would not work to combine Gmitro’s fiber-optic bundle with Tiziani’s system, and that a person of ordinary skill in the art would not have had a reasonable expectation of success in making such a combination. *Id.* at 51–54. As part of this argument, Patent Owner asserts that Petitioner does not explain adequately how Gmitro’s fiber-optic bundle would work with an array of light beams, as in Tiziani’s system. *Id.* at 51–52. Patent Owner also argues that Petitioner “applies at least four references (Tiziani, Ishihara, Gmitro, and Kino) to teach the claimed ‘optical system’ pursuant to [Petitioner’s means-plus-function] construction.” *Id.* at 53. Patent Owner further argues that Petitioner relies on Kino as teaching performance of a claimed function, but identifies no disclosure in Kino of structure for performing the function. *Id.* at 53–54. Patent Owner also argues that Petitioner fails to show adequately that there would have been a motivation to combine the references’ teachings and improperly relies on hindsight reconstruction of the claimed invention. *Id.* at 55–59.

We turn to the parties’ dispute regarding whether the Petition demonstrates adequately that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Gmitro’s fiber-optic bundle with Tiziani’s system. In our Institution Decision, we found the Petition lacks an adequate showing that a person of ordinary skill in the art would have had a reasonable expectation of success in modifying Tiziani’s

disclosure with Gmitro's. Inst. Dec. 36–37. Noting “Patent Owner asserts that Gmitro discloses using a flexible fiber-optic bundle with a confocal microscope having only one pinhole that generates only one light beam at a time” (*id.* at 36), we found that the Petition did not show adequately that a person of ordinary skill in the art would have had a reasonable expectation of successfully using Gmitro's fiber-optic bundle with the array of light beams taught by Tiziani and Ishihara (*id.* at 36–37).

Following our Institution Decision, the parties continue to dispute the merits of Petitioner's challenge of claims 15–19 and 21 as allegedly obvious over Tiziani, Gmitro, Ishihara, and Kino. PO Resp. 48–59; Pet. Reply 23–28; Sur-reply 21–22. Regarding whether there would have been a reasonable expectation of success for combining Gmitro's fiber-optic bundle with Tiziani, Petitioner presents multiple arguments. Pet. Reply 23–27.

We determine that Petitioner does not meet its burden of proof for two separate and independent reasons. First, Petitioner's reply arguments are not persuasive on the merits, and second, Petitioner's reply arguments exceed the proper scope of a reply brief. We address each of these reasons below.

First, we consider the merits of the arguments and evidence presented by Petitioner. Petitioner argues that Gmitro's fiber-optic bundle would need to carry only one light beam in the combination with Tiziani and Ishihara. *Id.* at 23–24. Petitioner notes that the Petition asserts it would have been obvious to add Gmitro's fiber-optic bundle upstream of Tiziani's microlens array. *Id.* at 23 (citing Pet. 57). Citing Figure 2 of Tiziani, Petitioner asserts that “Tiziani's microlens array splits the parent light beam into multiple light beams.” *Id.* Accordingly, if added upstream of the microlens array,

“Gmitro’s fiber-optic bundle relays the parent light beam (*i.e.*, a single light beam) in this particular combination, not multiple light beams as [Patent Owner] contends.” *Id.* at 23–24.

We find this argument unavailing to bolster the Petition’s conclusory assertion that a person of ordinary skill in the art would have had a reasonable expectation of success in modifying Tiziani’s system to use Gmitro’s fiber-optic bundle. Assuming, *arguendo*, that the combination of Tiziani and Gmitro needs to convey only a single light beam from Tiziani’s diode laser to its microlens array, it needs to return a plurality of light beams, as acknowledged by the Petition and Dr. Sergienko. *See* Pet. 44–45; Ex. 1008 ¶¶ 167–169. Assuming that a person of ordinary skill in the art would have had a reasonable expectation of success in using Gmitro’s fiber-optic bundle to carry a single light beam to the microlens array, that only addresses part of what the combined system must do. Additionally, the combination would need to return an array of light beams from inside the human body, either through Gmitro’s fiber-optic bundle or otherwise. The conclusory assertions and dearth of evidence presented in the Petition fail to demonstrate adequately that a person of ordinary skill in the art would have had a reasonable expectation of success in doing so with the proposed combination.

Petitioner also argues that even if relaying multiple light beams is required, a person of ordinary skill in the art would have had a reasonable expectation of success in combining the references. Pet. Reply 24–27. In support of this position, Petitioner’s Reply advances new arguments beyond those presented in the Petition regarding the allegation that there would have

been a reasonable expectation of success in combining the references. *Compare* Pet. 53–54, *with* Pet. Reply 24–27. Additionally, the Reply cites evidence not cited by the Petition in support of the assertion that a person of ordinary skill in the art would have a reasonable expectation of success in combining the fiber-optic bundle of Gmitro with Tiziani’s system. This new evidence includes portions of the ’448 patent, Picard, Exhibits 1038 and 1039, Gmitro’s title, and additional testimony from Dr. Sergienko. *Compare* Pet. 53–54 (citing Ex. 1005, Fig. 1, 565; Ex. 1008 ¶¶ 195–196), *with* Pet. Reply 24–27 (citing Ex. 1001, 7:53–8:3, 5:62–65, 5:39–41, 5:45–51, Fig. 1A; Ex. 1003, 25–26; Ex. 1005, title, 565; Exs. 1027, 1030–1033; Ex. 1036, 84:12–85:5; Ex. 1037 ¶¶ 22–28; Ex. 1038, 114; Ex. 1039, 19).

Petitioner’s new arguments and evidence do not present a persuasive showing that a person of ordinary skill in the art would have had a reasonable expectation of success in using Gmitro’s fiber-optic bundle to relay the multiple light beams of Tiziani’s system while maintaining the function of the system. Based on the disclosures of the ’448 patent, Picard, Exhibits 1038 and 1039, and Gmitro, Dr. Sergienko testifies that

Gmitro’s fiber-optic imaging bundle is explicitly structured and designed to relay images. In view of Gmitro’s disclosure that its fiber-optic bundle is an “imaging” bundle, a [person of ordinary skill in the art] would have understood that Gmitro’s bundle is capable of (and structured/designed for the purpose of) relaying a plurality of light beams (*i.e.*, which constitutes an *image*).

Ex. 1037 ¶ 27 (citing Ex. 1001, 7:53–8:3, 5:62–64; Ex. 1003, 25–26; Ex. 1038, 114; Ex. 1039, 19; Ex. 1005, title, 565; Ex. 1029).

Dr. Sergienko’s testimony is not sufficiently supported by the evidence. Gmitro’s “fiber-optic imaging bundle” transmits a single light

beam directed by an “x-y scanning” device to scan the surface of the sample.
Ex. 1005, 565, Fig. 1. There is no evidence that Gmitro’s “fiber-optic imaging bundle” is structured or designed to relay an array of light beams constituting an image, as illustrated in the image below from Dr. Sergienko’s testimony:

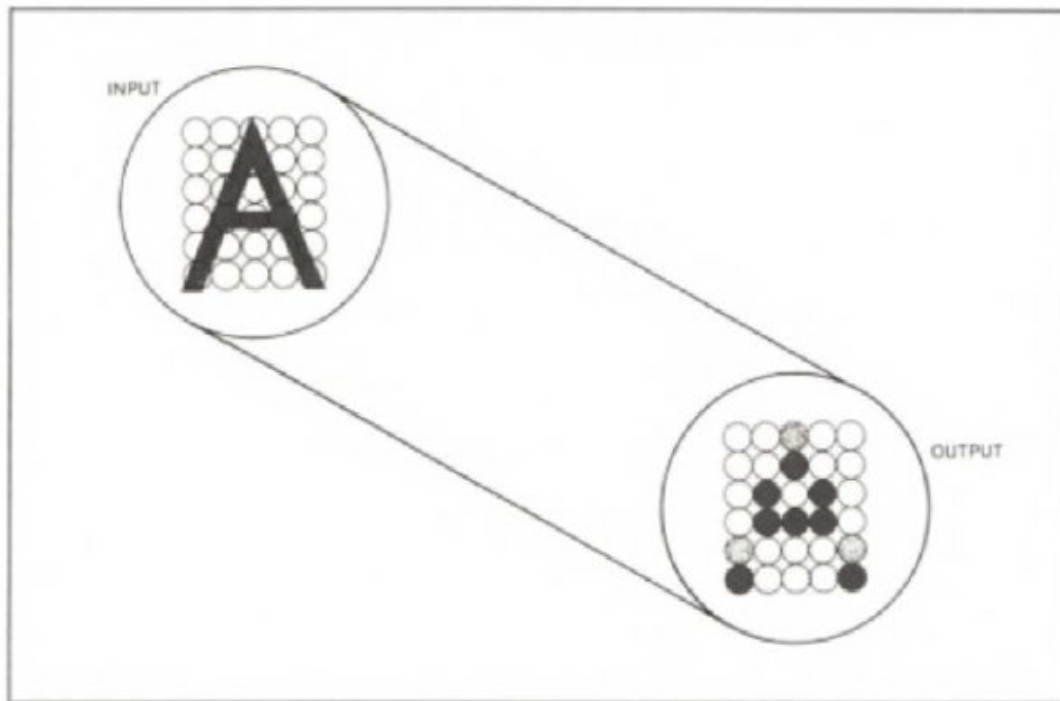


Exhibit 1029

Ex. 1037 ¶ 27 (citing Ex. 1029). The image from Dr. Sergienko’s testimony shows an input and an output.

Although Petitioner and Dr. Sergienko rely on Picard to show “the obviousness and predictability of incorporating a fiber-optic bundle into a confocal imaging system” (*id.* ¶ 26), Picard does not teach or suggest using a fiber optic bundle to transmit an x-y array of light beams. Picard discloses an embodiment that combines an “ordered fiber-optic bundle” and a Nipkow

disk. Ex. 1003, 24:9–12, Fig. 8. The Nipkow disk has a spiral arrangement of holes, not an x-y array. *Id.* at 5:18–20. Picard teaches another embodiment that replaces the Nipkow disk with a fixed mask having an array of openings, which “must be precisely aligned relative to the pixels” of two CCD cameras. *Id.* at 15:7–11, 23:12–19, 24:5–8, Fig. 7. Contrary to Dr. Sergienko’s suggestion (Ex. 1037 ¶¶ 26–27), Picard does not teach or suggest combining a fiber-optic bundle with an x-y array of light beams.

Tiziani uses a microlens to generate an array of light spots on the object to be measured. Ex. 1004, 124 (“The parallel beam is focused by the microlens array to a two-dimensional, diffraction-limited spot array.”); *id.* at 120 (“a microlens array generates many light spots onto the object to be detected simultaneously on a CCD array camera system.”). Petitioner and Dr. Sergienko do not cite evidence sufficient to persuade us of their conclusion that it would have been obvious to combine Tiziani’s microlens array with Gmitro’s fiber optic imaging bundle. *See* Pet. Reply 25; Ex. 1037 ¶ 25. Even if a person of ordinary skill in the art would have understood that Gmitro’s fiber-optic bundle could relay multiple light beams, Petitioner and Dr. Sergienko do not cite evidence persuading us that a person of ordinary skill in the art would have had a reasonable expectation of success in using Gmitro’s “fiber-optic imaging bundle” to relay an *array* of light in a manner compatible with Tiziani’s system.

The Petition fails to demonstrate adequately that a person of ordinary skill in the art would have had a reasonable expectation of success in using Gmitro’s fiber-optic bundle with Tiziani’s system, and the Reply does not salvage Petitioner’s position. As we explained in our Institution Decision,

[The Petition] merely asserts that “the objective lens of Gmitro serves a similar purpose as Tiziani’s microlens array by generating multiple light spots onto the object to be detected.” Pet. 54. This assertion provides no explanation of how the flexible fiber optic bundle would work with an array of light beams like those used in the systems of Tiziani and Ishihara. Moreover, [The Petition] does not provide persuasive explanation or evidence in support of the assertion that Gmitro’s objective lens “generat[es] multiple light spots onto the object to be detected.” In support of this assertion, [The Petition] cites the testimony of Dr. Sergienko (*id.*), who cites no evidence in support of his assertion that “[a person of ordinary skill in the art] would also have had a reasonable expectation of success because the objective lens of Gmitro serves a similar purpose as Tiziani’s microlens array by generating multiple light spots onto the object to be detected” (Ex. 1008 ¶ 195).

Dec. Inst. 36–37. Petitioner has not presented sufficient evidence to overcome the foregoing findings, which we adopt as part of the reasoning for our final decision. Thus, considering all of Petitioner’s arguments and evidence, Petitioner has not demonstrated obviousness of claims 15–19 and 21 over Tiziani, Gmitro, Ishihara, and Kino.

Second, we consider the parties’ arguments regarding whether Petitioner’s Reply exceeds the proper scope of a reply. Petitioner argues that it could not have foreseen Patent Owner’s argument about the compatibility of Gmitro’s fiber-optic bundle with the plurality of light beams used in Tiziani. Pet. Reply 24. Given this, Petitioner advances with its Reply considerable new argument and evidence that a person of ordinary skill in the art would have had a reasonable expectation of success in using Gmitro’s fiber optic bundle to carry Tiziani’s plurality of light beams. *Id.* at 24–27 (citing, among others, Ex. 1001, 7:53–8:3, 5:62–65, 5:39–41, 5:45–51,

Fig. 1A; Ex. 1003, 25–26; Ex. 1005, title, 565; Ex. 1037 ¶¶ 22–28; Ex. 1038, 114; Ex. 1039, 19).

Patent Owner disputes Petitioner’s assertion that it could not have foreseen Patent Owner’s argument. Sur-reply 22. Patent Owner notes that Petitioner “actually saw these arguments before it filed its petition.” *Id.* Patent Owner explains that it previously had argued before the ITC “that Gmitro ‘scans with a single beam through the fiber optic bundle’ and argued that [Petitioner] ‘has not established that simultaneously scanning with a plurality light beams is even possible with Gmitro’s fiber bundle.’” *Id.* (citing Ex. 2001, 202).

We agree with Patent Owner that Petitioner’s assertion it could not have foreseen Patent Owner’s argument does not justify its insufficient explanation and lack of evidence in the Petition. As Patent Owner argues, its ITC brief, filed approximately a month before the Petition was filed, provided effective notice of Patent Owner’s position that there would have been issues using Gmitro’s fiber-optic bundle to carry the plurality of light beams used in Tiziani. *Id.* Moreover, even without such express notice, Petitioner should have recognized the requirement that its Petition must “identif[y], in writing and with particularity, each claim challenged, the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim.” 35 U.S.C. § 312(a)(3). The Petition was also required to include “[a] full statement of the reasons for the relief requested, including a detailed explanation of the significance of the evidence including material facts, and the governing laws, rules, and precedent.” 37 C.F.R. § 42.22(a)(2). The Petition fails to

meet these requirements with respect to its assertion that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Gmitro's fiber-optic bundle with Tiziani's confocal imaging system and microlens array.

It is “improper for a reply to present new evidence (including new expert testimony) that could have been presented in a prior filing.” Patent Trial and Appeal Board Consolidated Trial Practice Guide (Nov. 2019), 74–75 (citing *Genzyme Therapeutic Prods. Ltd. v. Biomarin Pharm. Inc.*, 825 F.3d 1360, 1365–69 (Fed. Cir. 2016)). Petitioner does not provide any persuasive reason that the evidence it presented with its Reply to bolster its assertion of a reasonable expectation of success could not have been provided with the Petition. Accordingly, we find that Petitioner exceeded the proper scope of a reply with its newly presented arguments on pages 24–27 of the Reply and with the its new citations of portions of the '448 Patent (Ex. 1001, 7:53–8:3, 5:62–65, 5:39–41, 5:45–51, Fig. 1A), Picard (Ex. 1003, 25–26), Gmitro's title (Ex. 1005, title), Dr. Sergienko's new testimony (Ex. 1037 ¶¶ 22–28), and Exhibits 1038 and 1039.

For all of the foregoing reasons, Petitioner has not carried its burden of showing that claims 15–19 and 21 would have been obvious over Tiziani, Gmitro, Ishihara, and Kino.

D. Alleged Obviousness over Tiziani, Gmitro, Ishihara, Kino, and Watson

1. Overview of Watson

Watson discusses using confocal microscopes in dental applications. Ex. 1010, 352. Watson discusses certain confocal microscopes that had “potential for *in vivo* studies on horizontal human subjects.” *Id.* Watson

explains that such *in vivo* examination did not work due to certain problems, such as “[s]evere difficulties . . . in achieving fine focusing of the microscope objective.” *Id.*

Watson describes further development of *in vivo* use of confocal microscopes. *Id.* at 352–353. According to Watson, “special new objectives have been and are being developed.” *Id.* at 353. Watson elaborates that “[t]he plane of focus is altered by moving the optical components *within* the microscope objective itself, either manually or with a stepper motor, rather than moving the sample under the lens.” *Id.* Watson further explains that “[t]he end lens of the objective is maintained in steady, close, contact with the surface of the eye, or other tissue, so helping to reduce specimen movement.” *Id.* Watson asserts that “[t]his new technique offers numerous exciting opportunities for the microscopic investigation of many clinical operative procedures *in vivo*, allowing the response of the tissues to be non-destructively monitored, over time, at high resolution.” *Id.* at 352.

2. Discussion

Petitioner concedes that Tiziani does not teach certain limitations of claims 20, 22, and 23. Pet. 70–71. Petitioner concedes that Tiziani does not disclose expressly claim 20’s limitation that “the translation mechanism is further configured to change the focal plane of the plurality of incident light beams while maintaining a fixed distance between the probing end and the three-dimensional structure.” *Id.* at 71. Petitioner also concedes that Tiziani does not disclose expressly claim 22’s limitation that “the translation mechanism comprises a motor.” *Id.* at 71. Additionally, Petitioner concedes that Tiziani “does not explicitly disclose that the object, at least a portion of

which is imaged, and image data of which are generated by the apparatus, is a patient's dentition," as required by claim 23. *Id.* at 70. Petitioner argues that Watson teaches these limitations. *Id.* at 70–71. Additionally, Petitioner asserts that it would have been obvious to combine Watson's teachings with Tiziani's and Kino's. *Id.* at 72–75.

Petitioner asserts that a person of ordinary skill in the art would have had a reasonable expectation of successfully combining the teachings of Watson with Tiziani and Kino. *Id.* at 73, 75. Noting that Tiziani and Watson both teach a confocal imaging apparatus adapted to image a three-dimensional object, Petitioner asserts that using Tiziani's system to produce information for a patient's dentition, as disclosed by Watson, "would have been a simple matter of using Tiziani's apparatus to image a patient's dentition, well within the purview of a [person of ordinary skill in the art]." *Id.* at 73. Therefore, Petitioner argues, a person of ordinary skill in the art "would have easily modified Tiziani's method such that the object, at least a portion of which is imaged, and image data of which are generated by the apparatus, is a patient's dentition, with a reasonable expectation of success." *Id.* Regarding modifying Tiziani to use a translation mechanism that comprises a motor, as recited in claim 22, Petitioner cites Watson's disclosure as an example that it was known in the art that implementing a translation mechanism could easily be accomplished with a motor. *Id.* at 75. Thus, Petitioner asserts, a person of ordinary skill in the art "would have easily modified the combination of Tiziani and Kino to include the motor of Watson, as a mere substitution or addition with a reasonable expectation of success." *Id.* at 75.

Petitioner's challenge of claims 20 and 22–30 as allegedly obvious over Tiziani, Gmitro, Ishihara, Kino, and Watson does not cure the above-discussed deficiencies in the challenge of claims 15–19 and 21 as allegedly obvious over Tiziani, Gmitro, Ishihara, and Kino. *See* Pet. 63–75.

Accordingly, for the reasons explained in Section III.C.4 above, Petitioner has not demonstrated obviousness of claims 20 and 22–30 over Tiziani, Gmitro, Ishihara, Kino, and Watson.

E. Petitioner's Motion to Exclude

Petitioner moves for exclusion of Exhibits 2001, 2003, 2004, and 2007–2009. Mot. 1. Exhibit 2001 is a brief entered by Patent Owner in the related ITC proceeding. Exhibit 2003 is the prosecution history of U.S. 6,697,164, from which the '448 patent claims priority. Exhibit 2004 is the reexamination history of U.S. Patent No. 7,230,725, from which the '448 patent claims priority. Exhibit 2007 is a document titled “High-speed 3D shape measurement using a nonscanning multiple-beam confocal imaging system,” which lists as its authors Mitsuhiro Ishihara and Hiromi Sasaki. Exhibit 2008 is a document titled “Three-dimensional image sensing by chromatic confocal microscopy,” which lists as its authors H. J. Tiziani and H.-M. Uhde. Exhibit 2009 is U.S. Patent No. 4,575,805.

Citing our Institution Decision's statements that “[b]riefs are not evidence,” Petitioner argues that Exhibit 2001, Patent Owner's ITC brief, should be excluded because it is not evidence. *Id.* at 2. Petitioner also argues that Exhibit 2001 is impermissible hearsay. *Id.* Petitioner contends that “Patent Owner cites Exhibit 2001 to support Patent Owner's assertions (1) concerning alleged secondary considerations evidence of nonobviousness

and that the challenged claims of the '448 Patent are embodied by Patent Owner's iTero Scanners, and (2) that essentially the same invalidity grounds/arguments were considered in the ITC Proceeding.” *Id.* Petitioner also argues that the testimony of witnesses appearing in Exhibit 2001 constitutes “impermissible hearsay within hearsay.” *Id.* at 3. Petitioner further contends that unfair prejudice outweighs any probative value of Exhibit 2001, arguing that Patent Owner unfairly uses Exhibit 2001 as a vehicle to present additional attorney argument. *Id.* at 3–4. Petitioner argues that Exhibits 2003, 2004, and 2007–2009 should be excluded as irrelevant after our Institution Decision. *Id.* at 4–5.

Patent Owner opposes Petitioner's Motion to Exclude. Opp. 1–6. Patent Owner contends that Exhibit 2001 is not hearsay, arguing that it is not offered for the truth of the matter asserted therein. Rather, Patent Owner explains “Exhibit 2001 is documentary evidence showing what theories and defenses [Petitioner] was aware of at the time it filed its petition.” *Id.* at 3. Regarding Petitioner's assertion of unfair prejudice, Patent Owner argues that “the Board—as a non-jury tribunal with administrative expertise—is well-positioned to determine and assign appropriate weight to Exhibit 2001.” *Id.* at 4. Regarding the other Exhibits, Patent Owner argues that “[p]re-institution exhibits are as much a part of the administrative record as anything that follows.” *Id.* at 5.

We do not rely on most of the portions of Exhibit 2001 of which Petitioner complains. For example, we do not rely on the portions of Exhibit 2001 relating to allegations of objective evidence of non-obviousness, nor do we rely on the declaration testimony or the other evidence cited in Exhibit

2001. Therefore, we dismiss as moot Petitioner's request to exclude these portions of Exhibit 2001.

We cite Patent Owner's reliance on Exhibit 2001 for one purpose. Specifically, we cite Patent Owner's quotation of certain arguments from Exhibit 2001 as evidence that Petitioner should have known before its Petition that Patent Owner contended there would have been issues combining Gmitro's fiber-optic bundle with Tiziani's system. Section III.C.4; Sur-reply 22. With respect to this, Patent Owner does not cite Exhibit 2001 as evidence that the assertions in the Exhibit are true. Instead, Exhibit 2001 is cited as evidence that Petitioner knew Patent Owner had made the assertions therein. Section III.C.4; Sur-reply 22. Because they are not relied on for the truth of the matter therein, the portions of Exhibit 2001 that Patent Owner and we cite are not hearsay.

Regarding Petitioner's assertion that unfair prejudice outweighs any probative value of Exhibit 2001, we agree with Patent Owner. Specifically, as in a district court bench trial, we, sitting as a non-jury tribunal with administrative expertise, are well-positioned to evaluate and assign proper weight to presented evidence. *See Corning Inc. v. DSM IP Assets B.V.*, IPR2013-00053, Paper 66, 19 (PTAB May 1, 2014). We have done so here with respect to Exhibit 2001. In particular, consistent with Petitioner's concerns about Patent Owner unfairly presenting additional attorney argument via Exhibit 2001, we have not considered substantively the attorney arguments presented in Exhibit 2001.

Additionally, we do not agree with Petitioner's suggestion that briefs cannot be evidence. Mot. 1–2. To put the statement in our Institution

Decision that “[b]riefs are not evidence” into proper context, we meant that Patent Owner’s own ITC briefs, by themselves, are not objective evidence of nonobviousness. *See* Inst. Dec. 27. We did not mean that briefs cannot be evidence. Indeed, as cited on page 22 of Patent Owner’s Sur-reply, Patent Owner’s ITC brief is evidence that Petitioner knew Patent Owner contended there would have been issues combining Gmitro’s fiber-optic bundle with Tiziani’s system.

For the foregoing reasons, with respect to the portions of Exhibit 2001 on which we rely, we deny Petitioner’s Motion to Exclude.

Regarding Exhibits 2003, 2004, and 2007–2009, we do not rely on any part of these exhibits. Accordingly, we dismiss as moot Petitioner’s request that we exclude these exhibits.

IV. CONCLUSION

In summary,

Claims	35 U.S.C. §	References/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
15–18	103(a)	Picard, Ishihara		15–18
15–19, 21	103(a)	Tiziani, Gmitro, Ishihara, Kino		15–19, 21
20, 22–30	103(a)	Tiziani, Gmitro, Ishihara, Kino, Watson		20, 22–30
20, 21	103(a)	Tiziani, Gmitro, Ishihara, Kino, Watson		20, 21
Overall Outcome				15–30

V. ORDERS

In consideration of the foregoing, it is hereby

ORDERED that Petitioner has not shown unpatentability of claims 15–30 by a preponderance of the evidence;

FUTHER ORDERED that Petitioner’s Motion to Exclude Evidence is dismissed in part and denied in part; and

FURTHER ORDERED that because this is a Final Written Decision, any party to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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