

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.

IPR2019-00163
Patent 9,101,433 B2

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

ROESEL, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

Dismissing Petitioner's Motion to Exclude
37 C.F.R. § 42.64

3Shape A/S and 3Shape Inc. (“Petitioner”), filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 12 and 14 (“the challenged claims”) of U.S. Patent No. 9,101,433 B2 (Ex. 1001, “the ’433 Patent”). Align Technology, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 7 (“Prelim. Resp.”). On June 11, 2019, we instituted an *inter partes* review as to all claims challenged in the Petition. Paper 8 (“Dec.”).

After institution, Patent Owner filed a Patent Owner Response (Paper 14, “PO Resp.”), Petitioner filed a Reply (Paper 18, “Reply”), and Patent Owner filed a Sur-reply (Paper 25, “Sur-reply”). An oral hearing was held on March 11, 2020, and a transcript of the hearing is included in the record (Paper 35, “Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has not shown by a preponderance of the evidence that claims 12 and 14 of the ’433 Patent are unpatentable.

I. BACKGROUND

A. *Real Parties in Interest*

Petitioner identifies the real parties in interest as 3Shape A/S, 3Shape Inc., 3Shape Holding A/S, 3Shape Trios A/S, and 3Shape Poland sp. z.o.o. Pet. 1. Petitioner lists additional real parties in interest “[o]ut of an abundance of caution . . . for purposes of compliance with 35 U.S.C. § 312(a)(2).” *Id.* at 1–2, App. B. Patent Owner identifies the real party in interest as Align Technology, Inc. Paper 5, 1 (Mandatory Notices).

B. *Related Matters*

The parties identify the following civil action and International Trade Commission (“ITC”) investigation as related matters: *Align Technology*,

Inc. v. 3Shape A/S, No. 1:17-cv-01649 (D. Del., filed Nov. 14, 2017); and *In the Matter of Certain Intraoral Scanners and Related Hardware and Software*, Inv. No. 337-TA-1091 (U.S. Int’l Trade Comm’n, complaint filed Nov. 14, 2017). Pet. 2; Paper 5, 1.

Petitioner identifies IPR2020-00173 and IPR2020-00174, both captioned *3Shape A/S and 3Shape Inc. v. Align Technology, Inc.* and both involving related U.S. Patent No. 8,102,538 B2. Paper 27, 3 (Updated Mandatory Notices). Petitioner also identifies a number of related U.S. patents and patent applications. *Id.* at 1–3.

In the Institution Decision, we identified the following IPR proceedings involving patents related to the ’433 Patent: IPR2019-00154, IPR2019-00155, IPR2019-00156, IPR2019-00157, IPR2019-00159, and IPR2019-00160. Dec. 3. These proceedings were terminated on February 12, 2020 pursuant to Patent Owner’s Request for Adverse Judgment. See Paper 27, 1.

C. The ’433 Patent (Ex. 1001)

The title of the ’433 Patent is “Method and apparatus for colour imaging a three-dimensional structure.” Ex. 1001, (54). The patent discloses a device for determining the surface topology and associated color of a three-dimensional structure, such as a teeth segment. *Id.* at (57), 2:56–62. The resulting data can be used for design and manufacture of a dental prosthesis, such as a crown, bridge, restoration, or filling. *Id.* at 2:62–66. The device includes a scanner for providing depth data and a color imager for providing color data. *Id.* at (57), 4:66–5:8. A processor combines the color data and depth data to provide a three-dimensional color virtual model of the surface of the structure. *Id.* at (57), 5:28–30.

Figure 1 of the '433 Patent is reproduced below:

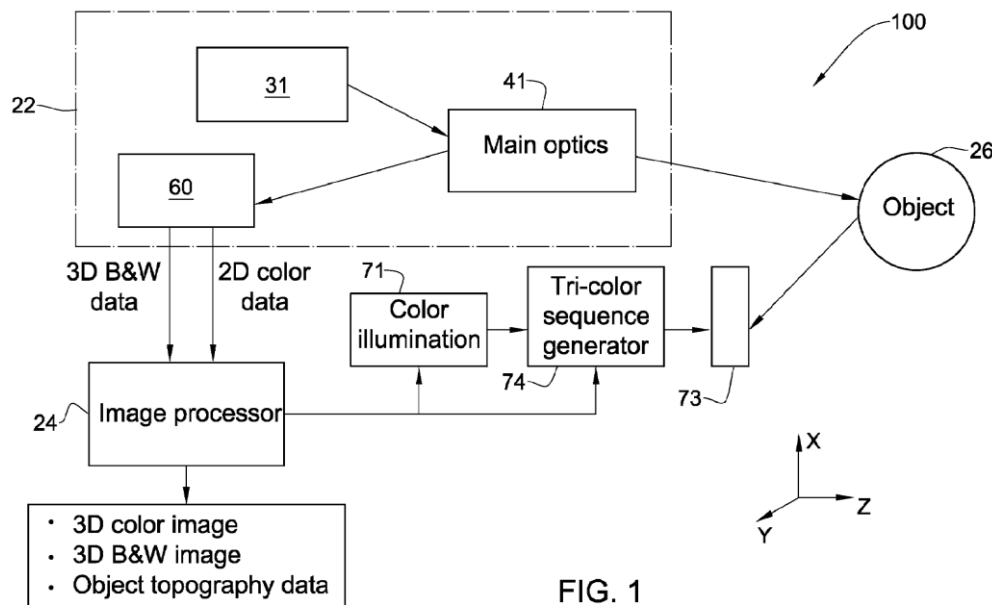


FIG. 1

Figure 1 is a block diagram illustrating the relationship among various elements of the imaging device according to the '433 Patent. Ex. 1001, 12:33–34, 13:10–13. As shown in Figure 1, device 100 includes optical device 22, which in turn includes main illumination source 31, main optics 41, and detection optics 60, which together provide a three-dimensional (“3D”) numerical entity comprising the surface coordinates of object 26. *Id.* at 13:14–28, Fig. 1. Device 100 also includes tri-color light sources 71, tri-color sequence generator 74, and delivery optics 73, which together illuminate object 26 with suitable colors, typically green, red and blue, allowing a two-dimensional (“2D”) color image of object 26 to be captured by detection optics 60. *Id.* at 13:29–34, 16:61–67. Device 100 further includes processor 24, which aligns the 2D color image with the 3D entity and maps color values to the 3D entity at aligned X-Y points. *Id.* at 13:41–44, 14:46–55, Fig. 1. According to the '433 Patent, “[s]uch alignment is straightforward because both the 3D data and the 2D color data are referenced to the same X-Y frame of reference.” *Id.* at 13:44–46; *see*

also id. at 4:41–43 (“the present invention provides a relatively simple and effective way for mapping 2D color information onto a 3D surface model”).

The ’433 Patent describes the mapping procedure as follows:

[E]ach X-Y point on the 2D image substantially corresponds to a similar point on the 3D scan having the same relative X-Y values. Accordingly, the same point of the structure being scanned has substantially the same X-Y coordinates in both the 2D image and the 3D scan, and thus the color value at each X, Y coordinate of the 2D color scan may be mapped directly to the spatial coordinates in the 3D scan having the same X, Y coordinates wherein to create a numerical entity I representing the color and surface topology of the structure being scanned.

Ex. 1001, at 4:15–24. A more detailed description of the mapping procedure is provided with reference to Figures 2A–2C. *Id.* at 13:46–14:16.

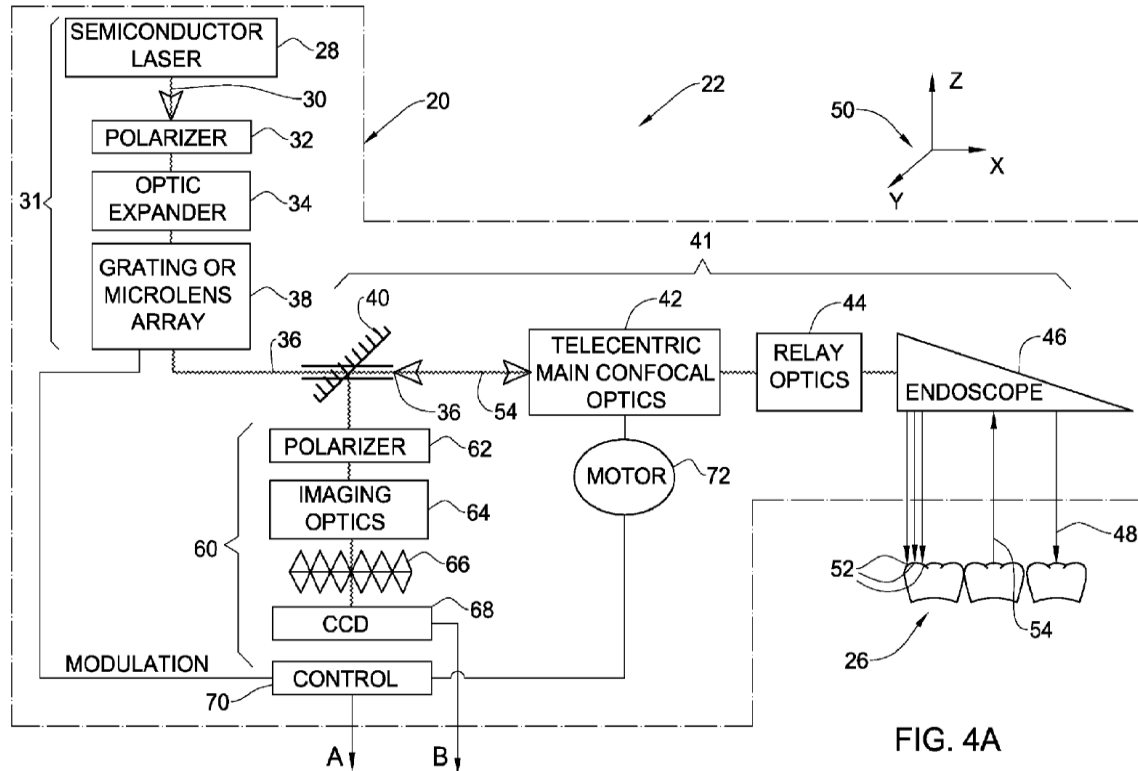
According to the ’433 Patent, the 3D numerical entity E comprises an array of (X, Y, Z) points obtained by determining depth Z-values for a grid of X-Y points. *Id.* at 13:47–51, Fig. 2A. The 2D color image corresponds to another numerical entity N comprised of the location and color value of each pixel forming this image, (X', Y', C). *Id.* at 13:63–66, Fig. 2B. The ’433 Patent discloses that the color value C of each pixel of entity N can be mapped to the data point of entity E having X-Y coordinates that are the same as the X'-Y' coordinates of the pixel, thereby creating another numerical entity I comprising surface coordinate and color data, (X, Y, Z, C). *Id.* at 14:11–16, Fig. 2C.

The ’433 Patent discloses that both the 3D entity E and the 2D color entity N are obtained “[a]lmost concurrently” using the same detection optics 60 at substantially the same relative spatial disposition between detection optics 60 and object 26. Ex. 1001, 13:54–59; *see also id.* at 4:6–8 (3D scan and 2D color image are taken “at substantially the same angle and

orientation”). According to the ’433 Patent, the X'-Y' coordinates of the pixels of the entity N are on a plane substantially parallel to the X-Y plane of the entity E, and the two sets of coordinates represent substantially the same part of object 26. *Id.* at 13:66–14:3; 14:9–11; *see also id.* at 4:9–13 (3D scan and 2D color image have “substantially parallel” X-Y planes and comprise “substantially the same portion of the structure”).

The ’433 Patent explains that the optical information for creating both of these entities is obtained almost simultaneously so there is insufficient time for significant relative movement between the image plane of detection optics 60 and object 26 to occur between the two scans. Ex. 1001, 14:3–9; *see also id.* at 4:2–6 (3D scan and 2D color image are obtained “within a short time interval”).

Figures 4A and 4B of the ’433 Patent are reproduced below:



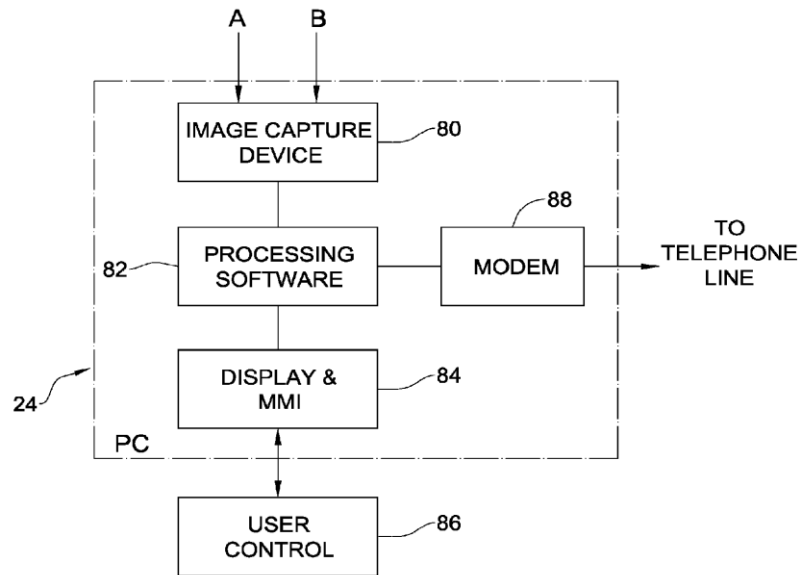


FIG. 4B

Figures 4A and 4B are block diagrams illustrating system 20 for confocal imaging of a 3D structure and providing a 3D monochrome entity.

Ex. 1001, 12:42–44, 14:58–60. As shown in Figures 4A and 4B, system 20 comprises optical device 22 coupled to processor 24. *Id.* at 14:65–66.

Optical device 22 comprises main illumination source 31, main optics 41, detection optics 60, control module 70, and motor 72. *Id.* at 14:56–58, 16:24–26, Fig. 4A. Main illumination source 31 includes semiconductor laser unit 28, polarizer 32, optic expander 34, and module 38, e.g., a grating or micro lens array. *Id.* at 14:66–15:7, Fig. 4A. Main optics 41 includes punctured mirror 40, confocal optics 42, relay optics 44, and endoscope 46. *Id.* at 15:12–13, 15:31–33, 15:66, Fig. 4A. Detection optics 60 comprises polarizer 62, imaging optic 64, array of pinholes 66, and charge coupled device (“CCD”) 68. *Id.* at 16:11–18, 16:60, Fig. 4A. Processor 24 includes image capturing module 80, a central processing unit (“CPU”) with processing software 82, and display 84. *Id.* at 16:19–20, 16:39, 16:49–50, 17:5, Fig. 4B. Processor 24 is connected to user control module 86, typically a computer keyboard. *Id.* at 16:50–52, Fig. 4B.

According to the '433 Patent, light from laser unit 28 travels as light beam 30, incident light beams 36, and incident light beams 48 and impinges on teeth segment 26 as light spots 52 on the surface of the teeth. Ex. 1001, 14:66–15:9, 15:45–15:55, Fig. 4A. Light scattered from the light spots includes returned light beams 54 travelling in the opposite direction from incident light beams 36. *Id.* at 16:4–8. Returned light beams 54 are received by detection optics 60 where CCD 68 measures the light intensity at each pixel. *Id.* at 16:8–18. Light intensity data from CCD 68 is grabbed by image capturing module 80 and analyzed by CPU 82 to determine the relative intensity at each pixel over a range of focal planes of optics 42, 44. *Id.* at 16:19–23, 16:33–38. Before each light pulse from laser 18, the focal plane is changed by displacing optical element 42 along the Z-axis by the action of motor 72 under the control of module 70. *Id.* at 16:24–33. The relative position of each light spot along the Z-axis is determined from the maximal light intensity or maximum displacement derivative of the light intensity for each pixel. *Id.* at 15:55–16:3, 16:41–47; *see also id.* at 3:3–67 (describing confocal focusing method). In this manner, data representative of the three-dimensional structure of the surface of the teeth segment is obtained and displayed on display 84. *Id.* at 16:47–50.

The '433 Patent discloses four techniques for obtaining a 2D color image of object 26. Ex. 1001, 16:53–61, 23:64–67, 24:45–25:2. These techniques involve illuminating object 26 either sequentially with red, green, and blue light or with white light and using either a monochromatic CCD or a color CCD to capture the light reflected from the object. *Id.*; *see also id.* at 13:56–63 (describing method for obtaining 2D color image of object 26). According to a first technique, processing software 82 combines the red,

green, and blue images to provide a 2D color image comprising an array of data points having location (X, Y) and color (C) information for each pixel of the 2D color image. *Id.* at 17:5–8.

The '433 Patent discloses and illustrates seven embodiments of device 100, each of which has a different configuration for obtaining a 2D color image. Ex. 1001, 12:45–13:6, 17:9–24:44, Figs. 5A–13. According to a fourth embodiment, color illumination of object 26 is provided within confocal optics 42. *Id.* at 19:35–42, Fig. 8. The illumination sources may be a laser and two or more light-emitting diodes (LEDs) and may be tri-color, i.e., red, green, and blue, and may include intermediate wavelengths, such as aqua and amber. *Id.* at 19:52–54, 19:64–20:19, 20:42–21:3, Fig. 9; *see also id.* at 21:15–18 (“in each cycle the object 26 is separately illuminated in each of the five colors blue, aqua, green, amber, red, in quick succession, and each time a monochromatic image is obtained”). In one mode of operation, the color light sources are moved with the objective lens in the z-direction, and a set of monochromatic images—red, green, blue, and intermediate wavelengths—is taken at each z-position. *Id.* at 22:1–14. Regarding this mode of operation, the '433 Patent discloses:

Thus, a plurality of color images can be obtained, each based on a different z-position, so that each illumination wavelength is used to illuminate in focus a different part (depth) of the object 26. Advantageously, suitable algorithms may be used to form a composite color image of the set of color images associated with a particular z-scan of the object 26 to provide even more precise and accurate color image, than can then be combined with the depth data.

Id. at 22:19–27.

D. Illustrative Claim

The '433 Patent includes 20 claims. Petitioner challenges claims 12 and 14. Claim 12 is reproduced below, with bracketed identifiers added to correspond with Petitioner's identification of claim elements:

12. [Preamble] A system for determining surface topology and associated color of at least a portion of a three-dimensional structure, the system comprising:

[12.1] an apparatus comprising an image gathering member to generate depth data of the structure portion corresponding to a two-dimensional reference array substantially orthogonal to a depth direction; and

[12.2] one or more processors configured to cause the system to at least:

[12.3] receive, from the apparatus, the depth data of the structure portion corresponding to the two-dimensional reference array substantially orthogonal to a depth direction;

[12.4] receive, from the apparatus, two-dimensional image data of the structure portion associated with the two-dimensional reference array for each of a plurality of focal lengths relative to the image gathering member; and

[12.5] selectively map the image data to the depth data for the two-dimensional reference array based on the plurality of focal lengths and the depth data such that the resulting associated color of the structure portion is in focus relative to the structure portion for a plurality of distances in the depth direction.

Ex. 1001, 28:1–23; see Pet. 25–45 (headings identify elements of claim 12).

E. Prior Art and Asserted Grounds

Petitioner asserts the following grounds of unpatentability:

	Claims Challenged	35 U.S.C. §	References/Basis
1	12, 14	103(a) ¹	Okamoto, ² Babayoff ³
2	12, 14	103(a)	Babayoff, Okamoto

F. Additional Evidence

In addition to the prior art cited above, Petitioner relies on a Declaration of Sohail Dianat, Ph.D. (Ex. 1024) and a reply Declaration of David Schaafsma, Ph.D. (Ex. 1114). Patent Owner cross-examined Petitioner’s declarants and filed transcripts of their depositions as Exhibit 2014 (Dr. Dianat) and Exhibit 2045 (Dr. Schaafsma).

Patent Owner relies on a Declaration of Dr. Milan Sonka (Ex. 2041) and a Declaration of Dave Aikens (Ex. 2042). Petitioner cross-examined Patent Owner’s declarants and filed transcripts of their depositions as Exhibit 1099 (Dr. Sonka) and Exhibit 1097 (Mr. Aikens).

II. ANALYSIS

A. Legal Standards

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed.

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the application from which the ’433 patent issued was filed before this date, the pre-AIA version of § 103 applies.

² Ex. 1004, Japanese Patent Publication No. 2001-82935, published March 30, 2001 (“Okamoto”). Exhibit 1004 includes a Japanese language document, a certified English translation, and two certificates of translation.

³ Ex. 1003, PCT Publication No. WO 00/08415, published February 17, 2000 (“Babayoff”).

Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)); *see also* 37 C.F.R. § 42.104(b) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied upon).

A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and when in evidence (4) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (*citing In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2016) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)). Furthermore, Petitioner does not satisfy its burden of proving obviousness by employing “mere conclusory statements,” but “must instead articulate specific reasoning, based on evidence of record, to support

the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

B. Level of Ordinary Skill in the Art

Relying on the testimony of Dr. Dianat, Petitioner asserts that a person of ordinary skill in the art (“POSITA”) would have at least (1) a bachelor’s degree in electrical engineering, optical engineering, or physics (or equivalent course work) and three to four years of work experience in the areas of optical imaging systems and image processing or (2) a master’s degree in electrical engineering or physics (or equivalent course work) with a focus in the area of optical imaging systems and image processing. Pet. 14 (citing Ex. 1024 ¶ 27). Patent Owner does not dispute Petitioner’s definition of a POSITA.

We accept Petitioner’s definition of a POSITA, which is unchallenged by Patent Owner, supported by Dr. Dianat’s testimony, and consistent with the scope and content of the ’433 Patent and the asserted prior art.

C. Trial Testimony

Patent Owner argues that we “should not credit Dr. Dianat’s testimony because (1) his testimony demonstrates that he lacks a sufficient understanding of optical systems that is necessary to provide probative testimony; and (2) the opinions in his Declaration are unsupported, lack technical merit, and merely adopt attorney argument.” PO Resp. 70–71.

First, Patent Owner argues that Dr. Dianat never worked with or used a confocal microscope, was never involved in the design of lenses, beam splitters, or polarizers, and was unable to answer certain questions at his deposition. PO Resp. 71–72 (citing excerpts from Ex. 2014).

After reviewing the deposition excerpts cited by Patent Owner, we determine that it is not appropriate to discredit the whole of Dr. Dianat's testimony based on his answers to selected deposition questions. In many instances cited by Patent Owner, Dr. Dianat answered Patent Owner's questions by asserting that he did not want to speculate. Ex. 2014, 60:22–61:11, 121:5–124:11, 138:20–139:10, 144:19–145:3, 148:8–16, 194:14–195:14. Most of the cited testimony relates to motivation and feasibility of Petitioner's combination of Okamoto and Babayoff. *Id.* In our view, these answers do not show a lack of credibility on topics unrelated to the subject matter of Patent Owner's questions. In any event, it is not necessary for us to assess the credibility of Dr. Dianat's testimony on the subject matters of cited testimony because we determine that Petitioner has not met its burden of proof for reasons unrelated to whether a POSITA would have combined Okamoto and Babayoff.

In addition, we do not discredit the whole of Dr. Dianat's testimony based on Patent Owner's argument that he lacks hands-on experience with confocal microscopes and specific optical components. PO Resp. 71–72 (citing Ex. 2014, 44:18–45:19, 47:5–48:6, 50:6–20, 51:7–12, 59:4–9, 183:12–15). The cited testimony does not show that Dr. Dianat lacks sufficient knowledge, understanding, or expertise to provide the opinions in his declaration.

Second, Patent Owner argues that Dr. Dianat's testimony should not be given weight because it “simply parrots the same statements made in the Petition” with “no additional analysis or evidence beyond what is already cited in the Petition.” PO Resp. 72–73 (citing examples from the Petition and Dianat Declaration). As one example, Patent Owner asserts that

Petitioner’s allegations that Okamoto teaches claim element 12.5 “are identical—or nearly identical—word-for-word, break-for-break” in the Petition and the Dianat Declaration. *Id.* at 72 (citing Pet. 45–49; Ex. 1024 ¶¶ 93–100).

We do not discredit Dr. Dianat’s testimony solely on the basis of its identity or near identity to the Petition. Instead, we assess the substantive merits of the testimony and, for the reasons discussed below, we determine that Dr. Dianat’s testimony regarding claim element 12.5 is outweighed by the evidence relied upon by Patent Owner, including Dr. Sonka’s testimony regarding Okamoto.

Based on our review of the qualifications of the parties’ declarants,⁴ we determine that each declarant has sufficient education and experience to be “qualified in the pertinent art” and to offer testimony in the form of an opinion. *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1363–64 (Fed. Cir. 2008); Fed. R. Evid. 702; Consolidated Trial Practice Guide 34 (November 2019), <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

D. Claim Construction

Because the Petition was filed before November 13, 2018, and the ’433 Patent has not yet expired, claim terms are to be given their broadest reasonable interpretation in light of the specification. 37 C.F.R. § 42.100(b) (2018).⁵ Under that standard, we generally give claim terms their ordinary

⁴ Ex. 1024 ¶¶ 5–16; Ex. 1025 (Dianat CV); Ex. 1114 ¶¶ 5–9; Ex. 1115 (Schaafsma CV); Ex. 2038 (Sonka CV); Ex. 2039 (Aikens CV); Ex. 2041 ¶¶ 8–24; Ex. 2042 ¶¶ 8–10.

⁵ A recent amendment to this rule does not apply here. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings

and customary meaning, as would be understood by a person of ordinary skill in the art, in the context of the entire patent disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

We address one disputed claim term below. We determine that no other claim term requires express construction for purposes of resolving the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy”); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of *inter partes* review).

1. “*the resulting associated color of the structure portion is in focus relative to the structure portion for a plurality of distances in the depth direction*” (claim 12)

Claim element 12.5 recites:

selectively map the image data to the depth data for the two-dimensional reference array based on the plurality of focal lengths and the depth data such that ***the resulting associated color of the structure portion is in focus relative to the structure portion for a plurality of distances in the depth direction.***

Ex. 1001, 28:18–23. We refer to the entirety of claim element 12.5 as the “Selectively Map” limitation, and we refer to the highlighted portion (also quoted in the heading) as the “In Focus” limitation.

Petitioner proposes an express construction for the phrase “selectively map the image data to the depth data.” Pet. 23. Petitioner contends this phrase should be construed to mean: “map monochrome image data to the

Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (now codified at 37 C.F.R. pt. 42 (2019)).

depth data such that the monochrome image data is a substantially focused image of the structure.” *Id.* (citing papers filed in the ITC). Petitioner contends that its construction “is informed by the specification which discloses the use of monochrome image data.” *Id.* at 24 (citing Ex. 1001, 20:20–22:27). In the Reply Brief, Petitioner clarifies that its proposed construction is only for the phrase “selectively map the image data to the depth data,” not the entirety of claim element 12.5. Reply 1–2.

Relying on Dr. Sonka’s testimony, Patent Owner addresses the meaning of the In Focus limitation. PO Resp. 16–20 (citing Ex. 2041 ¶¶ 181–200). Patent Owner argues that “resulting associated color of the structure portion is in focus,” as recited in claim 12, “does not mean that one resulting associated color component of the structure portion is all that is required to be in focus.” PO Resp. 16. According to Patent Owner, “[s]uch a broad meaning of Selectively Map would be inconsistent with the ’433 Patent and with what a POSITA would have understood.” *Id.* at 17. Patent Owner argues that its interpretation of the In Focus limitation is consistent with the Specification. *Id.* (citing Ex. 1001, 19:42–46, 20:20–29; 20:40–42, 21:9–17; 21:33–52, 21:65–67, 22:7–14). In addition, Patent Owner argues that its interpretation of the In Focus limitation is consistent with contemporaneous dictionary definitions of the word “color.” *Id.* at 18 (citing Ex. 2041 ¶ 192). Patent Owner argues that the Institution Decision is incorrect to the extent that it implicitly construed the Selectively Map limitation as requiring that only a single color component be in focus. *Id.* at 19 (citing Dec. 30–31, Ex. 3001).

Petitioner does not respond to Patent Owner’s arguments regarding the meaning of the In Focus limitation. *Compare* PO Resp. 16–20, with

Reply 1–3 (addressing claim construction). Nor does Dr. Schaafsma respond to Patent Owner’s interpretation of the In Focus limitation or the corresponding testimony of Dr. Sonka. *See generally* Ex. 1114.

After considering both parties’ arguments and evidence, we agree with Patent Owner’s argument that, “to be consistent with the specification, Selectively Map cannot be construed to simply mean one resulting associated color component of the structure portion is all that is required to be in focus.” PO Resp. 19–20.

Patent Owner’s argument is consistent with the claim language. The In Focus limitation recites: “the resulting associated color of the structure portion is in focus relative to the structure portion for a plurality of distances in the depth direction.” The claim language requires that the “associated color” be “in focus,” not just one component of color. According to dependent claims 17 and 18, the image data may be generated by separately illuminating the structure portion with each of three different wavelengths of light, and the depth data may be generated by illuminating the structure portion with one of the three different wavelengths of light.

Ex. 1001, 28:43–48. In contrast to dependent claims 17 and 18, the In Focus limitation pertains to “the resulting associated color,” not merely one wavelength component of the color. The In Focus limitation requires that “the resulting associated color” be in focus, including the entire wavelength composition of the color.

Patent Owner’s argument is also consistent with the Specification. The ’433 Patent discloses “providing an improved focus 2D color image” of a structure, including the steps of: (1) sequentially illuminating the structure with each of a plurality of different wavelengths of illumination;

(2) providing a monochrome image corresponding to each wavelength; (3) manipulating the resulting image data to provide a best focus composite image; and (4) manipulating the resulting image data to provide a composite focused color image of the structure. Ex. 1001, 9:62–10:6. This disclosure supports Patent Owner’s interpretation in two ways. First, it shows that generation of a color image requires illumination at a plurality of different wavelengths. Second, it shows that monochromatic image data needs to be manipulated in order to provide an in focus color image.

The ’433 Patent discloses providing “improved precision of the color data” by illuminating an object with tri-color light sources “with as wide a depth of field as possible.” Ex. 1001, 20:20–26. The ’433 Patent explains that each same-color light source, e.g., blue, “illuminates a particular depth of the object 26 in the z-direction while substantially in focus.” *Id.* at 20:26–29. According to the ’433 Patent, the optical system downstream of the light sources “is chromatic, and in particular maximizes the chromatic dispersion therethrough” such that “each one of the different-colored light sources 377 illuminates a different portion of the object 26 along the z-direction.” *Id.* at 20:33–36, 20:40–42. The blue source illuminates “in focus” a portion of the object closest to the scanning device, the red source illuminates “in focus” a portion of the object furthest from the scanning device, and the green source illuminates “in focus” a portion of the object intermediate the blue and red portions. *Id.* at 20:42–48. The ’433 Patent also discloses providing illumination at intermediate wavelengths, such as aqua and amber. *Id.* at 20:52–67.

The ’433 Patent discloses that, in one mode, the scanning device illuminates the object in cycles, wherein in each cycle the object is

“separately illuminated in each of the five colors blue, aqua, green, amber, red, in quick succession, and each time a monochromatic image is obtained by the monochromatic image sensor.” Ex. 1001, 21:9–19. Thereafter, each set of five monochromatic images is analyzed to provide a composite color image. *Id.* at 21:19–20. The ’433 Patent discloses that parts of each monochromatic image will be in focus and other parts of the image will appear out of focus. Specifically, according to the ’433 Patent:

Each of the monochrome images in any particular set corresponds to a particular illumination color or wavelength, and thus the zone(s) of the object 26 within the depth of field corresponding to this illumination will be in focus, while the other parts of the object 26 will appear out of focus. Thus, each such image in the aforesaid set of images will contain a portion which has high precision focused image of a part of the object, for the particular illumination wavelength.

Id. at 21:25–32. As Dr. Sonka explains, “not all parts of the object of interest 26 will be in focus in the set of five monochromatic images.”

Ex. 2041 ¶¶ 109, 185.

The ’433 Patent discloses that, in order to provide a focused image, suitable algorithms are used to manipulate the monochrome image data. Specifically, according to the ’433 Patent,

In forming a composite image for each set of images, the images are combined in such a way as to maximize the precision of the focused image and corresponding color thereof. Thus, for example, suitable algorithms may be applied to each of the five images of a set to distinguish between the focused and unfocused . . . areas thereof. Such algorithms may employ, for example, techniques which apply FFT techniques to areas of the images, and which search for high frequency portions which correspond to focused areas. In any case, such algorithms, as well as software and hardware to accomplish the same are well known in the art. Then, the focused areas of each of the five images are

merged to provide a monochrome composite substantially focused image of the object.

Ex. 1001, 21:33–45.

The '433 Patent discloses obtaining depth and color scans by displacing both an objective lens and color light sources in the z-direction and taking a set of monochromatic images at each z-position. Ex. 1001, 22:1–14. According to the '433 Patent, at each z-position, “each one of the colored illuminations—red, green, blue and intermediate wavelengths—illuminates a progressively deeper part of the object along the z-direction.” *Id.* at 22:8–14. The '433 Patent cautions that, at one end of the depth scan, the green and red illuminations may “completely overshoot the object,” and “the corresponding images may be discarded or otherwise manipulated to provide a composite color image at this station.” *Id.* at 22:15–19.

The In Focus feature of claim 12 is described in the following summary passage:

Thus, a plurality of color images can be obtained, each based on a different z-position, so that each illumination wavelength is used to illuminate in focus a different part (depth) of the object 26. Advantageously, suitable algorithms may be used to form a composite color image of the set of color images associated with a particular z-scan of the object 26 to provide even more precise and accurate color image, than [*sic* that] can then be combined with the depth data.

Ex. 1001, 22:19–27.

Thus, the '433 Patent exploits the chromatic nature of the optical system and the wavelength properties of light sources to improve the precision and accuracy of the color data. Ex. 1001, 20:20–29, 20:33–52, 21:25–35, 22:19–27. More specifically, the '433 Patent recognizes that each illumination color, e.g., red, green, or blue, is “in focus” at a different depth,

and the resulting monochromatic image data includes both in-focus and out-of-focus portions that need to be manipulated with suitable algorithms in order to produce a focused full color image. *Id.* at 20:26–29, 20:40–52, 21:25–45, 22:9–27. These disclosures support Patent Owner’s argument that “resulting associated color of the structure portion is in focus,” as recited in claim 12, “does not mean that one resulting associated color component of the structure portion is all that is required to be in focus.” PO Resp. 16.

Patent Owner’s interpretation of the In Focus limitation is also supported by extrinsic evidence. Patent Owner’s un rebutted evidence includes dictionary definitions that define the word “color” as “wavelength composition of light that is reflected by an object.” Ex. 2041 ¶ 192 (reproducing definitions from Exhibits 2019 and 2021). That definition supports Patent Owner’s argument that the phrase, “the resulting associated color of the structure portion is in focus,” should not be construed so broadly as merely requiring that one resulting associated color component of the structure portion be in focus. PO Resp. 18. The claim requires that the “associated color” be in focus (Ex. 1001, 28:20–22), and the Specification refers to monochromatic color components, such as red, green, and blue, that are combined to form a full color image (*id.* at 10:19–24, 10:32–36, 13:29–34, 13:59–63). The “in focus” requirement applies to the “associated color,” not merely a color component, such as red, green, or blue. The “associated color” includes the entire wavelength composition of light reflected by an object. Ex. 2041 ¶ 192 (reproducing dictionary definitions for “color”).⁶

⁶ In the Institution Decision, we relied on a different dictionary definition for “color” (Ex. 3001), which Patent Owner argues led to an implicit construction that is inconsistent with the ’433 Patent. Dec. 31; PO Resp. 19. Although we do not believe the definition in Exhibit 3001 is inconsistent

Patent Owner's interpretation of the In Focus limitation is also supported by the un rebutted testimony of Dr. Sonka. Ex. 2041 ¶¶ 180–200.

Dr. Sonka testifies:

Under its plain and ordinary meaning, the claimed “resulting associated color of the structure portion is in focus” does not mean that the one or more processors are merely configured to cause a system to selectively map the image data to the depth data such that one resulting associated color component of the structure portion is all that is required to be in focus.

Ex. 2041 ¶ 180.

It is my opinion that such a broad meaning of the Selectively Map Feature would be inconsistent with the '433 Patent and with what a POSITA would have understood.

Id. ¶ 181.

In view of the above [disclosures in columns 20–22 of the '433 Patent], a POSITA would have understood that using a single illumination source (e.g., red laser beam) that would result in a single color component (e.g., red) being in focus is insufficient to describe the Selectively Map Feature. In other words, to broadly interpret Selectively Map Feature to simply mean that the one or more processors are configured to cause a system to selectively map the image data to the depth data such that one resulting associated color component of the structure portion is all that is required to be in focus would be inconsistent with the '433 patent.

Id. ¶ 189.

We find that the foregoing testimony is credible and consistent with the teachings of the '433 Patent, as summarized above and in Dr. Sonka's

with our final Decision, we no longer rely on it because Patent Owner has submitted an alternative definition that is undisputed by Petitioner. Ex. 2041 ¶ 192 (citing Exs. 2019, 2021).

testimony. Ex. 1001, 20:20–22:27; Ex. 2041 ¶ 182–188. We also credit Dr. Sonka’s testimony that, when an object is illuminated by white light or by different colored monochromatic illuminations, such as red, green, and blue, the light reflected by the object would not be limited to a single color component or a single wavelength, but would instead include at least some light at each wavelength component of the illumination. Ex. 2041 ¶¶ 190, 191 (citing Ex. 2020, Fig. 2). For the color of the object to be in focus, it is not sufficient that only a single component of the reflected light to be in focus. *Id.* ¶¶ 189, 193.

Dr. Sonka’s testimony is un rebutted by Petitioner’s expert, Dr. Schaafsma. His reply declaration does not address the meaning of the In Focus limitation of claim 12, nor whether that limitation is taught or suggested by the prior art. *See generally* Ex. 1114.

Accordingly, we adopt Patent Owner’s construction for the In Focus limitation, namely that “resulting associated color of the structure portion is in focus,” as recited in claim 12, “does not mean that one resulting associated color component of the structure portion is all that is required to be in focus.” PO Resp. 16.

E. Overview of Prior Art References

Below we provide an overview of the prior art references relied upon by Petitioner.

1. Okamoto (Ex. 1004)

Okamoto discloses a three-dimensional shape measurement device that measures both the three-dimensional shape of a target object and the color of the target object and displays the three-dimensional shape with the

color close to the actual color of the target object. Ex. 1004, code (57), ¶¶ 1, 8, 9.

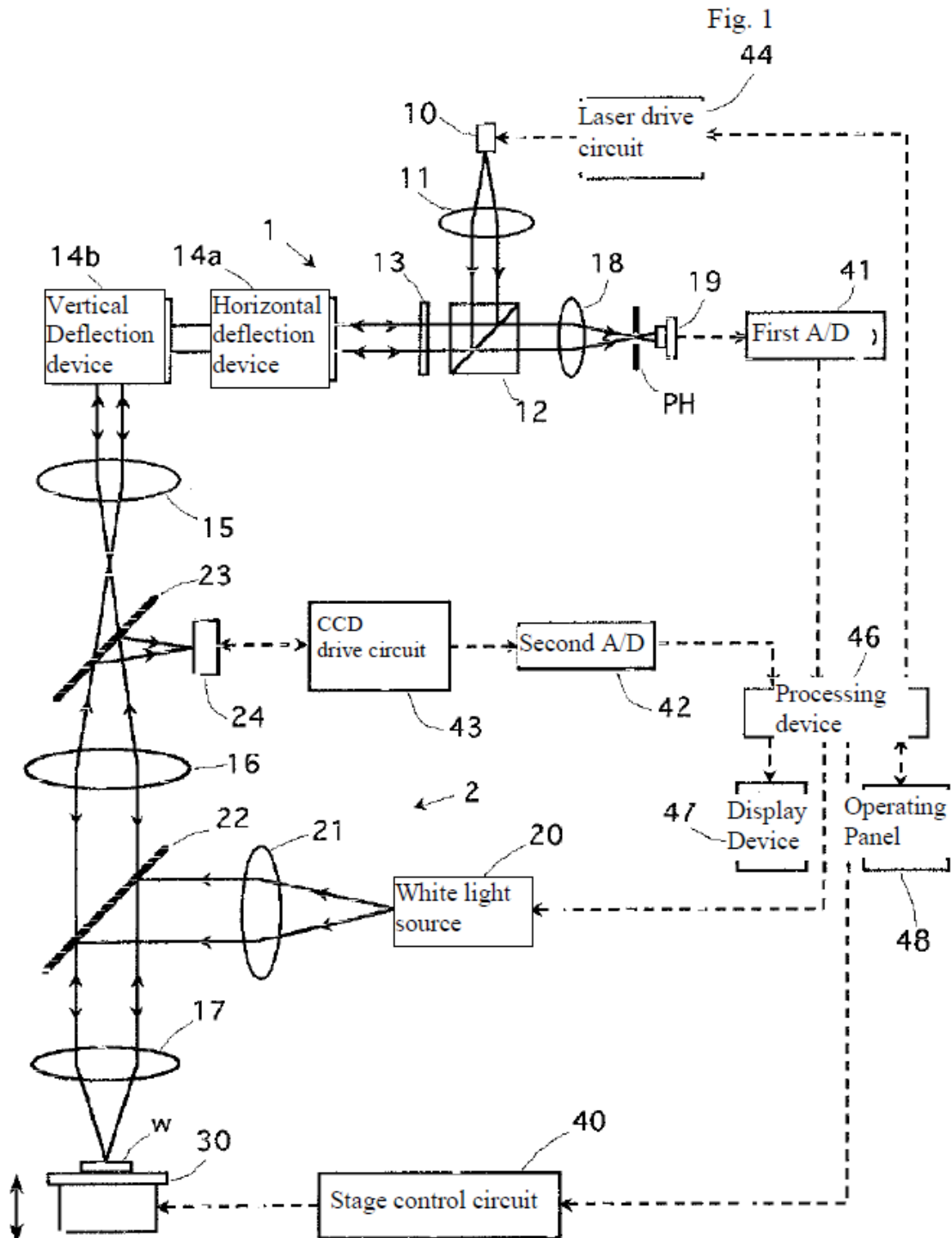
Okamoto's measurement device includes a confocal optical system for obtaining height information for a target object. Ex. 1004 ¶¶ 15, 21, Fig. 1. The confocal optical system includes (1) a single color light source, such as a semiconductor laser that emits a red laser beam; (2) a Z direction displacement mechanism for changing the position of the target object relative to a focal point of an objective lens in the optical axis direction; (3) an XY scanning mechanism for scanning the target object perpendicular to the optical axis direction; and (4) a photo receptor for measuring the amount of light reflected from the target object as a function of XY and Z positions. *Id.* ¶¶ 12, 16–18. Okamoto discloses that, when the Z position is adjusted such that the focal point coincides with the sample surface, i.e., when the laser beam is focused on the sample, the light reception amount is maximized, and the height information can be derived from the corresponding Z position. *Id.* ¶¶ 3, 22–24.

Okamoto's measurement device includes a non-confocal optical system for obtaining color information for the target object. Ex. 1004 ¶ 15, Fig. 1. The non-confocal system includes a white light source that illuminates the sample with white light for color imaging and a color CCD for obtaining color information for each pixel (XY position) and each Z position. *Id.* ¶¶ 12, 28.

Okamoto's measurement device includes a processing device that “seeks and stores for each pixel the height information and color information that correspond to the relative position in the optical axis direction of the measurement target object w when the light reception amount is

maximized.” Ex. 1004, code (57), ¶ 12. Thus, the color information stored for each pixel corresponds to a Z position where light from a single color light source, e.g., a red laser beam, is in focus when reflected off the sample. *Id.* ¶ 22.

Figure 1 of Okamoto is reproduced below.



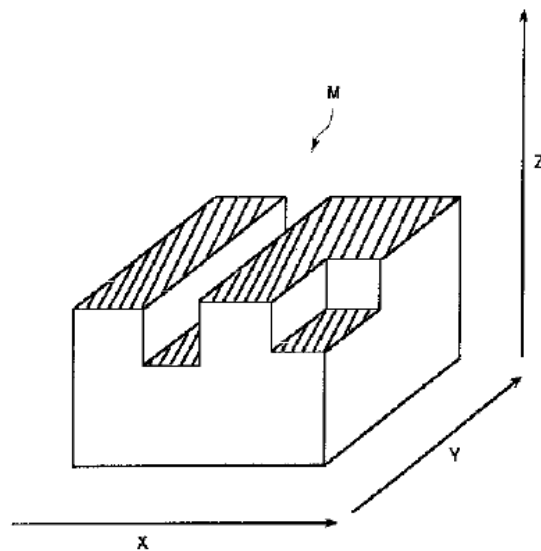
Okamoto Figure 1 is a block diagram showing the schematic configuration of a confocal microscope, i.e., a three-dimensional measurement device.

Ex. 1004 ¶ 15, p. 8 (brief description of the drawings). Okamoto's confocal microscope includes "confocal optical system 1 to obtain the 3-dimensional surface shape information that includes sample height and non-confocal optical system 2 to obtain the sample color image." *Id.* ¶ 15.

Okamoto describes confocal optical system 1. Ex. 1004 ¶¶ 16–27. Light source 10 for the confocal optical system is a semiconductor laser that emits a red laser beam. *Id.* ¶ 17. According to Okamoto, the confocal optical system obtains information concerning the three-dimensional surface profile, including information regarding the height of the sample. *Id.* ¶ 21. More specifically, the distribution of surface heights of the sample in the XY plane is obtained. *Id.* ¶ 24. Okamoto discloses that the height distribution (surface profile) of the sample can be displayed three-dimensionally. *Id.* ¶ 25.

Figure 3 of Okamoto is reproduced below.

Fig. 3



Okamoto Figure 3 shows an example of a three-dimensional display of a simple solid model M. Ex. 1004 ¶ 26, p. 8 (brief description of the drawings).

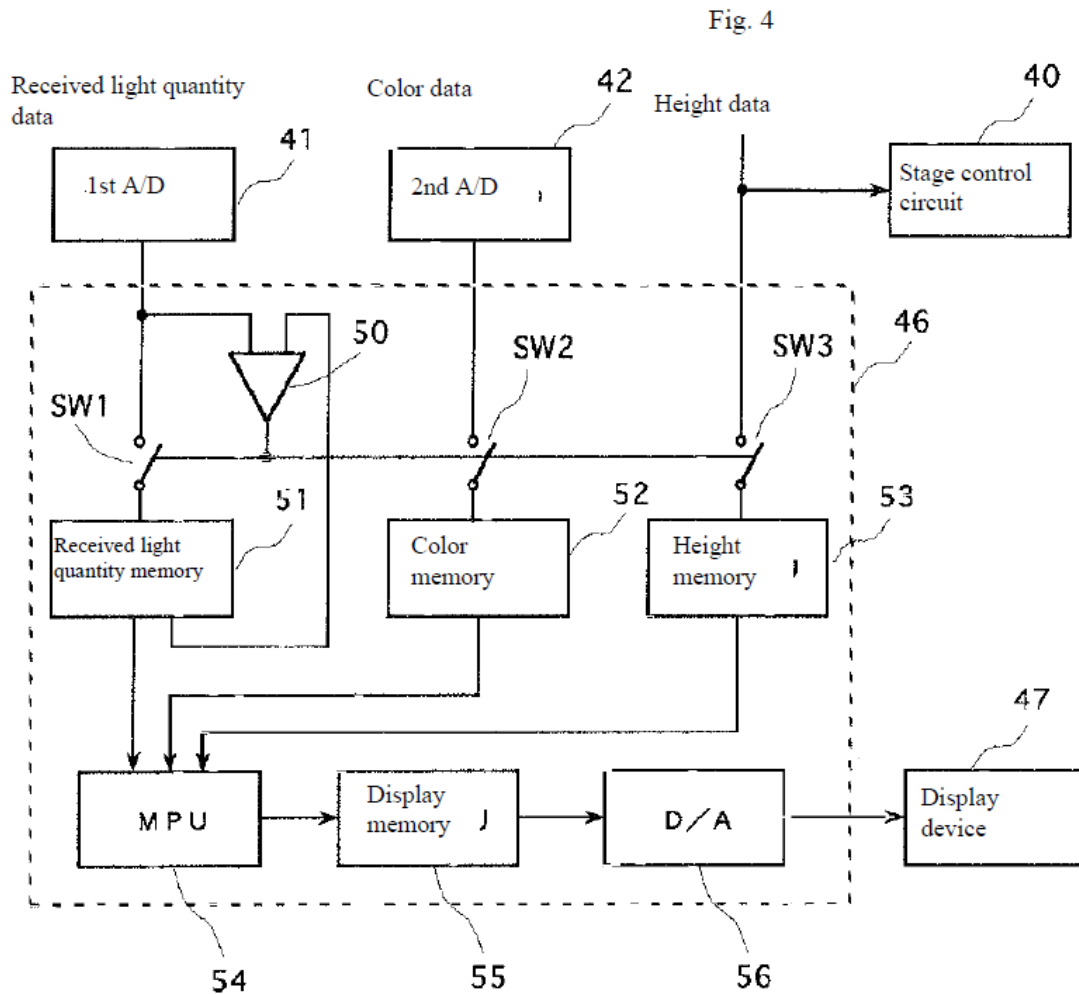
Okamoto describes non-confocal optical system 2. Ex. 1004 ¶¶ 28–30. Light source 20 for the non-confocal system is a white light source that illuminates the sample for color imaging. *Id.* ¶ 28. The non-confocal system uses a color CCD as a color information capture sensor. *Id.* According to Okamoto, the CCD “is provided at a position that is conjugate or nearly conjugate to the pinhole . . . of the confocal optical system 1.” *Id.* ¶ 30. The non-confocal system obtains a color image that is “converted to digital values” and displayed on a screen “as an enlarged color image for observing the sample.” *Id.*

Okamoto describes how the information from the confocal and non-confocal optical systems are combined and displayed. Ex. 1004 ¶¶ 31–37. Okamoto discloses:

Color images obtained with the non-confocal optical system 2 are combined in a three-dimensional display of the surface profile of the sample obtained by the confocal optical system 1 described above, and color three-dimensional display is carried out. As a result, portions represented by hatching viewed from above in the Z-axis direction are colored with the colors of a color image in the display model shown in Fig. 3. Picture elements of the hatched portions are imaged in the XY plane and are associated with picture elements of the color image.

Ex. 1004 ¶ 31. According to Okamoto, processing for carrying out color three-dimensional display is executed “in accordance with software by a microprocessor contained in processing device 46,” which is indicated in Figure 1 and shown in more detail in Figure 4. *Id.* ¶¶ 24, 33, 34.

Figure 4 of Okamoto is reproduced below.

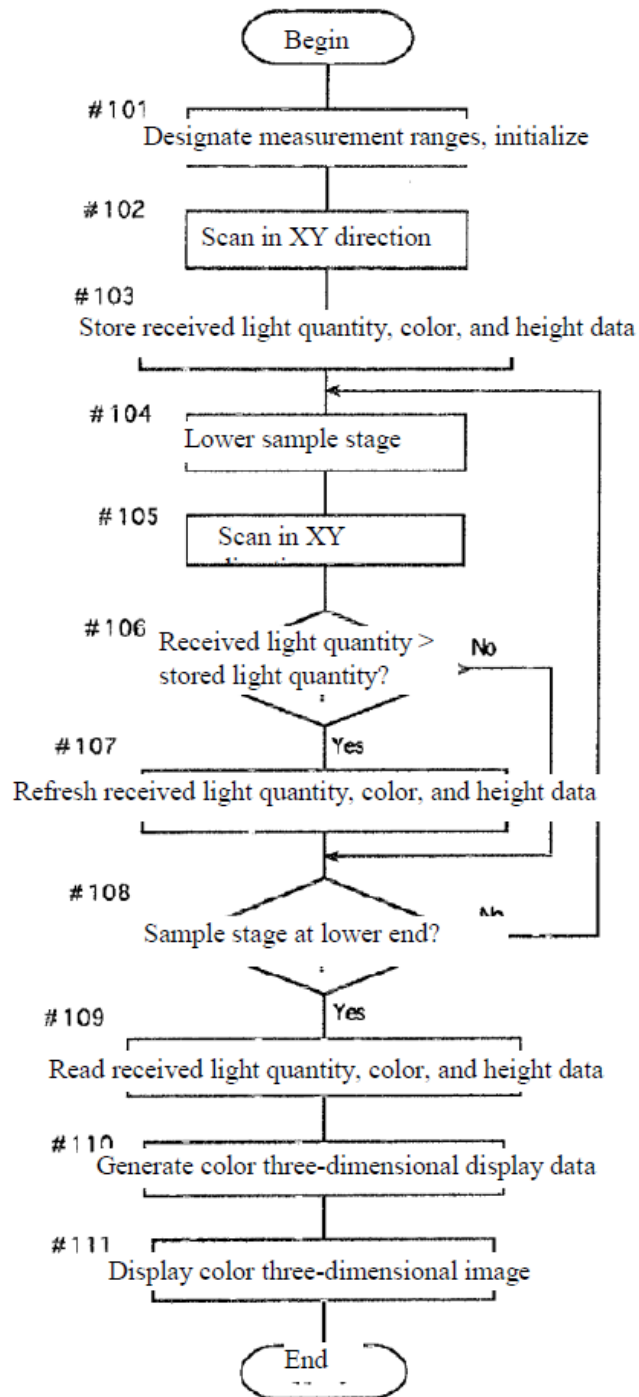


Okamoto Figure 4 is a block diagram showing a configuration that focuses on processing device 46 for carrying out color three-dimensional display. Ex. 1004 ¶ 34, p. 8 (brief description of the drawings). Okamoto discloses that color data and height data for the corresponding picture elements are stored in color memory 52 and height memory 53. *Id.* ¶ 35. According to Okamoto, the color data is input from the color CCD 24 to processing device 46. *Id.* Microprocessor 54 uses the stored color data and the stored height data to generate color three-dimensional display data of the surface profile of the sample, which is input to display memory 55 and provided to display device 47. *Id.* ¶ 36. Okamoto discloses that “[t]he color three-

dimensional display data . . . is generated from the height data and color data for each picture element in the XY plane.” *Id.* ¶ 37.

Figure 5 of Okamoto is reproduced below.

Fig. 5



Okamoto Figure 5 is a flow chart showing processing for color three-dimensional display. Ex. 1004 ¶ 38, p. 8 (brief description of the drawings). In step 101, the XY scanning range and the Z scanning range are designated. *Id.* ¶ 38. In step 102, laser light scans the surface of the sample in the XY direction. *Id.* ¶ 39. In step 103, the received light quantity data, the color data, and the height data for each picture element are stored. *Id.* In steps 104 and 105, the sample stage is lowered one step, and the sample is scanned again. *Id.* ¶ 40. In steps 106 and 107, the new light received quantity is compared with the stored light quantity data, and if the new light received quantity is greater than the stored light quantity, then the stored data for the light quantity, color, and height are refreshed. *Id.* In step 108, the Z direction position of the sample stage is compared with the lower end of the designated measurement range. *Id.* ¶ 41. Steps 104 to 108 are repeated until the sample stage reaches the end of the measurement range. At that point, the maximum received light quantity, color, and height data for each picture element in the XY scanning range are stored. *Id.* ¶ 42. In steps 109 to 111, the stored data are read, color three-dimensional display data of the surface profile of the sample are generated, and a color three-dimensional image is displayed. *Id.*

According to Okamoto, the effect of the disclosed three-dimensional measurement device is that “three-dimensional display of the surface profile is colored with colors that are close to the actual colors of the object to be measured.” Ex. 1004 ¶ 46.

2. *Babayoff (Ex. 1003)*

Babayoff discloses a method and an apparatus for imaging of a three-dimensional structure by confocal focusing an array of light beams.

Ex. 1003, 1 (title). According to Babayoff, the method is particularly useful for surveying of teeth in the oral cavity of a patient and imaging of a three-dimensional topology of a teeth segment. *Id.* at 1:2–4, 1:8–9, 2:25–27.

Babayoff discloses an apparatus for determining surface topology of a portion of a three-dimensional structure. Ex. 1003, 3:23–4:14. The apparatus comprises a probing member, an illumination unit, light focusing optics defining one or more focal planes, a translation mechanism for displacing the focal plane, a detector, and a processor. *Id.* According to Babayoff, the probing member, illumination unit, focusing optics, translation mechanism, and detector are preferably included together in a hand-held device. *Id.* at 4:15–17.

Babayoff is incorporated by reference in the '433 Patent. Ex. 1001, 14:61–63. In addition, the '433 Patent incorporates large portions of Babayoff's disclosure with little modification. *Compare* Ex. 1003, 3:3–4:14, 4:18–5:21, 8:10–12, 8:24–12:15, 12:21–13:5, Figs. 1A, 1B, 2A, 2B, *with* Ex. 1001, 3:3–62, 5:30–56, 14:58–60, 14:65–16:52, 25:16–29, 17:12–26, Figs. 4A, 4B, 5A, 5B. It is undisputed that Babayoff does not disclose obtaining color image data or mapping such data to depth data.

F. Petitioner's Obviousness Grounds

Petitioner contends that claims 12 and 14 of the '433 Patent are unpatentable under 35 U.S.C. § 103(a) over Okamoto and Babayoff. Pet. 25–75. Patent Owner opposes. PO Resp. 21–70, 73–75. We address the parties' arguments below, concentrating on the In Focus limitation of claim 12.

Petitioner presents two obviousness grounds: (1) Okamoto in view of Babayoff, and (2) Babayoff in view of Okamoto. For both grounds,

Petitioner relies on Okamoto for claim element 12.5, which includes the In Focus limitation. Pet. 45–49, 68–69.

For its first obviousness ground, Petitioner contends:

Okamoto discloses at least one processor (“processing device”, “microprocessor”) configured to cause the system to selectively map the image data (“color data”) to the depth data (“height data”) for the two-dimensional reference array (“XY plane”) and the depth data such that the resulting associated color of the structure portion is in focus relative to the structure portion for a plurality of distances in the depth direction.

Pet. 45 (citing Ex. 1004 ¶¶ 12, 24, 33–42, 46, Figs. 1, 4, 5; Ex. 1024 ¶ 94).

Regarding the In Focus limitation, Petitioner submits the following:

In Okamoto’s process, the data at each pixel is updated such that the resulting associated color of the structure portion is in focus. This is because Okamoto discloses that maximum light quantity data, and the color data and height data thereat for each picture element, is updated (“stored”). . . . Okamoto discloses that the maximum light quantity corresponds to when the pixel is in focus.

Pet. 47 (citing Ex. 1004 ¶¶ 3, 10, 37, 40; Ex. 1024 ¶ 97).

Recognizing that Okamoto may be deficient with respect to the In Focus limitation, Petitioner asserts the following as a fall-back position:

Patent Owner in the ’433 Patent admits that algorithms, software and hardware for combining images “in such a way as to maximize the precision of the focused image and corresponding color thereof . . . are well known in the art.” . . . Further, Pulli⁷ provides evidence that additional techniques for selectively mapping color data to depth data were well-known and conventional at the time of the purported invention. . . . Thus, if there are any differences between the manner in which

⁷ Ex. 1013, Kari Pulli, *Surface Reconstruction and Display from Range and Color Data* (Dec. 2, 1997), available at UMI Microform No. 9819292 (1998).

Okamoto maps image data to depth data and what is claimed, it would have been obvious to modify Okamoto in light of the well-known techniques (admitted to in the '433 Patent) for combining image and depth data to maximize the precision of the focused image.

Pet. 48–49 (citing Ex. 1001, 21:33–43; Ex. 1013, 81–97; Ex. 1024 ¶ 100).

For claim element 12.5, including the In Focus limitation, Petitioner relies on the same contentions for its second obviousness ground as are presented for its first obviousness ground. Pet. 69.

Patent Owner challenges Petitioner's contentions, arguing that Okamoto does not teach or suggest the In Focus limitation. PO Resp. 36–45. Patent Owner and Dr. Sonka assert that Okamoto's system would suffer from chromatic aberration resulting in out-of-focus color data. *Id.* at 37–43; Ex. 2041 ¶¶ 312–335. According to Patent Owner, "Okamoto merely presumes that when its light quantity data, received by illuminating the sample with its single color laser beam, is at its maximum, then any color data captured at this time using a white light would also be in focus." PO Resp. 37 (citing Ex. 2041 ¶ 317). Patent Owner and Dr. Sonka assert that this presumption is incorrect due to chromatic aberration—a phenomenon that results in different focal lengths for different wavelengths of light passing through a lens, such that red, green, and blue light are "in focus" at different distances from the lens. *Id.* at 38–43; Ex. 2041 ¶¶ 312–335.

According to Patent Owner and Dr. Sonka, Okamoto ignores chromatic aberration, and as a result, "at least blue and green colors of Okamoto's color data would be out of focus with respect to the plane of the color CCD." PO Resp. 42; Ex. 2041 ¶ 324. Patent Owner and Dr. Sonka

assert that a later Okamoto reference⁸ recognizes and addresses the chromatic aberration problem. PO Resp. 42–43; Ex. 2041 ¶¶ 326–335. Patent Owner contends that Okamoto fails to teach the In Focus limitation because it ignores the effect of chromatic aberration and, as a result, its color data is not in focus. PO Resp. 43–45 (citing Ex. 2041 ¶¶ 383–391).

In its Reply, Petitioner does not respond to Patent Owner’s argument that Okamoto fails to teach or suggest the In Focus limitation due to chromatic aberration. At most, Petitioner and Dr. Schaafsma assert that aberration errors would not have been an insurmountable challenge when combining Okamoto and Babayoff. Reply 21–22; Ex. 1114 ¶¶ 33, 35.

After considering both parties’ arguments and evidence, we determine that Petitioner has not met its burden to show that Okamoto teaches or suggests the In Focus limitation of claim 12. Patent Owner advances a credible, evidence-supported argument that Okamoto does not teach or suggest the In Focus limitation due to chromatic aberration. PO Resp. 36–45. Patent Owner supports its argument with detailed testimony from Dr. Sonka, analyzing the teachings of Okamoto. Ex. 2041 ¶¶ 312–335, 382–391. Patent Owner and Dr. Sonka rely on objective scientific evidence to explain the phenomenon of chromatic aberration. PO Resp. 38–39; Ex. 2041 ¶¶ 313–316 (citing Ex. 2020, 1–3, Fig. 2; Ex. 2027, 438, Fig. 8; Ex. 2028, 325; Ex. 2034, 176). Patent Owner and Dr. Sonka also rely on Okamoto ’373, which they assert recognizes and addresses the chromatic aberration problem. PO Resp. 42–43; Ex. 2041 ¶¶ 326–335 (citing Ex. 2023

⁸ Ex. 2023, Japanese Patent Publication No. JP 2004-29373, published January 29, 2004 (“Okamoto ’373”). Exhibit 2023 includes a Japanese language document, a certified English translation, and a certificate of translation.

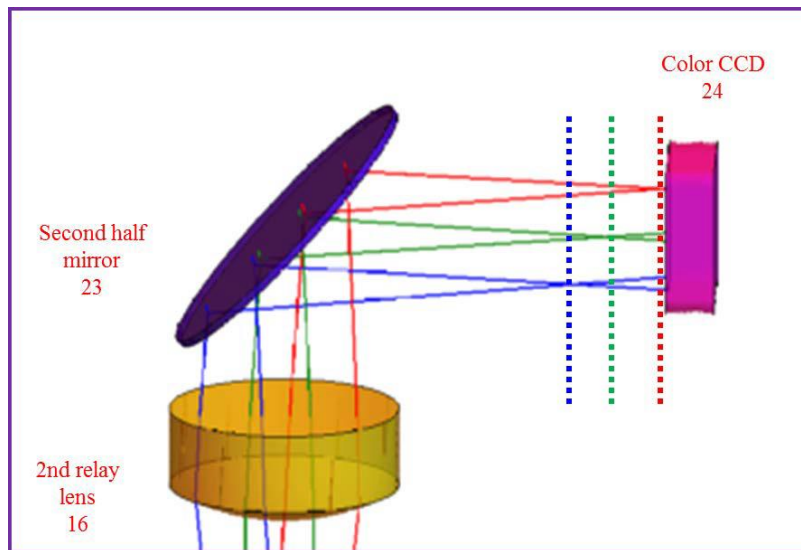
¶¶ 2, 4, 5, 9, 11, 38, 39, 43–48, Figs. 1, 6). Patent Owner’s arguments and evidence are un rebutted by Petitioner and Dr. Schaafsma. For this reason alone, we conclude that Petitioner does not meet its burden of proof.

Our conclusion is reinforced when we consider the substance of Patent Owner’s argument. For the reasons discussed above, we adopt Patent Owner’s construction of the In Focus limitation that “resulting associated color of the structure portion is in focus,” as recited in claim 12, “does not mean that one resulting associated color component of the structure portion is all that is required to be in focus.” PO Resp. 16.

We are persuaded by Patent Owner’s characterization of Okamoto, namely that “Okamoto merely presumes that when its light quantity data, received by illuminating the sample with its single color laser beam, is at its maximum, then any color data captured at this time using a white light would also be in focus.” PO Resp. 37 (citing Ex. 2041 ¶ 317). Patent Owner’s characterization is consistent with Okamoto’s disclosure. Okamoto teaches a confocal system that makes an “in focus” determination based on **single color light**, e.g., a red laser beam. Ex. 1004 ¶¶ 16, 17, 20, 22. There is no corresponding “in focus” determination for the white light used in Okamoto’s non-confocal color imaging system. Nor is there any other accommodation for the differing focal planes of red, green, and blue light. Instead, Okamoto teaches refreshing stored data for light quantity, color, and height when a newly received light quantity is greater than a previously stored light quantity. *Id.* ¶¶ 34, 35, 40, Fig. 5, step 107. The light quantity being measured and compared is **single color light**, e.g., from a semiconductor laser that emits a red laser beam. *Id.* ¶¶ 16, 17, 22, 23.

Okamoto assumes that a pixel is in focus when the received quantity of reflected laser light is at a maximum. *Id.* ¶¶ 3, 10, 22–24, 27, 37.

Patent Owner's un rebutted evidence shows that Okamoto's assumption is not accurate. More particularly, Patent Owner's evidence shows that, when Okamoto's red laser light is in focus, other components of Okamoto's white light source, such as blue and green light, would not be in focus due to chromatic aberration. PO Resp. 42; Ex. 2041 ¶¶ 322–324. Patent Owner and Dr. Sonka use the following figure to illustrate this point:



PO Resp. 42; Ex. 2041 ¶ 323. The above Figure is a modification of a portion of Okamoto Figure 1 showing parts of a non-confocal optical system, including second relay lens 16, second half mirror 23, and color CCD 24. As shown in the figure, components of white light reflected by the sample—illustrated as red, green, and blue light beams—propagate through optical components and are received by color CCD 24. Ex. 2041 ¶ 321. The red, green, and blue wavelengths have different focal planes when they reach the CCD, as illustrated by colored dashed lines in the figure. *Id.* ¶ 324.

Dr. Sonka uses the above figure to illustrate his testimony as follows:

Assuming that light source 10 driven by its laser drive circuit 44 emits a monochromatic laser beam (e.g., red) when scanning its sample w, then a POSITA would have understood that with exception of the wavelength that matches the wavelength of the monochromatic laser beam, other colors or wavelengths reflected back from the sample will be out of focus as they propagate and reach the color CCD 24. This is because Okamoto merely presumes that when its light quantity data received by illuminating the sample with its monochromatic laser beam is at its maximum, then any color data captured at this time using a white light would also be in focus.

Ex. 2041 ¶ 322.

As illustrated above, and in the above example where a monochromatic laser beam (e.g., red) is used, a POSITA would have understood that the blue and green colors or wavelengths will have different focal planes as compared to the red color or wavelength (shown as red dashed line), when the wavelength of the red color matches the wavelength of the monochromatic laser beam (e.g., red). Therefore, a POSITA would have understood that because not all colors or wavelengths reflected by the sample will be in the same focal plane as the monochromatic laser beam, the color of the sample as captured by Okamoto's color CCD 24 and represented as color data will be out of focus as a result of chromatic aberration. Additionally, while apochromatic objectives may be able to correct for some colors or wavelengths, a POSITA would have understood that such correction will still result in all other color components being out of focus.

Ex. 2041 ¶ 324.

Accordingly, a POSITA would have understood that Okamoto would have been affected by chromatic aberration causing the color of its sample to be out of focus.

Ex. 2041 ¶ 325.

We find that the foregoing testimony of Dr. Sonka is credible and consistent with Okamoto's teachings. *See, e.g.,* Ex. 1004 ¶¶ 3, 10, 22–24,

27–30, 37. The testimony is un rebutted by Petitioner and its reply declarant, Dr. Schaafsma. Although Petitioner cross-examined Dr. Sonka (Ex. 1099), we are not aware of any cross-examination pertaining to the foregoing declaration testimony or the teachings of Okamoto relative to the In Focus limitation or chromatic aberration.

We agree with Patent Owner that the foregoing testimony supports a finding that the In Focus limitation is not taught or suggested by Okamoto. PO Resp. 36–45. As discussed above, the In Focus limitation requires that “the resulting associated color” be in focus, not merely one component of the associated color. Patent Owner has shown persuasively that Okamoto merely presumes that any color data captured using its non-confocal optical system and white light source would be in focus, but in reality a POSITA would understand that chromatic aberration would lead to out-of-focus color data. *Id.* at 37, 41–44; Ex. 2041 ¶¶ 299, 312, 322–325, 335.

After considering Patent Owner’s arguments and evidence, Petitioner’s evidence does not persuade us that Okamoto teaches or suggests the In Focus limitation. Petitioner and Dr. Dianat assert that “Okamoto discloses that the maximum light quantity corresponds to when the pixel is in focus.” Pet. 47; (citing Ex. 1004, ¶ 3 (“when it is focused on the sample surface, the light reception amount is maximized”); *id.* ¶ 10 (“the light reception amount (maximum light reception amount) when each pixel is focused”); *id.* ¶ 37 (“the maximum received light quantity for each picture element when in focus is reflected as brightness information in the color data”)); Ex. 1024 ¶ 97 (same as Petition). Patent Owner’s un rebutted evidence shows that Okamoto’s “light reception amount” or “light quantity” refers to Okamoto’s confocal optical system and the amount of ***single color***

light, e.g., red laser light, reflected by the sample. Ex. 1004 ¶¶ 16, 17, 22, 23. Petitioner does not show sufficiently Okamoto’s maximum received light quantity would lead to the resulting associated color being in focus.

As a fall-back position, Petitioner and Dr. Dianat rely on the disclosure of the ’433 Patent and another reference—Pulli—to assert “it would have been obvious to modify Okamoto in light of the well-known techniques (admitted to in the ’433 Patent) for combining image and depth data to maximize the precision of the focused image.” Pet. 48–49 (citing Ex. 1001, 21:33–43; Ex. 1013, 81–97); Ex. 1024 ¶ 100 (same as Petition). Similarly, Petitioner asserts that “a POSITA was aware of numerous prior art deblurring techniques to address any purported ‘aberration errors’ and ‘distortions.’” Reply 22 (citing Exs. 1121–1124; Ex. 2014, 60:4–11, 60:22–61:10; Ex. 1114 ¶ 35; Ex. 1074, 3:60–65). We agree with Patent Owner, however, that Petitioner’s fall-back position is deficient. PO Resp. 48. Petitioner has not provided a sufficient explanation of how or why a POSITA would have combined Okamoto with the teachings of Pulli, the alleged Applicant Admitted Prior Art, or the references cited in the Reply to arrive at the In Focus limitation of claim 12. *See Metalcraft of Mayville, Inc. v. Toro Co.*, 848 F.3d 1358, 1367 (Fed. Cir. 2017) (“Without any explanation as to how or why the references would be combined to arrive at the claimed invention, we are left with only hindsight bias that KSR warns against.”).

For all of the foregoing reasons, we determine that Petitioner has not shown that the In Focus limitation of claim 12 is taught or suggested by Okamoto in view of Babayoff. Challenged claim 14 depends from claim 12, and the deficiencies in Petitioner’s arguments and evidence for claim 12 are

not remedied by its arguments and evidence for claim 14. *See* Pet. 69 (relying on the same contentions for claim 14 as are presented for claim 12).

In view of these determinations, we do not reach Patent Owner’s contention that Petitioner “ignores known objective indicia evidence of non-obviousness patent owner presented in a related ITC action.” PO Resp. 73 (original text of heading in upper case).

G. Petitioner’s Motion to Exclude

Petitioner moves to exclude Patent Owner’s Exhibits 2001, 2002, 2005, and 2007–2010. Paper 24. Patent Owner opposes. Paper 26. We address each of these exhibits below.

Exhibits 2001, 2002, and 2007 are Patent Owner’s briefs from the related ITC investigation. Patent Owner relies on Exhibits 2002 and 2007 to show what the parties argued and what evidence was relied upon in the related ITC proceeding and as support for an argument regarding objective indicia of non-obviousness. PO Resp. 73–74. Exhibits 2008, 2009, and 2010 are journal articles discussing iTero intraoral scanners and were relied upon in the Preliminary Response to show objective indicia of non-obviousness. *See* Dec. 34 n.13. Exhibits 2001, 2008, 2009, and 2010 are not cited or relied upon in Patent Owner’s post-institution briefs on the merits.

In view of our determination that Petitioner has not shown that the In Focus limitation of claim 12 is taught or suggested by Okamoto, we do not reach the issue of objective indicia of non-obviousness and do not rely on any of Exhibits 2001, 2002, or 2007–2010 in reaching our Decision.

Exhibit 2005 includes a machine translation of Okamoto ’373, and Petitioner objects that the exhibit is not authenticated. Paper 26, 7. Patent

Owner argues that Petitioner's objection is moot in view of Exhibit 2023, which includes a certified translation of Okamoto '373. Paper 29, 4. Exhibit 2005 is not cited or relied upon in Patent Owner's post-institution briefs on the merits, and we do not rely on the exhibit in reaching our Decision.

For these reasons, Petitioner's motion to exclude is dismissed as moot.

III. CONCLUSION

Petitioner has not shown by a preponderance of the evidence that claims 12 and 14 are unpatentable as obvious under 35 U.S.C. § 103(a) in view of Okamoto and Babayoff.

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
12, 14	103(a)	Okamoto, Babayoff		12, 14
12, 14	103(a)	Babayoff, Okamoto		12, 14
Overall Outcome				12, 14

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, Petitioner has not shown by a preponderance of the evidence that claims 12 and 14 of the '433 Patent are unpatentable;

FURTHER ORDERED that Petitioner's motion to exclude is *dismissed* as moot;

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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