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Paper 31
Date: June 9, 2026

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SHENZHEN TUOZHU TECHNOLOGY CO., LTD.,
Petitioner,

v.

STRATASYS, INC.,
Patent Owner.

IPR2025-00311
Patent 8,562,324 B2

Before MITCHELL G. WEATHERLY, CHRISTOPHER M. KAISER, and LILAN REN, *Administrative Patent Judges*.

KAISER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background and Summary

Shenzhen Tuozhu Technology Co., Ltd. ("Petitioner") filed a Petition (Paper 2, "Pet.") requesting *inter partes* review of claims 1, 3–11, and 17–22 ("the challenged claims") of U.S. Patent No. 8,562,324 B2 (Ex. 1001, "the '324 patent"). Stratasys, Inc. ("Patent Owner") filed a Preliminary Response (Paper 7, "Prelim. Resp.").

On June 18, 2025, we instituted *inter partes* review of the challenged claims on all grounds set forth in the Petition. Paper 9 ("Inst. Dec."). Patent Owner filed a Response (Paper 17, "PO Resp."), Petitioner filed a Reply (Paper 21, "Reply"), and Patent Owner filed a Sur-reply (Paper 24, "Sur-reply"). At the request of both parties, we held an oral hearing, the transcript of which has been entered into the record. Paper 30 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6. This is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the challenged claims of the '324 patent. For the reasons discussed below, we determine Petitioner has established by a preponderance of the evidence that all of the challenged claims are unpatentable.

B. Real Parties-in-Interest

Petitioner identifies itself, Bambulab Limited, Shanghai Lunkuo Technology Co., Ltd., Tuozhu Technology Limited, and Bambulab USA Inc. as real parties-in-interest. Pet. 99. Patent Owner identifies itself and Stratasys Ltd. as real parties-in-interest. Paper 5, 2.

C. Related Matters

The parties identify the following related court proceedings: *Stratasys, Inc. v. Shenzhen Tuozhu Technology Co. Ltd. et al.*, Case No. 2:24-cv-00645

(E.D. Tex.) (consolidated with Case No. 2:24-cv-00644 (E.D. Tex.)), and *BambuLab USA, Inc. et al. v. Stratasys, Inc.*, Case No. 1:24-cv-01511 (W.D. Tex.). Pet. 99–100; Paper 5, 2. In addition, the parties note that related patents are being challenged in IPR2025-00257, IPR2025-00321, and IPR2025-00354. Pet. 100; Paper 5, 2.

D. The '324 Patent

The '324 patent, titled "Networked Three-Dimensional Printing," is directed to improving "[t]hree-dimensional fabrication resources . . . by adding networking capabilities to three-dimensional printers and providing a variety of tools for networked use of three-dimensional printers." Ex. 1001, code (54), 1:32–35. The application giving rise to the '324 patent was filed on January 12, 2012, and asserts an earliest priority claim to U.S. Application No. 12/858,622, filed on August 18, 2010. *Id.* at codes (21), (22), (63).

According to the '324 patent, "[w]eb-based servers or the like can provide a single point of access for remote users to manage access to distributed content on one hand, and to manage use of distributed fabrication resources on the other." *Id.* at 1:35–38. Figure 5, reproduced below, illustrates "a user interface for networked three-dimensional printing." *Id.* at 21:18–19.

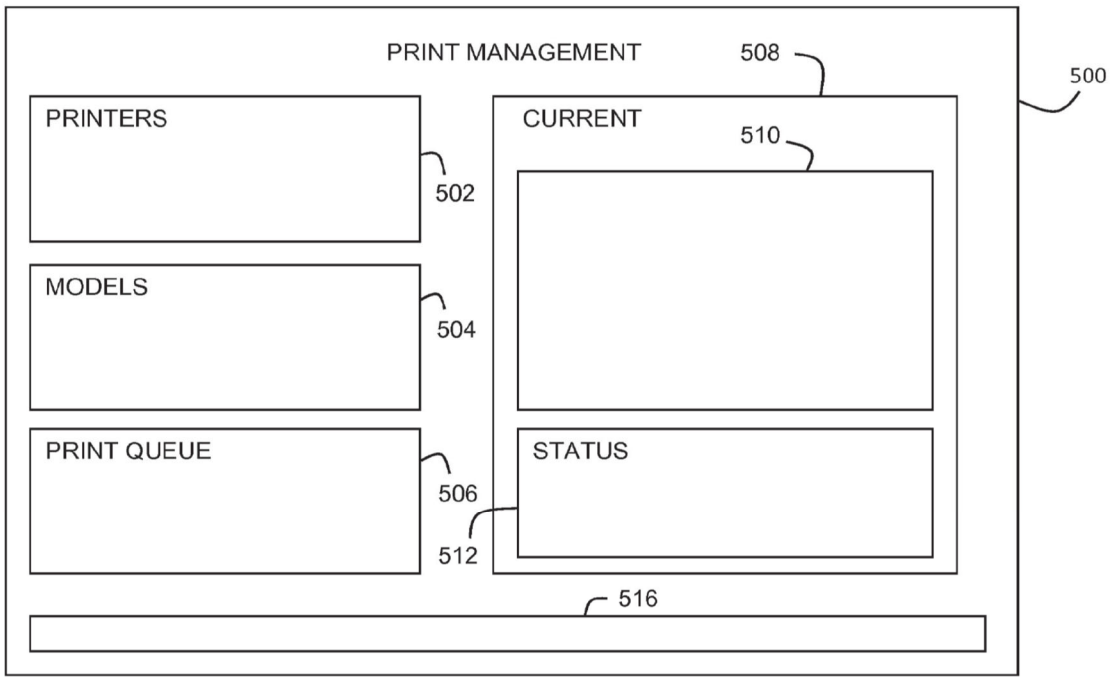

Fig. 5

As shown in Figure 5, "user interface 500" includes several display areas, including "first display area 502 that shows a list of available online three-dimensional printers," "second display area 504 that shows a list of available models for fabrication," "third display area 506 that shows a print queue," and "fourth display area 508 that displays information for a currently active print job." *Id.* at 21:40–22:31.

The fourth display area "may include a visualization area 510 that displays a visual representation of the print job." *Id.* at 22:41–42. The visual representation may take any of several forms, including "a current tool path of the printer that is executing the print job," "a simulated print object, such as a rendering of a three-dimensional model depicting a current state of the completion of an object being fabricated," or "an image of a working volume of a three-dimensional printer or other fabrication resource captured during execution of the print job." *Id.* at 22:41–53. This permits a

user to "visually monitor progress or status of a remote print job through the user interface 500." *Id.* at 22:56–57.

E. Illustrative Claim

Petitioner challenges claims 1, 3–11, and 17–22 of the '324 patent. Claims 1 and 19 are independent. Claim 1 is illustrative; it is reproduced below.

> 1. A device comprising:
>
> a three-dimensional printer including a build volume;
>
> a network interface coupled to a data network;
>
> a video camera positioned to capture video of the build volume from a point of view; and
>
> a processor configured to receive a three-dimensional model through the network interface, and to control operation of the three-dimensional printer to fabricate the three-dimensional model as an object within the build volume of the three-dimensional printer, the processor further configured to provide a user interface to a remote user accessing the device through the network interface, and to present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

Ex. 1001, 27:20–35.

F. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 1–2, 6–98):

Claim(s) Challenged	35 U.S.C. §[1]	Reference(s)/Basis
1, 3, 5–7, 9, 10, 19–22	103	Mazumder,[2] Mori[3]
4	103	Mazumder, Mori, Tian[4]
8	103	Mazumder, Mori, Hull[5]
11	103	Mazumder, Mori, Seki[6]
17	103	Mazumder, Mori, Waehner[7]
18	103	Mazumder, Mori, Lan[8]
20–22	103	Mazumder, Mori, Anderson[9]
1, 3, 5–7, 9, 10, 19–22	103	Kritchman,[10] Tay,[11] Henke[12]
4	103	Kritchman, Tay, Henke, Tian
8	103	Kritchman, Tay, Henke, Hull
11	103	Kritchman, Tay, Henke, Seki
17	103	Kritchman, Tay, Henke, Waehner

[1] Amendments to 35 U.S.C. §§ 102 and 103 enacted by the Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), took effect in March 2013. The '324 patent issued from an application claiming priority to an application filed in August 2010. *See* Ex. 1001, codes (22), (63). Therefore, we apply the pre-AIA versions of §§ 102 and 103. Neither party, however, argues that the outcome of this case would differ based on applying the pre-AIA or post-AIA versions of these laws.
[2] US 6,580,959 B1, issued June 17, 2003 (Ex. 1004).
[3] US 2010/0063615 A1, published Mar. 11, 2010 (Ex. 1005).
[4] US 2009/0015668 A1, published Jan. 15, 2009 (Ex. 1006).
[5] JP P2000-218708A, published Aug. 8, 2000 (Ex. 1007; English translation provided as Ex. 1008).
[6] US 5,278,479, issued Jan. 11, 1994 (Ex. 1009).
[7] US 2006/0171452 A1, published Aug. 3, 2006 (Ex. 1010).
[8] Hongbo Lan, *Web-based Rapid Prototyping and Manufacturing Systems: A Review*, Computers in Industry (December 2009) (Ex. 1011).
[9] US 2004/0207662 A1, published Oct. 21, 2004 (Ex. 1012).
[10] US 2006/0054039 A1, published Mar. 16, 2006 (Ex. 1015).
[11] Francis E.H. Tay et al., *Distributed Rapid Prototyping – A Framework for Internet Prototyping and Manufacturing*, Integrated Manufacturing Systems (November 2001) (Ex. 1013).
[12] Karsten Henke et al., *Rapid Prototyping Modules for Remote Engineering Applications*, International Journal of Online Engineering, Vol. 4, Issue 1 (July 2008), available at https://online-journals.org/index.php/i-joe/article/view/532/513 (Ex. 1014).

Claim(s) Challenged	35 U.S.C. §[1]	Reference(s)/Basis
18	103	Kritchman, Tay, Henke, Lan
3, 5, 9, 10, 20–22	103	Kritchman, Tay, Henke, Anderson

In support of its unpatentability arguments, Petitioner relies on the declarations of Andrew Wolfe, Ph.D. (Ex. 1003; Ex. 1022). Patent Owner relies on the declaration of Dr. Denis R. Cormier (Ex. 2009).

II. ANALYSIS

A. Legal Standards

A claim may be unpatentable as anticipated if "each and every limitation is found either expressly or inherently in a single prior art reference." *Sanofi-Synthelabo v. Apotex, Inc.*, 470 F.3d 1368, 1375 (Fed. Cir. 2006). Anticipation under § 102 may be established by showing, as a matter of fact, that all elements arranged as specified in a claim are disclosed within the four corners of a reference, either expressly or inherently, in a manner enabling one skilled in the art to practice an embodiment of the claimed invention without undue experimentation. *See ClearValue, Inc. v. Pearl River Polymers, Inc.*, 668 F.3d 1340, 1344 (Fed. Cir. 2012).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter 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 ordinary skill in the art; and (4) when in evidence, objective

evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). "While the sequence of these questions might be reordered in any particular case," *KSR*, 550 U.S. at 407, the U.S. Court of Appeals for the Federal Circuit has repeatedly emphasized that "it is error to reach a conclusion of obviousness until all those factors are considered," *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1328 (Fed. Cir. 2016). Because Patent Owner does not address objective evidence of non-obviousness, we focus solely on the first three *Graham* factors.

"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. 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")). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

We analyze the asserted grounds with the above-noted principles in mind.

B. Level of Ordinary Skill in the Art

The level of ordinary skill in the pertinent art at the time of the invention is a factor in how we construe patent claims. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). It is also one of the factors we consider when determining whether a patent claim is obvious over the prior art. *See Graham*, 383 U.S. at 17–18.

Factors pertinent to a determination of the level of ordinary skill in the art include "(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field." *Envtl. Designs, Ltd. v. Union Oil Co. of Cal.*, 713 F.2d 693, 696–697 (Fed. Cir. 1983) (citing *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 1381–82 (Fed. Cir. 1983)). "Not all such factors may be present in every case, and one or more of these or other factors may predominate in a particular case." *Id.*

Petitioner contends that one of ordinary skill in the art "would have had a bachelor's degree in Mechanical Engineering, Computer Engineering, Electrical Engineering, Materials Science, or a comparable field and at least two years of experience related to 3D printers including remote control of rapid fabrication systems." Pet. 6 (citing Ex. 1003 ¶¶ 40–42). Petitioner also argues that "[a]dditional years of experience could substitute for an advanced-level degree (and vice versa)." *Id.* Patent Owner proposes a slightly different level of skill, arguing that a person of ordinary skill in the art "would have had a bachelor's degree in Mechanical Engineering, Computer Engineering, Electrical Engineering, Materials Science, or a comparable field and at least two years of experience related to 3D printing, with additional experience potentially being a substitute for a formal degree or training (and vice versa)." PO Resp. 11–12. Neither party explains why the outcome of this case would be affected by the adoption of either of the proffered definitions of a person of ordinary skill in the art.

We adopt Petitioner's assessment of the level of ordinary skill in the art, as it appears consistent with the '324 patent and the asserted prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

C. Claim Construction

We apply the same claim-construction standard used in the federal courts—in other words, the claim-construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), which is articulated in *Phillips*. *See* 37 C.F.R. § 42.100(b). Under the *Phillips* standard, the "words of a claim 'are generally given their ordinary and customary meaning,'" which "is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." *Phillips*, 415 F.3d at 1312–13.

Patent Owner argues that the challenged claims all "require a user interface that presents both the image and projection together from the point of view of the video camera at the same time." PO Response 12–19; *see* Sur-reply 9–12. Petitioner disagrees, arguing that the challenged claims do not require simultaneous display of the image and the projection, "only that each is 'present[ed] in the user interface.'" Reply 1–5. For the reasons discussed below, we determine that the proper construction of the challenged claims does not require simultaneous display of the image and the projection.

1. Claim Language

We begin our analysis with the language of the challenged claims themselves. Claim 1 recites a "processor configured to…provide a user interface to a remote user . . . , and to present in the user interface an image

of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." Ex. 1001, 27:25–35. Similarly, claim 19 recites "providing a user interface to a remote user . . . , wherein the user interface presents an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." Ex. 1001, 28:41–46. Neither claim specifies any temporal limitation on the display of the two types of visualization. Thus, these claims do not, in and of themselves, require that the image and projection be displayed simultaneously in the user interface. Accordingly, we proceed to an analysis of the specification and the prosecution history to determine how a person of ordinary skill in the art would have interpreted the claim language.

2. Specification

Patent Owner directs us to language in the specification that states that the purpose of the '324 patent's user interface and visualizations is to enable a user to "compar[e] actual to expected two-dimensional" results "without waiting for completion and physical inspection of the constructed object." Ex. 1001, 25:45–49, 22:35–38. According to Patent Owner, "nothing suggests that the remote user can compare actual to expected two-dimensional results by the user interface presenting the actual results followed or preceded by presenting the expected results at different times," so simultaneous display of both visualizations is necessary. PO Resp. 16. Patent Owner does not, however, cite any evidence that a comparison of images displayed *seriatim* in the user interface would have been impossible.

Patent Owner also argues that "[n]othing in the patent's disclosure suggests that the user interface can present an image followed or preceded by presenting a two-dimensional projection at different times," so simultaneous display of both visualizations is necessary. PO Resp. 15. On the record developed at trial, Patent Owner's argument is not supported. Figure 5 of the '324 patent depicts a user interface with "visualization area 510 that displays a visual representation of the print job," which may be "a simulated print object, such as a rendering of a three-dimensional model depicting a current state of the completion of an object being fabricated according to a print job" or "also or instead . . . an image of a working volume of a three-dimensional printer." Ex. 1001, 22:43–53, Fig. 5. The fact that the specification describes displaying an image "instead" of "a rendering of a three-dimensional model" demonstrates that the specification does not limit these visualizations to simultaneous display but instead also permits display of one of them at a time.

According to Patent Owner, Figure 7 of the '324 patent "includes a single step (708) that 'provide[s] a user interface' for 'remote user' access to the printer in which 'user interface presents an image of the build volume from the camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.'" PO Resp. 14–15 (quoting Ex. 1001, 24:47–52, Fig. 7) (emphasis added by Patent Owner). Immediately after the portion of the specification that Patent Owner quotes, however, the specification goes on to state that the user interface "may be . . . any . . . suitable interface for conveying visual information such as a video image and/or model projection." Ex. 1001, 24:52–55. Thus, this language does not limit the video image and model

projection to simultaneous display, permitting instead display of one or the other at a time.

3. Prosecution History

Whether the prosecution history disavows the non-simultaneous display of the image and the projection that is described in the specification and permitted under the claim language itself is a closer question. Disavowal of claim scope "may be inferred from clear limiting descriptions of the invention in the specification or prosecution history." *Aventis Pharma S.A. v. Hospira, Inc.*, 675 F.3d 1324, 1330 (Fed. Cir. 2012). Such a disavowal need not be explicit, but it must be clear. *Techtronic Indus. v. Int'l Trade Comm'n*, 944 F.3d 901, 907 (Fed. Cir. 2019). It must demonstrate clearly that the invention does not include the disavowed feature. *GE Lighting Sols., LLC v. AgiLight, Inc.*, 750 F.3d 1304, 1309 (Fed. Cir. 2014).

Here, Patent Owner argues that a statement in the prosecution history disavows non-simultaneous display of the image and the projection. PO Resp. 17–18. In particular, during examination of the application that issued as the '324 patent, the examiner rejected the pending claims as anticipated by Taminger. Ex. 1002, 93–96. According to the examiner, Taminger disclosed "present[ing] in the user interface an image of the build volume from the camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." *Id.* at 94 (citing Ex. 2012, 11:20–12:10). In response, the applicant argued that "there is nothing in [Taminger] that specifically leads to the applicant's claimed user interface, which provides both video and model views *from the same point of view* in order to permit side-by-side

comparison of model and results by a remote user." *Id.* at 161. Patent Owner argues that this statement "confirms the plain and ordinary meaning of the claims, which requires a user interface that presents both an image and a projection from the same point of view at the same time." PO Resp. 18. We note, however, that the applicant also distinguished Taminger on bases other than side-by-side or simultaneous display in the same response. For example, immediately after the language that Patent Owner highlights, the applicant continued by stating that "*Taminger* cannot anticipate the invention of claim 1 because *Taminger* does not teach . . . a user interface . . . that includes an image of a build volume from a video camera *and* a two-dimensional projection of a three-dimensional model from the point of view of the video camera." Ex. 1002, 161. In addition, the applicant argued that "*Taminger* does not teach or suggest any processor that provides an interface to a remote user that includes both an image from a camera *and* a two-dimensional rendering of a model from the point of view of the camera." *Id.* at 160. These arguments distinguished Taminger on the basis that it failed to disclose both an image and a projection from the same point of view, not on the basis that it failed to disclose displaying both the image and projection simultaneously. And this argument proved persuasive: the examiner allowed the claims of the '324 patent because Taminger failed to disclose "presenting [in] the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." *Id.* at 174. We cannot say that the arguments presented during examination were so clear that they amount to a disavowal of non-simultaneous display. Instead, while some of the

applicant's arguments might be interpreted as distinguishing Taminger on the basis of a disclosure there of non-simultaneous display, other arguments distinguish Taminger on the basis of a failure to disclose display of the recited image and projection at all.

Even if the prosecution history does not contain a clear disavowal of claim scope, it still can serve as evidence of how a person of ordinary skill in the art would have interpreted the language of the claims. To that end, we note that the statements in the prosecution history about Taminger failing to disclose a system that "permit[s] side-by-side comparison of model and results by a remote user," *id.* at 161, are some evidence supporting Patent Owner's view that simultaneous display is necessary.

4. Conclusion

There is evidence to support Patent Owner's proposed construction of the challenged claims as requiring simultaneous display of both the recited image and the recited projection, in order to permit a remote user to compare the images side by side. This evidence includes one of the three relevant statements the applicant made during examination, as well as language in the specification that states that the purpose of the '324 patent's user interface and visualizations is to enable a user to "compar[e] actual to expected two-dimensional" results "without waiting for completion and physical inspection of the constructed object." Ex. 1001, 25:45–49, 22:35–38; Ex. 1002, 161.

There is also evidence that supports Petitioner's proposed construction, under which a user interface may display both the image and the projection if it displays them at different times. This evidence includes statements in the specification that describe displaying an image "instead" of

"a rendering of a three-dimensional model" and that describe displaying a "video image and/or model projection" rather than merely a video image and a model projection. Ex. 1001, 22:43–53, 24:52–55, Figs. 5, 7. It also includes arguments in the prosecution history distinguishing Taminger on the basis of failure of disclose any display of both an image and a projection at all, rather than on the basis of failure to disclose simultaneous display of both visualizations. Ex. 1002, 160, 161. Based on our review of all the probative evidence, we find that the preponderance of the evidence supports Petitioner's view, so we construe the challenged claims as not requiring simultaneous display of the image and the projection.

D. Asserted Obviousness on Grounds Based on the Combination of Mazumder and Mori

Petitioner argues that claims 1, 3, 5–7, 9, 10, and 19–22 of the '324 patent would have been obvious over the combination of Mazumder and Mori. Pet. 6–30. Petitioner also argues that claim 4 would have been obvious over the combination of Mazumder, Mori, and Tian; that claim 8 would have been obvious over the combination of Mazumder, Mori, and Hull; that claim 11 would have been obvious over the combination of Mazumder, Mori, and Seki; that claim 17 would have been obvious over the combination of Mazumder, Mori, and Waehner; that claim 18 would have been obvious over the combination of Mazumder, Mori, and Lan; and that claims 20–22 would have been obvious over the combination of Mazumder, Mori, and Anderson. *Id.* at 30–54.

1. Overview of Mazumder

Mazumder, titled "System and Method for Remote Direct Material Deposition," relates to "[a] system and method for remotely controlling the fabrication of a product at a local manufacturing site" in which "[t]he

product is fabricated by depositing successive material layers." Ex. 1004, codes (54), (57). "The fabrication process" of Mazumder "is recorded by video or television camera and the[n] shown in real-time on a screen display connected to the remote computer." *Id.* at code (57).

2. Overview of Mori

Mori, titled "Machining Status Monitoring Method and Machining Status Monitoring Apparatus," relates to "[a] machining status monitoring apparatus [that] is provided on a machine tool." Ex. 1005, codes (54), (57). The apparatus "has a plurality of actual CCD cameras for imaging the tool and workpiece from different view points and generating actual two-dimensional image data thereof [and] a virtual image generating section having a plurality of virtual CCD cameras corresponding to the actual CCD cameras." *Id.* at code (57).

The "machining status monitoring apparatus" of Mori has "a plurality of actual CCD cameras" to "generate two-dimensional image data (actual image data)" of "the tool . . . and the workpiece." *Id.* ¶¶ 43, 49. In addition, "virtual CCD cameras . . . are respectively arranges at the same positions and in the same orientations as the actual CCD cameras," with "the view points of the virtual CCD cameras . . . match[ing] the view points of the actual CCD cameras." *Id.* ¶ 62.

3. Analogous-Art Status of Mori

To properly include a reference in an obviousness analysis, the reference must be analogous art to the claimed invention. *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004). For a reference to be analogous art, it must be "either in the field of the applicant's endeavor or [be] reasonably pertinent to the problem with which the inventor was concerned." *In re*

Kahn, 441 F.3d 977, 986-87 (Fed. Cir. 2006) (citing *In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992)). "A reference is reasonably pertinent if, even though it may be in a different field from that of the inventor's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem." *In re Clay*, 966 F.2d 656, 659 (Fed. Cir. 1992).

Patent Owner argues that Mori is not analogous art to the claimed invention . PO Resp. 29–33. In the Petition, Petitioner argues that Mori is "directed to 'three-dimensional fabrication' systems, which is the same field identified in the '324 patent." Pet. 12 (citing Ex. 1001, 1:14–20). Patent Owner argues that Petitioner should be limited to this argument in favor of Mori's analogous-art status, with no opportunity to argue that Mori also would have commended itself to the attention of the '324 patent's inventor. PO Resp. 30–31. Patent Owner also argues that Petitioner is incorrect in its argument that Mori is in the same field as the '324 patent. *Id.* at 31–33. In the Reply, Petitioner argues both that Mori is in the same field as the '324 patent and that Mori is reasonably pertinent to the problems addressed by the '324 patent. Reply 7–8. Patent Owner disagrees with both of these arguments. Sur-reply 3–7.

a) Is Petitioner Permitted to Offer a Pertinent-to-the-Problem Argument for the First Time in the Reply?

According to Patent Owner, "[c]onsideration of whether Mori is analogous art should begin and end with [the] Petition's sole theory that Mori is in the same field as the '324 Patent." PO Resp. 30–31 (citing Consolidated Trial Practice Guide (84 Fed. Reg. 64,280 (Nov. 21, 2019)) ("Practice Guide") at 74 (cannot proceed "with a new approach as compared to [prior] positions")). In other words, Patent Owner argues that, although

Petitioner is not required to present an analogous-art argument in the Petition, if it chooses to do so, it is limited to that argument for the duration of the proceeding and may not change its position later. *Id.* at 31 (citing *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1357 (2018) ("the petitioner's contentions, not the Director's discretion, define the scope of the litigation all the way from institution through to conclusion")). Thus, Patent Owner argues that Petitioner's pertinent-to-the-problem argument, offered for the first time in the Reply, is untimely and may not be considered.

We disagree.

"'A petitioner is not required to anticipate and raise analogous art arguments in its petition; instead a petitioner can use its reply' to respond to, for example, arguments raised in a patent owner response." *Corephotonics, Ltd. v. Apple Inc.*, 84 F.4th 990, 1009 (Fed. Cir. 2023) (quoting *Sanofi-Aventis Deutschland GmbH v. Mylan Pharms. Inc.*, 66 F.4th 1373, 1379 (Fed. Cir. 2023)). Patent Owner argues that *Corephotonics* applies only to situations in which a petition is ambiguous and fails to make clear whether the prior art is in the field of the challenged patent, which Patent Owner argues is not the case in this proceeding, because the Petition here states that Mori is in the field of the challenged patent. PO Resp. 30–31. This is incorrect. In *Corephotonics*, the Federal Circuit found that "Apple's petition only invoked the field of endeavor test," but the court still determined that the Board did not err in permitting Apple to address both that test and the "pertinent to the problem test[]" in its reply. 84 F.4th at 1010. Thus, under *Corephotonics*, Petitioner is permitted to expand its analogous-art argument from the same-field argument presented in the Petition to include a pertinent-to-the-problem argument presented for the first time in the Reply.

b) Is Mori in the Same Field as the '324 Patent?

According to Petitioner, Mori is "directed to 'three-dimensional fabrication' systems, which is the same field identified in the '324 patent." Pet. 12 (citing Ex. 1001, 1:14–20). Patent Owner disagrees, arguing that "Mori's hardware is a destructive machining tool that destructively cuts into a workpiece," but "the hardware in the '324 Patent is a three-dimensional printer or additive fabrication." PO Resp. 31–32 (citing Ex. 1001, codes (54), (57), 1:34–35, 1:41–61, 1:65–2:5, 2:17–18, 27:20–21, 28:31–33, Figs. 1, 3–7; Ex. 1005, codes (54), (57), ¶¶ 69, 85, Fig. 10). Further, Patent Owner argues that Mori deals with a workpiece being hidden by a machine tool and therefore unable to be monitored, but the '324 patent does not relate to a workpiece being hidden from view. PO Resp. 33 (citing Ex. 1001, 24:43–25:5, Fig. 7; Ex. 1005 ¶¶ 4, 21–22, 24–25, 85).

On the record developed at trial, we agree with Petitioner. Contrary to Patent Owner's argument, the '324 patent is not limited to three-dimensional printing or additive manufacturing. Although it describes mostly additive processes, it also "relates to three-dimensional fabrication" and states that "the principles of the invention may be adapted to a wide variety of three-dimensional fabrication processes." Ex. 1001, 1:14–15, 2:1–3. This is echoed in the '324 patent's description of a visualization area that may "show an image of a working volume of a three-dimensional printer or other fabrication resource." *Id.* at 22:50–53. Meanwhile, Mori "relates to . . . machining." Ex. 1005 ¶ 2. Dr. Cormier testifies that machining is a type of three-dimensional fabrication. Ex. 1027, 32:1–7, 54:16–21. Thus, Mori and the '324 patent are in the same field: three-dimensional fabrication.

c) Is Mori Reasonably Pertinent to the Problem Solved by the '324 Patent?

Petitioner argues that the '324 patent solves the problem of "monitoring an automated process" and that Mori is reasonably pertinent to this problem. Reply 8 (citing Ex. 1001, 8:49–51, 12:47–51, 14:63–15:5; Ex. 1005, code (57), ¶¶ 43, 49–50, 59–65). Patent Owner argues that Petitioner's definition of the problem solved by the '324 patent is overly abstract and that the problem should be limited to "monitoring networked three-dimensional printers and three-dimensional prints." Sur-reply 6–7.

We disagree with both Petitioner and Patent Owner. As discussed above, the field of both the '324 patent and Mori is not limited to three-dimensional printing, but rather extends to three-dimensional fabrication more generally, so the problems solved by the '324 patent should not be limited exclusively to those related to three-dimensional printing. Thus, Patent Owner is incorrect in its identification of the problem solved by the '324 patent as "monitoring networked three-dimensional printers and three-dimensional prints." As for Petitioner's identification of the problem solved by the '324 patent, "monitoring an automated process" is too broad. The '324 patent relates to solving problems with monitoring automated three-dimensional fabrication processes, not with automated processes more generally.

With the problem solved by the '324 patent defined as monitoring automated three-dimensional fabrication processes, we find that Mori is at least reasonably pertinent to the problem. Mori discloses "[a] machining status monitoring apparatus." Ex. 1005, code (57), ¶ 43. That apparatus uses "actual CCD cameras . . . to image the workpiece." *Id.* ¶ 49. It also has a "virtual image generating section" with "virtual CCD cameras" having

"view points" that "match the view points of the actual CCD cameras." *Id.* ¶¶ 59, 61, 62. This disclosure relates quite closely to monitoring an automated three-dimensional fabrication process and thus is at least reasonably pertinent to solving that problem.

d) Conclusion

For the reasons discussed above, Mori is both in the same field as the '324 patent and at least reasonably pertinent to the problem solved by the '324 patent. Accordingly, it is analogous art to the '324 patent.

4. Analysis of Claim 1

a) Disputed Limitation: "the processor further configured to . . . present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera"

Claim 1 recites "the processor further configured to . . . present in the user interface an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera." Ex. 1001, 27:29–35. According to Petitioner, Mori "displays virtual images of the model as if captured from 'virtual CCD cameras' that 'are respectively arranged at the ***same positions*** and in the ***same orientations*** as the actual CCD cameras," and Mori teaches a "user interface [that] displays the actual image data from the actual CCD cameras [and] the virtual image dat[a]." Pet. 22–23 (quoting Ex. 1005 ¶¶ 61–62, 70, 74–76, Figs. 4, 7, 10).

Patent Owner argues that this argument fails to the extent that it is intended to argue that displaying both the actual camera images and the virtual camera images, but one after another, rather than both at the same

time, is sufficient to teach the subject matter of the recited limitation. PO Resp. 34–43; Sur-reply 13–14. As discussed above, however, we construe the challenged claims to require only display of both types of visualization, not display of both types of visualization simultaneously. Thus, we do not find Patent Owner's argument persuasive.

> Mori teaches a "display-image switching section" that
>
> displays . . . the actual image data output from any one of the actual CCD cameras . . . , the virtual image data transmitted from the camera selection section . . . , or the sectional image data transmitted from the section image generating section . . . , and switches the image to be displayed between the actual image data, the virtual image data and the sectional image data.

Ex. 1005 ¶ 70. Mori teaches that its "camera selection section" can choose "virtual image data transmitted from the virtual image generating section." *Id.* ¶ 66. The "virtual image generating section . . . generates two-dimensional image data" using "virtual CCD cameras" that "are respectively arranged at the same positions and in the same orientations as the actual CCD cameras." *Id.* ¶¶ 62–63. The virtual CCD cameras image a "three-dimensional model." *Id.* ¶ 63. The "camera selection section" also can choose an image from an "actual CCD camera" to display. *Id.* ¶ 65.

Thus, as Petitioner argues, Mori teaches switching between the display of the recited "image of the build volume from the video camera and . . . two-dimensional projection of the three-dimensional model from the point of view of the video camera." Accordingly, Petitioner has shown by a preponderance of the evidence that Mori teaches the disputed limitation of claim 1.

b) Undisputed Limitations

Claim 1 also recites

> 1. A device comprising:
>
> a three-dimensional printer including a build volume;
>
> a network interface coupled to a data network;
>
> a video camera positioned to capture video of the build volume from a point of view; and
>
> a processor configured to receive a three-dimensional model through the network interface, and to control operation of the three-dimensional printer to fabricate the three-dimensional model as an object within the build volume of the three-dimensional printer, the processor further configured to provide a user interface to a remote user accessing the device through the network interface . . . .

Ex. 1001, 27:20–32. Petitioner argues that the combination of Mazumder and Mori teaches these limitations and that a person of ordinary skill in the art would have had reason to combine the teachings of these references. Pet. 10–25. Patent Owner does not dispute these arguments. PO Resp. 20–52). On the record developed at trial, for the reasons discussed below, we agree with Petitioner that the combination of Mazumder and Mori teaches these limitations and that a person of ordinary skill in the art would have had reason to combine the teachings of these references.

Regarding the preamble ("A device"), Mazumder discloses a "manufacturing system" that includes several "subsystems." Ex. 1004, 2:3–13, 2:61–62, 3:3–39, 7:5–12, 7:39–51, Fig. 1.

Regarding the next limitation ("a three-dimensional printer including a build volume"), Mazumder teaches "a laser-aided, computer-controlled direct material deposition system 10, which is used to fabricate, repair or modify three-dimensional products by applying sequentially layers of

material 20 on a substrate 30." *Id.* at 3:11–25; *see id.* at 1:10–13, 1:62–2:2, 7:39–51, Fig. 1.

Regarding the next limitation ("a network interface coupled to a data network"), Mazumder teaches that remote site 200 communicates with local site 205 via communications system 75, "preferably including the Internet." *Id.* at 3:5–7, Figs. 1–2. "[L]ocal computer 70 communicates with a remote computer 95 via the communication system 75 and receives the necessary computer files defining the deposition tool path for the numerical controller (CNC) 90." *Id.* at 3:36–39. Mazumder "utilizes advances in telecommunications" "including the Internet" using "high-speed links in asynchronous transfer mode (ATM) or using Ethernet and Fast-Ethernet in a Local Access Network (LAN) or Wide Access Network (WAN) environment." *Id.* at 1:24–35, 1:62–2:2.

Regarding the next limitation ("a video camera positioned to capture video of the build volume from a point of view"), Mazumder teaches ""video or television camera 65" that "records the laser-aided DMD process and transmits the images to the local computer 70." *Id.* at code (57), 3:26–31, 6:36–55; *see id.* at 7:26–28, 8:13–17, 8:51–54, Fig. 1.

Regarding the next limitation ("a processor configured to receive a three-dimensional model through the network interface, and to control operation of the three-dimensional printer to fabricate the three-dimensional model as an object within the build volume of the three-dimensional printer, the processor further configured to provide a user interface to a remote user accessing the device through the network interface"), Mazumder teaches that local computer 70 controls the functions of the subsystems at local site 205. *Id.* at 4:32–38; 6:18–23, 6:36–53, 7:44–50, 7:58–61. Mazumder also teaches

that the user of remote computer 95 uses "computer-aided design/computer-aided manufacturing (CAD/CAM) software" to generate a model "of the product to be manufactured at the local site 205." *Id.* at 2:14–23, 3:40–56, 4:44–49. "[T]he CAM file of the product description" is "transmit[tted], e.g. over the Internet, to the manufacturing site." *Id.* at 2:24–43.

Regarding combining the teachings of Mazumder with those of Mori, the evidence of record shows that the print head of Mazumder's three-dimensional printer could obscure portions of the actual camera's view of the object being printed and that displaying Mori's virtual image of the object in addition to Mazumder's actual image of the object "would have allowed the user to of the remote computer to monitor the progress of the object even when the actual view of the object is partially or totally obscured." Ex. 1003 ¶ 86.

c) Conclusion Regarding Claim 1

For the reasons discussed above, the preponderance of the evidence shows that claim 1 would have been obvious over the combination of Mazumder and Mori.

5. Analysis of Claim 19

Claim 19 recites

> A method comprising:
>
> providing a three-dimensional printer including a build volume, a network interface coupled to a data network, and a video camera positioned to capture video of the build volume from a point of view;
>
> receiving a three-dimensional model through the network interface;
>
> fabricating the three-dimensional model as an object within the build volume of the three-dimensional printer; and

> providing a user interface to a remote user accessing the device through the network interface, wherein the user interface presents an image of the build volume from the video camera and a two-dimensional projection of the three-dimensional model from the point of view of the video camera.

Ex. 1001, 28:31–46. This claim is similar to claim 1, but rephrased as a method claim rather than a device claim. *Compare* Ex. 1001, 28:31–46, *with* Ex. 1001, 27:20–35. Relying on its claim 1 argument, Petitioner argues that claim 19 would have been obvious over the combination of Mazumder and Mori. Pet. 28–29 (citing Pet. 13–25). Patent Owner repeats its arguments regarding claim 1 with respect to claim 19. PO Resp. 34–46. For the same reasons discussed above with respect to claim 1, we determine that Petitioner has shown by a preponderance of the evidence that claim 19 would have been obvious over the combination of Mazumder and Mori.

6. Analysis of Claim 5

Claim 5 depends from claim 1 and recites that "the two-dimensional projection is dynamically updated to correspond to a state of physical completion of the object." Ex. 1001, 27:46–48. Petitioner argues that Mori teaches this limitation. Pet. 25–26. Patent Owner disagrees, arguing that "Petitioner and its expert fail to provide any evidence of why it would have been obvious to adapt Mori's destructive machining teachings to an additive process in the combination." PO Resp. 46–48.

On the record developed at trial, we disagree with Patent Owner. As Petitioner points out, presenting both Mazumder's actual camera view and Mori's virtual camera view would allow a user to monitor the three-dimensional printer's progress even when the actual view is obscured, such as by "the material deposition head/extruder or another part of the rapid fabrication device, or a printed support structure." Pet. 11–12. This is

supported by the testimony of Petitioner's expert, Dr. Wolfe. Ex. 1003 ¶ 86. It is immaterial that Petitioner's proposed combination uses Mori's teachings for a purpose other than Mori's purpose. *In re Lintner*, 458 F.2d 1013, 1016 (CCPA 1972) ("The fact that appellant uses sugar for a different purpose does not alter the conclusion that its use in a prior art composition would be prima facie obvious from the purpose disclosed in the references.")

In addition, Petitioner shows that Mori teaches the limitation of claim 5. In particular, Mori teaches that the model data on which its virtual images are based is updated "synchronically with the actual operations" of the fabrication system. Ex. 1005 ¶ 78; *see* Ex. 1005 ¶¶ 53–60 ("if the model data of the tool T and model data of the workpiece W partially overlap each other, the model data updating section 17 calculates the overlap area (cutting area), and generates the model data of the workpiece W so that this cutting area is removed therefrom"), ¶ 79 ("virtual image data of the tool T, workpiece W and a part of the table 56 are generated corresponding to each of the virtual CCD cameras 19, 20, 21, and 22, based on . . . the model data updated by the model data updating section 17").

Accordingly, Petitioner has shown by a preponderance of the evidence that claim 5 would have been obvious over the combination of Mazumder and Mori.

7. Analysis of Claim 6

Claim 6 depends from claim 1 and recites that "the two-dimensional projection is a video image from the video camera." Ex. 1001, 27:49–50. Petitioner argues that Mazumder teaches this limitation. Pet. 26. Patent Owner disagrees, arguing that Petitioner improperly relies on the same

images taught in Mazumder for the image of claims 1 and 19 and the projection of claim 6. PO Resp. 48–50.

On the record developed at trial, we are not persuaded that Petitioner's use of the same images to satisfy the "image" limitation of claim 1 and the "projection [that] is a video image" limitation of claim 6 is improper. In arguing for the infringement of claims 1 and 6, Patent Owner relies on the same images to satisfy both the "image of the build volume from the video camera" of claim 1 and the "projection [that] is a video image from the video camera" of claim 6. *Compare* Ex. 1016, 102–104 (relying on images for infringement of claim 6), *with* Ex. 1016, 42–44 (relying on precisely the same images for infringement of claim 1). If the same image can satisfy both claim 1 and claim 6 for infringement purposes, it also can satisfy both claim 1 and claim 6 for obviousness purposes. *Peters v. Active Mfg. Co.*, 129 U.S. 530, 537 (1889) ("That which infringes, if later, would anticipate, if earlier.").

In addition, Petitioner shows that Mazumder teaches the limitation of claim 6. In particular, Mazumder's "fabrication process is recorded by video or television camera and . . . shown in real-time on a screen display connected to the remote computer." Ex. 1004, code (57); *see* Ex. 1004, 6:36–43, 8:14–18.

Accordingly, Petitioner has shown by a preponderance of the evidence that claim 6 would have been obvious over the combination of Mazumder and Mori.

8. Analysis of Claim 8

Claim 8 depends from claim 1 and recites that "the processor is configured to provide credential-based access to the user interface."

Ex. 1001, 27:54–55. Petitioner argues that this claim would have been obvious over the combination of Mazumder, Mori, and Hull. Pet. 33–34; Reply 20–22. Patent Owner disagrees. PO Resp. 50–52; Sur-reply 17–18.

According to Petitioner, Hull teaches that, "[t]o access the process computer at the fabrication site, the user at the remote computer logs in as a 'Remote user' by entering a 'password.'" Pet. 33 (quoting Ex. 1008 ¶ 157). Petitioner argues that a person of ordinary skill in the art "would have been prompted to apply Hull's teaching to the Mazumder-Mori combination" because doing so "would have prevented unauthorized users from accessing the fabrication system," which "would have prevented unauthorized waste of fabrication time, power usage, and deposition material." *Id.* at 33–34 (citing Ex. 1003 ¶¶ 149–152). Patent Owner argues that Petitioner misunderstands Hull's disclosure, which does not teach using authentication to access the fabrication system from a remote computer, but rather teaches using authentication to access a remote computer from the fabrication system. PO Resp. 50–51.

Patent Owner is correct that Hull's disclosure relates to the use of authentication to access a computer other than the computer at the fabrication site. Ex. 1008 ¶ 157. But Petitioner does not argue for the bodily incorporation of Hull's system into the Mazumder-Mori combination. Pet. 33–34. Instead, Petitioner argues that a person of ordinary skill in the art would have had a reason to apply Hull's teaching—requiring credentials to access a remote computer—to the Mazumder-Mori combination's remote access to the computer at the fabrication site. *Id.* And the evidence of record supports that argument. Ex. 1003 ¶ 149 ("A POSITA would have beneficially applied Hull's teachings to the Mazumder-Mori system to

require login credentials, including a password, to remotely access the computing system in control of the 3D printer to prevent unauthorized users from accessing the fabrication system."). To limit Hull "to the particular way it implements" its teachings, as Patent Owner suggests, "would improperly fail to read these references for all that they disclose." *AliveCor, Inc. v. Apple Inc.*, 130 F.4th 1006, 1015 (Fed. Cir. 2025) (citing *In re Mouttet*, 686 F.3d 1322, 1331 (Fed. Cir. 2012) ("A reference may be read for all that it teaches, including uses beyond its primary purpose.")). Patent Owner's "approach also conflicts with the reality that the skilled artisan is not an automaton, so we must 'take account of the inferences and creative steps that a person of ordinary skill in the art would employ.'" *Id.* (quoting *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007)). Here, the evidence shows that a person of ordinary skill in the art would have had reason to transfer Hull's credential-based access to a remote computer from access to a computer remote from the user and the fabrication site to access to a computer at the fabrication site but remote from the user, and we cannot ignore this creative step.

Accordingly, Petitioner has shown by a preponderance of the evidence that claim 8 would have been obvious over the combination of Mazumder, Mori, and Hull.

9. Analysis of Remaining Claims

Claims 3, 4, 7, 9–11, 17, and 18 all depend directly or indirectly from claim 1, and claims 20–22 depend directly or indirectly from claim 19. Petitioner argues that claims 3, 7, 9, 10, and 20–22 of the '324 patent would have been obvious over the combination of Mazumder and Mori. Pet. 6–30. Petitioner also argues that claim 4 would have been obvious over the

combination of Mazumder, Mori, and Tian; that claim 11 would have been obvious over the combination of Mazumder, Mori, and Seki; that claim 17 would have been obvious over the combination of Mazumder, Mori, and Waehner; that claim 18 would have been obvious over the combination of Mazumder, Mori, and Lan; and that claims 20–22 would have been obvious over the combination of Mazumder, Mori, and Anderson. *Id.* at 30–54. Other than the arguments we have already discussed with respect to claims 1 and 19, Patent Owner does not contest any of Petitioner's arguments with respect to these claims. PO Resp. 20–52.

Claim 3 depends from claim 1 and recites that "the two-dimensional projection is simulated based upon operation of the three-dimensional printer." Ex. 1001, 27:39–41. Petitioner argues that Mori teaches this limitation. Pet. 25 (citing Ex. 1005 ¶¶ 53–60, 78, 79). Patent Owner does not contest this argument. PO Resp. 20–52. Mori discloses that "the model data . . . is updated by the model data updating section 17 synchronically with the actual operations." Ex. 1005 ¶ 78. It also discloses that "[t]he virtual image generating section 18 generates two-dimensional image data (virtual image data) . . . based on . . . the model data updated by the model data updating section 17." *Id.* ¶ 59. Thus, Petitioner has shown by a preponderance of the evidence that claim 3 would have been obvious over the combination of Mazumder and Mori.

Claim 4 depends from claim 3 and recites that "the processor is configured to monitor operation of the three-dimensional printer based upon a comparison of the two-dimensional projection with the image of the build volume." Ex. 1001, 27:42–45. Petitioner argues that Tian teaches this limitation and that a person of ordinary skill in the art would have had

reason to combine the teachings of Tian with those of Mazumder and Mori. Pet. 30–32. Patent Owner does not contest this argument. PO Resp. 20–52. Tian teaches comparing "the two-dimensional image data related to the actual attached object generated in the actual-image-data generating process and the two-dimensional image data of the attached object related to the three-dimensional model" to determine if the actual object and the model "match." Ex. 1006 ¶ 13. In addition, Mazumder teaches allowing a user to identify "a defect, an abnormality or some other undesirable characteristic affecting the final quality of the product" and to "pause or abort the fabrication process." Ex. 1004, 2:34–42. A person of ordinary skill in the art would have taken advantage of Tian's ability to compare the model and the actual object to automate Mazumder's defect identification and fabrication process stoppage. Ex. 1003 ¶ 142. Accordingly, Petitioner has shown by a preponderance of the evidence that claim 4 would have been obvious over the combination of Mazumder, Mori, and Tian.

Claim 7 depends from claim 1 and recites that "the user interface provides at least one control for manual operation of the three-dimensional printer by the remote user." Ex. 1001, 27:51–53. Petitioner argues that Mazumder teaches this limitation. Pet. 27 (citing Ex. 1004, code (57), 2:14–17, 2:34–39, 4:30–31). Patent Owner does not contest this argument. PO Resp. 20–52. Mazumder teaches that a user "operates, through a user interface, their 'remote' host computer" and that the user "may pause or abort the fabrication process by sending a command to the controller of the DMD System at the 'local', i.e. the manufacturing site." Ex. 1004, 2:14–17, 2:34–39. Thus, Petitioner has shown by a preponderance of the evidence

that claim 7 would have been obvious over the combination of Mazumder and Mori.

Claim 9 depends from claim 1 and recites that "the user interface provides status information for the three-dimensional printer." Ex. 1001, 27:56–57. Petitioner argues that Mazumder teaches this limitation. Pet. 28 (citing Ex. 1004, code (57), 5:25–36, 6:24–55). Patent Owner does not contest this argument. PO Resp. 20–52. Mazumder teaches that "data from the sensor systems 40, 50, 60 are processed by the local computer to produce real-time temperature, strain and stress data during the fabrication process" and that "the sensor data are transmitted through the communications system 75 to the remote computer 95 for remote control of the process." Ex. 1004, 6:24–55. Thus, Petitioner has shown by a preponderance of the evidence that claim 9 would have been obvious over the combination of Mazumder and Mori.

Claim 10 depends from claim 1 and recites that "the user interface provides status information for a build process executing on the three-dimensional printer." Ex. 1001, 28:1–3. Petitioner argues that Mazumder teaches this limitation. Pet. 28 (citing Ex. 1004, code (57), 5:25–36, 6:24–55). Patent Owner does not contest this argument. PO Resp. 20–52. Mazumder teaches that "data from the sensor systems 40, 50, 60 are processed by the local computer to produce real-time temperature, strain and stress data during the fabrication process" and that "the sensor data are transmitted through the communications system 75 to the remote computer 95 for remote control of the process." Ex. 1004, 6:24–55. Thus, Petitioner has shown by a preponderance of the evidence that claim 10 would have been obvious over the combination of Mazumder and Mori.

Claim 11 depends from claim 1 and recites that "the user interface displays a two-dimensional tool path for the three-dimensional printer, the two-dimensional tool path corresponding to a current layer of the object during a fabrication of the object by the three-dimensional printer." Ex. 1001, 28:4–8. Petitioner argues that Seki teaches this limitation and that a person of ordinary skill in the art would have had reason to combine the teachings of Seki with those of Mazumder and Mori. Pet. 34–38. Patent Owner does not contest this argument. PO Resp. 20–52. Seki teaches that "[e]very time NC data associated with a motion definition statement is executed, thereafter, one of first to fifth sections of a tool path 7 which corresponds to this NC data, along with its preceding tool path section, is drawn on a peripheral surface 2 of the workpiece FIG. 1 which is drawn on the display screen 25a." Ex. 1009, 2:32–37. In addition, Mazumder teaches giving the user the ability to "monitor, control and modify the fabrication of the product." Ex. 1004, code (57). "Providing a display of the tool path of the 3D printer for the current portion of the fabrication procedure being conducted . . . would have given the remote designer additional visual information with which to better monitor the fabrication process." Ex. 1003 ¶ 156. Accordingly, Petitioner has shown by a preponderance of the evidence that claim 11 would have been obvious over the combination of Mazumder, Mori, and Seki.

Claim 17 depends from claim 1 and recites that "the user interface includes at least one control to capture a stop-motion animation of a fabrication of the object using the video camera." Ex. 1001, 28:24–26. Petitioner argues that Waehner teaches this limitation and that a person of ordinary skill in the art would have had reason to combine the teachings of

Waehner with those of Mazumder and Mori. Pet. 38–41. Patent Owner does not contest this argument. PO Resp. 20–52. Waehner teaches "time lapse recording where the various cameras are recorded at a slower rate and, if desired, at a lower resolution." Ex. 1010 ¶ 10. Providing the time-lapse functionality of Waehner in the Mazumder-Mori combination would have reduced the amount of storage required for the captured video images. *Id.* ¶¶ 4, 19. Accordingly, Petitioner has shown by a preponderance of the evidence that claim 17 would have been obvious over the combination of Mazumder, Mori, and Waehner.

Claim 18 depends from claim 1 and recites that "the processor is configured to couple the three-dimensional printer in a communicating relationship with a remote print server through the data network." Ex. 1001, 28:27–30. Petitioner argues that Lan teaches this limitation and that a person of ordinary skill in the art would have had reason to combine the teachings of Lan with those of Mazumder and Mori. Pet. 41–48. Patent Owner does not contest this argument. PO Resp. 20–52. Lan teaches systems that include a print server to connect a remote user to an available rapid prototyping machine. Ex. 1011, 3–5. In addition, Lan teaches that use of the web-based print server it discloses would allow for automated scheduling of rapid fabrication processes "to minimiz[e] idle time" and lower "the effective cost rate." *Id.* at 9–10. Thus, Petitioner has shown by a preponderance of the evidence that claim 18 would have been obvious over the combination of Mazumder, Mori, and Lan.

Claim 20 depends from claim 19 and recites "transmitting status information over the data network upon completion of the object." Ex. 1001, 28:47–49. Petitioner argues that Mazumder teaches this

limitation. Pet. 29 (citing Ex. 1004, code (57), 4:1–3, 4:39–41, 6:27–55, 7:56–61, 8:31–38). Patent Owner does not contest this argument. PO Resp. 20–52. Mazumder teaches that "temperature, strain and stress data" are sent "to the remote computer . . . in real time on line." Ex. 1004, 6:27–55, 7:56–61. Mazumder also teaches that its system "fabricate[s] completed parts and products." *Id.* at 4:1–3. Thus, Petitioner has shown by a preponderance of the evidence that claim 20 would have been obvious over the combination of Mazumder and Mori.

Petitioner also argues that Anderson teaches this limitation and that a person of ordinary skill in the art would have had reason to combine the teachings of Anderson with those of Mazumder and Mori. Pet. 48–54. Patent Owner does not contest these arguments. PO Resp. 20–52. Anderson teaches "[a] method of providing three-dimensional object fabrication status," including "fabrication progress" and "provid[ing] a visual representation of the three-dimensional object(s) fabrication progress in the form of one or more progressively filled-in wireframe model representations." Ex. 1012, code (57), ¶¶ 15–17. This status information can also include "the number of passes completed by the printhead," a numerical percentage of the completion of the object, or an indication of whether the object is waiting (in queue), active (printing), or completed. *Id.* ¶¶ 18–19, Fig. 1. In addition, Mori discloses displaying views of the object generated based on the model. Ex. 1005 ¶¶ 59–65, 79–83. Anderson's teaching of displaying visual information about the completion status of the object would have complemented Mori's teaching by providing additional context for the virtual view of the object by showing which layers have been completed with respect to a wireframe of the completed object. Ex. 1003

¶¶ 184–186. Accordingly, Petitioner has shown by a preponderance of the evidence that claim 20 would have been obvious over the combination of Mazumder, Mori, and Anderson.

Claim 21 depends from claim 20 and recites that "the status information includes data presented through the user interface." Ex. 1001, 28:50–51. Petitioner argues that Mazumder teaches this limitation. Pet. 29–30 (citing Ex. 1004, code (57), 6:24–55). Patent Owner does not contest this argument. PO Resp. 20–52. Mazumder teaches that "temperature, strain and stress data" are sent "to the remote computer . . . in real time on line." Ex. 1004, 6:27–55, 7:56–61. Mazumder also teaches that its system "fabricate[s] completed parts and products." *Id.* at 4:1–3. Thus, Petitioner has shown by a preponderance of the evidence that claim 21 would have been obvious over the combination of Mazumder and Mori.

Petitioner also argues that Anderson teaches this limitation and that a person of ordinary skill in the art would have had reason to combine the teachings of Anderson with those of Mazumder and Mori. Pet. 48–54. Patent Owner does not contest these arguments. PO Resp. 20–52. Anderson teaches "[a] method of providing three-dimensional object fabrication status," including "fabrication progress" and "provid[ing] a visual representation of the three-dimensional object(s) fabrication progress in the form of one or more progressively filled-in wireframe model representations." Ex. 1012, code (57), ¶¶ 15–17. This status information can also include "the number of passes completed by the printhead," a numerical percentage of the completion of the object, or an indication of whether the object is waiting (in queue), active (printing), or completed. *Id.* ¶¶ 18–19, Fig. 1. Anderson also discloses displaying this information in the

user interface. *Id.* ¶¶ 17–21. In addition, Mori discloses displaying views of the object generated based on the model. Ex. 1005 ¶¶ 59–65, 79–83. Anderson's teaching of displaying visual information about the completion status of the object in the user interface would have complemented Mori's teaching by providing additional context for the virtual view of the object by showing which layers have been completed with respect to a wireframe of the completed object. Ex. 1003 ¶¶ 184–186. Accordingly, Petitioner has shown by a preponderance of the evidence that claim 21 would have been obvious over the combination of Mazumder, Mori, and Anderson.

Claim 22 depends from claim 20 and recites that "the status information includes a digital image from the video camera." Ex. 1001, 28:52–53. Petitioner argues that Mazumder teaches this limitation. Pet. 30 (citing Pet. 16–26, 29–30). Patent Owner does not contest this argument. PO Resp. 20–52. Mazumder teaches that "temperature, strain and stress data" and "video or TV . . . images" are sent "to the remote computer . . . in real time on line." Ex. 1004, 6:27–55, 7:56–61. Mazumder also teaches that its system "fabricate[s] completed parts and products." *Id.* at 4:1–3. Thus, Petitioner has shown by a preponderance of the evidence that claim 22 would have been obvious over the combination of Mazumder and Mori, as well as over the combination of Mazumder, Mori, and Anderson.

E. Asserted Obviousness on Grounds Based on the Combination of Kritchman, Tay, and Henke

Petitioner argues that claims 1, 3, 5–7, 9, 10, and 19–22 of the '324 patent would have been obvious over the combination of Kritchman, Tay, and Henke. Pet. 54–84. Petitioner also argues that claim 4 would have been obvious over the combination of Kritchman, Tay, Henke, and Tian; that claim 8 would have been obvious over the combination of Kritchman, Tay,

Henke, and Hull; that claim 11 would have been obvious over the combination of Kritchman, Tay, Henke, and Seki; that claim 17 would have been obvious over the combination of Kritchman, Tay, Henke, and Waehner; that claim 18 would have been obvious over the combination of Kritchman, Tay, Henke, and Lan; and that claims 3, 5, 9, 10, and 20–22 would have been obvious over the combination of Kritchman, Tay, Henke, and Anderson. *Id.* at 84–98.

1. Overview of Henke

Henke relates to "integration of microcontroller- and FPGA- based Rapid Prototyping modules into a Remote Lab system" that "enables a Web-based access to control electro-mechanical models." Ex. 1014, 2. Henke's "Web-interface" allows a remote user to test and control remote, real-world devices including "handl[ing] the laboratory procedure (start, stop, reset)," "chang[ing] environmental variables if necessary," and "watch[ing] the laboratory procedure by supervising the model," including "observing the hardware model directly via a Web-Cam." *Id.* at 5. According to Henke, this procedure "can open opportunities, allowing an experimental approach for a wider audience and an independence of opening times of the laboratory." *Id.* Henke illustrates both "Visual Prototyping (offline control) of [a] Water level control" experiment and "Online control of the Water level control" experiment, the latter "with Internet control to the Remote Lab." *Id.* at Figs. 7, 8.

2. Analogous-Art Status of Henke

Patent Owner argues that Petitioner fails to show that Henke is analogous art to the '324 patent. PO Resp. 60–66; Sur-reply 7–9. Petitioner disagrees, arguing that Henke is both in the same field of endeavor as the

’324 patent (“rapid prototyping from computer models”) and reasonably pertinent to the problem solved by the ’324 patent (“remote control and monitoring of an automated process”). Reply 8–10.

a) Is Henke in the Same Field as the ’324 Patent?

As discussed above with respect to the analogous-art status of Mori, the general field of endeavor of the ’324 patent is three-dimensional fabrication. Despite Petitioner’s attempt to change the identification of the field of endeavor to “rapid prototyping from computer models” in order to bring Henke within that field, Reply 8, we maintain the definition of the field of endeavor we found above, for the reasons identified there. Henke does not relate to three-dimensional fabrication. Although there is some evidence that a person of ordinary skill in the art might have referred to additive manufacturing as rapid prototyping, Ex. 1027, 30:6–18, there is no evidence of record that all processes identified as rapid prototyping fall within the field of three-dimensional fabrication. And Henke’s “rapid prototyping” refers not to the fabrication of any items but to a type of circuit board used by students who must design or “test a designed control algorithm.” Ex. 1014, 2, 4. Thus, Henke is not within the field of endeavor of the ’324 patent.

b) Is Henke Reasonably Pertinent to the Problem Solved by the ’324 Patent?

As discussed above with respect to the analogous-art status of Mori, the problem solved by the ’324 patent is monitoring automated three-dimensional fabrication processes. As Petitioner argues, Henke is “reasonably pertinent to the problem[] . . . of remote control and monitoring of an automated process,” but that definition of the problem is too broad for the reasons we discussed above with respect to the analogous-art status of

Mori. Reply 9. Petitioner does not argue that Henke is reasonably pertinent to the narrower problem actually solved by the '324 patent, monitoring automated three-dimensional fabrication processes. *Id.* at 8–10. Thus, Petitioner does not show that Henke is reasonably pertinent to the problem solved by the '324 patent.

c) Conclusion

Because Petitioner does not show that Henke is either in the same general field of endeavor of the '324 patent or reasonably pertinent to the problem solved by the '324 patent, Petitioner does not show that Henke is analogous art to the '324 patent.

3. Analysis of the Kritchman-Tay-Henke Grounds

Each of the Kritchman-Tay-Henke grounds relies in part on the disclosure of Henke to teach or suggest the subject matter of the challenged claims. Pet. 54–98. But Henke is not analogous art to the '324 patent. Thus, Petitioner does not show that any of the challenged claims would have been obvious based on any ground including Henke.

III. CONCLUSION[13]

After considering the briefs, evidence, and oral arguments in this case, we determine that Petitioner has proven by a preponderance of the evidence that each of claims 1, 3–11, and 17–22 of the '324 patent is unpatentable.

[13] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent

The following table summarizes the outcome for the challenged claims of this Final Written Decision:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1, 3, 5–7, 9, 10, 19–22	103	Mazumder, Mori	1, 3, 5–7, 9, 10, 19–22	
4	103	Mazumder, Mori, Tian	4	
8	103	Mazumder, Mori, Hull	8	
11	103	Mazumder, Mori, Seki	11	
17	103	Mazumder, Mori, Waehner	17	
18	103	Mazumder, Mori, Lan	18	
20–22	103	Mazumder, Mori, Anderson	20–22	
1, 3, 5–7, 9, 10, 19–22	103	Kritchman, Tay, Henke		1, 3, 5–7, 9, 10, 19–22
4	103	Kritchman, Tay, Henke, Tian		4
8	103	Kritchman, Tay, Henke, Hull		8
11	103	Kritchman, Tay, Henke, Seki		11
17	103	Kritchman, Tay, Henke, Waehner		17
18	103	Kritchman, Tay, Henke, Lan		18
3, 5, 9, 10, 20–22	103	Kritchman, Tay, Henke, Anderson		3, 5, 9, 10, 20–22

Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
Overall Outcome			1, 3–11, 17–22	

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has demonstrated, by a preponderance of the evidence, that claims 1, 3–11, and 17–22 of the '324 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties 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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