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Paper 29
Entered: May 13, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HAAS AUTOMATION, INC.,
Petitioner,

v.

OLATI LLC,
Patent Owner.

IPR2021-00146
Patent 8,136,432 B2

Before, PATRICK R. SCANLON, JAMES A. WORTH, and JASON W. MELVIN, *Administrative Patent Judges.*

SCANLON, *Administrative Patent Judge*.

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

I. BACKGROUND

Haas Automation, Inc. ("Petitioner") challenges claims 1–8 of U.S. Patent No. 8,136,432 B2 (Ex. 1001, "the '432 patent"). We have jurisdiction under 35 U.S.C. § 6, and this Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–8 of the '432 patent are unpatentable.

A. Procedural History

Petitioner filed a Petition requesting an *inter partes* review of the challenged claims. Paper 1 ("Pet."). Olati LLC ("Patent Owner") filed a Preliminary Response. Paper 7 ("Prelim. Resp."). With our authorization, Petitioner filed a Reply to Patent Owner's Preliminary Response (Paper 8), and Patent Owner filed a Sur-reply (Paper 9).[1] We instituted a trial as to all challenged claims. Paper 11 ("Decision on Institution" or "Dec. Inst.").

After institution, Patent Owner filed a Patent Owner Response (Paper 14, "PO Resp."), Petitioner filed a Reply (Paper 17, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 19, "PO Sur-reply").

Petitioner relies on the Declaration of Elliot L. Stern, Ph.D. (Ex. 1003), the Declaration of Fran Abbs (Ex. 1010, "the Abbs Declaration"), the Affidavit of Duncan Hall (Ex. 1021), and the Declaration of Michael J. Lyons (Ex. 1024) in support of its contentions. Patent Owner relies on the Declaration of Dr. James L. Glancey, Ph.D., P.E. (Ex. 2001) and the Supplemental Declaration of Dr. James L. Glancey, Ph.D., P.E. (Ex. 2002) in support of its contentions.

[1] The arguments presented in the Reply and Sur-reply were limited to addressing a claim construction issue raised in the Preliminary Response.

An oral hearing was held on February 17, 2022. A transcript of the hearing is included in the record. Paper 28 ("Tr.").

B. Real Parties-in-Interest

Petitioner identifies itself and Haas Holdings, Inc. as the real parties-in-interest. Pet. 1. Patent Owner identifies itself as the sole real party-in-interest. Paper 4, 1.

C. Related Matters

The parties identify the following proceeding as a related matter involving the '432 patent: *Olati LLC v. Haas Automation, Inc.*, Civ. No. 2:20-cv-01650-PSG-JPR (C.D. Cal., filed Feb. 20, 2020). Pet. 2; Paper 4, 1.

D. The '432 Patent

The '432 patent, titled "Closed-Loop CNC Machine System and Method," issued March 20, 2012, with claims 1–8.[2] Ex. 1001, code (54), code (45), 8:7–53. The '432 patent describes "a method and system that provide[] real-time control of the machining operation by measuring properties of the tool in real-time and adjusting the machining parameters in real-time." *Id.* at 2:18–22. "The system includes a machine, a tool, at least one sensor, at least one signal analyzer, and at least one controller," and "[t]he machine includes a workpiece holder, a tool holder, a spindle drive system and a feed drive system." *Id.* at 2:46–50. At least one signal converter is operatively associated with the sensor. *Id.* at 2:54–56.

Figure 6 of the '432 patent is reproduced below.

[2] "CNC" refers to Computer Numerical Control or Computer Numerically Controlled. Ex. 1001, 1:13, 7:12.

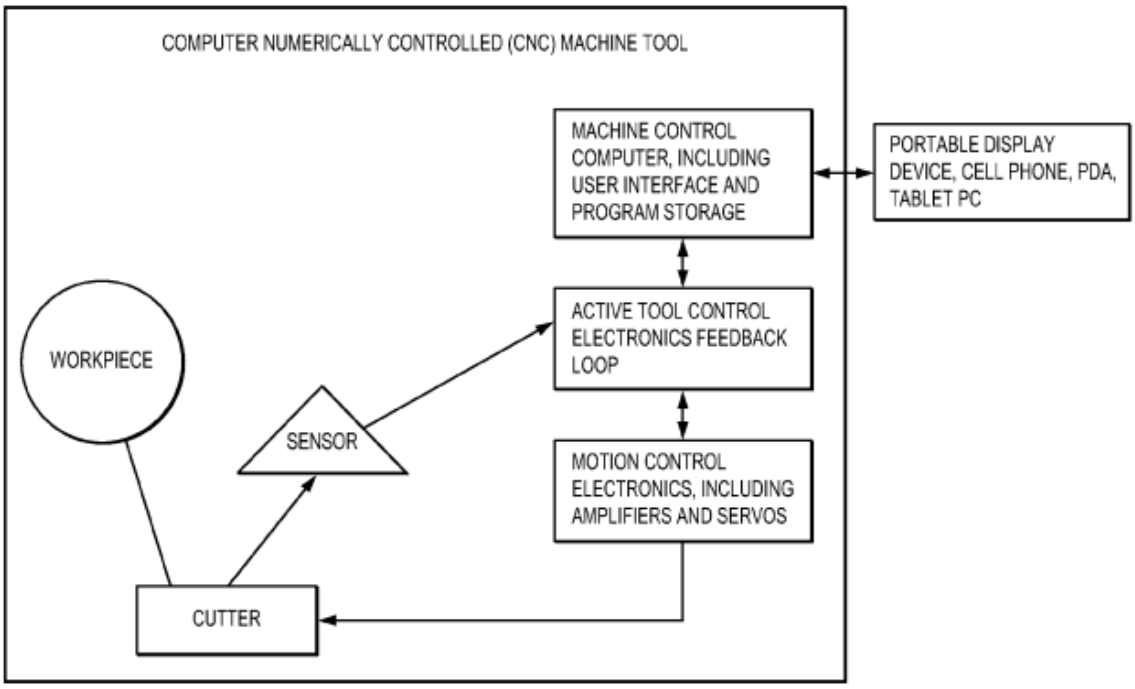

FIG. 6

Figure 6 is "a block diagram of a closed-loop feedback CNC controlled machining operation." Ex. 1001, 3:13–15. A sensor senses physical properties of a tool or cutter that performs an operation on a workpiece and communicates with an Active Tool Control Electronics Feedback Loop. *Id.* at 5:11–14. The Feedback Loop analyzes the sensed physical properties and determines new operational parameters for the process based on the analysis, and motion control electronics in communication with the Feedback Loop change the operational parameters. *Id.* at 5:14–20. The Feedback Loop also communicates with a machine control computer that includes a user interface and program storage. *Id.* at 5:20–23. The machine control computer communicates with a portable display device for providing remote communication of the information displayed on the user interface to a remote machine operator. *Id.* at 5:26–30.

E. Illustrative Claims

Of the challenged claims, claim 1 is the sole independent claim. Claim 1 is reproduced below, with line breaks added for clarity:

> 1. A closed-loop feedback control machining system, the system comprising:
>
> a machine comprising:
>
> a workpiece holder;
>
> a tool holder;
>
> a spindle drive system for providing relative rotation between a workpiece and a tool; and
>
> a feed drive system for providing relative translational movement between a workpiece and a tool;
>
> a tool;
>
> at least one sensor operatively associated with the tool;
>
> at least one signal converter operatively associated with the at least one sensor;
>
> at least one signal analyzer operatively associated with the at least one signal converter; and
>
> at least one controller operatively associated with the at least one signal analyzer and operatively associated with the spindle drive system and the feed drive system,
>
> wherein the at least one sensor receives a signal from the tool and transmits the signal to the at least one signal converter,
>
> wherein the at least one signal converter converts the received signal to a set of digital parameters and transmits the digital parameters to the at least one signal analyzer,
>
> wherein the at least one signal analyzer determines in real-time at least one of the elements selected from the group consisting of: the force on the tool, the deflection of the tool, and the vibration of the tool, and

> wherein the at least one controller adjusts the power exerted by at least one of the spindle drive system and the feed drive system in real-time based on the real-time determinations.

Ex. 1001, 8:7–30 (line breaks added).

F. Instituted Grounds of Unpatentability

We instituted *inter partes* review of the challenged claims based on the following grounds of unpatentability asserted by Petitioner:

Claims Challenged	35 U.S.C. §[3]	Reference(s)/Basis
1, 2, 4, 6	102(b)	Oraby[4]
1–4, 6	103(a)	Oraby
4, 5	103(a)	Oraby, Bartow[5]
7, 8	103(a)	Oraby, Edie[6]
1, 2, 6	102(b)	Delio[7]
1–4, 6	103(a)	Delio
4, 5	103(a)	Delio, Bartow
7, 8	103(a)	Delio, Edie

Dec. Inst. 43; Pet. 13–14.

II. ANALYSIS

A. Legal Standards

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior

[3] The Leahy-Smith America Invents Act ("AIA") included revisions to 35 U.S.C. §§ 102, 103 that became effective on March 16, 2013. Pub. L. No. 112-29, §§ 3(b), 3(c), 3(n)(1), 125 Stat. 284, 287, 293 (2011). Because the application from which the '432 patent issued has an effective filing date prior to March 16, 2013, we apply the pre-AIA versions of §§ 102, 103.
[4] S.E. Oraby, Mathematical Modelling and In-Process Monitoring Techniques for Cutting Tools, University of Sheffield, PhD Thesis, 1989 (Ex. 1014).
[5] Bartow, M., Fiber Bragg Grating Sensors for Dynamic Machining Applications, Proceedings of SPIE, Vol. 5278, pp. 21–31 (Ex. 1007).
[6] US 6,845,340, issued January 18, 2005 (Ex. 1008).
[7] US 5,170,358, issued December 8, 1992 (Ex. 1005).

art reference." *Verdegaal Bros. Inc., v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987). Moreover, "[b]ecause the hallmark of anticipation is prior invention, the prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements 'arranged as in the claim.'" *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). Whether a reference anticipates is assessed from the perspective of an ordinarily skilled artisan. *See Dayco Prods., Inc. v. Total Containment, Inc.*, 329 F.3d 1358, 1368 (Fed. Cir. 2003) ("'[T]he dispositive question regarding anticipation [i]s whether *one skilled in the art* would reasonably understand or infer from the [prior art reference's] teaching' that every claim element was disclosed in that single reference.").

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 indicia of non-obviousness (also called secondary considerations), such as commercial success, long-felt but unsolved needs, and failure of others.

Graham v. John Deere Co., 383 U.S. 1, 17–18 (1966). We analyze grounds based on obviousness in accordance with the above-stated principles.[8]

Furthermore, "[a] petitioner in an inter partes review may request to cancel as unpatentable 1 or more claims of a patent only on a ground that could be raised under section 102 or 103 and *only on the basis of prior art consisting of patents or printed publications*." 35 U.S.C. § 311 (emphasis added). For a reference to qualify as a "printed publication," and therefore an applicable prior art reference, the reference must be "publicly accessible." *Acceleration Bay, LLC v. Activision Blizzard Inc.*, 908 F.3d 765, 772 (Fed. Cir. 2018) ("Because there are many ways in which a reference may be disseminated to the interested public, 'public accessibility' has been called the touch-stone in determining whether a reference constitutes a 'printed publication' . . . ." (alteration in original) (quoting *Jazz Pharms., Inc. v. Amneal Pharm., LLC*, 895 F.3d 1347, 1356 (Fed. Cir. 2018))). "A reference is considered publicly accessible if it was 'disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art, exercising reasonable diligence, can locate it.'" *Id.* (quoting *Jazz Pharms.*, 895 F.3d at 1356). "If accessibility is proved, there is no requirement to show that particular members of the public actually received the information." *Jazz Pharms.*, 895 F.3d at 1356 (quoting *Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1569 (Fed. Cir. 1988)).

[8] The record does not include any evidence of objective indicia of non-obviousness.

B. Level of Ordinary Skill in the Art

In determining whether an invention would have been obvious at the time it was made, 35 U.S.C. § 103 requires us to resolve the level of ordinary skill in the pertinent art at the time of the invention. *Graham*, 383 U.S. at 17. The person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors that may be considered in determining the level of ordinary skill in the art include, but are not limited to, the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* In a given case, one or more factors may predominate. *Id.*

Petitioner submits that a person having ordinary skill in the art "would have been a person holding at least a Bachelors or Masters degree in Engineering and with at least three years training or experience with the machine cutting tool processes and controls, sensor, and signal processing." Pet. 14. Petitioner adds that "[a]dditional work or research experience can substitute for less or different education, and vice-versa." *Id.* (citing Ex. 1003 ¶¶ 5–26).

In response, Patent Owner argues that because a Master's degree is more advanced than a Bachelor's degree, "at least a Bachelor's or Master's degree" really means "at least a Bachelor's degree." PO Resp. 7. Patent Owner also argues that "Petitioner's reference to 'Engineering' is too broad, as there are many fields of engineering that have no direct relationship to CNC machining." *Id.* (citing Ex. 2001 ¶ 24). Thus, in Patent Owner's view, a person having ordinary skill in the art "would have been a person holding at least a Bachelor's degree in Mechanical, Manufacturing or Electrical Engineering having at least three years training or experience with the

machine cutting tool processes and controls, sensor, and signal processing," and "[a]dditional work or research experience can substitute for less or different education, and vice-versa." *Id.* at 8. Patent Owner made essentially the identical argument in its Preliminary Response. *See* Prelim. Resp. 7–8.

In the Decision on Institution, we agreed with Patent Owner's arguments and adopted Patent Owner's proposed level of ordinary skill in the art, stating it was "consistent with the evidence of record, including the asserted prior art." Dec. Inst. 10. Petitioner indicates that it does not challenge this determination for the purposes of this proceeding. Pet. Reply 1. Based on our review of the complete record, we continue to apply the level of ordinary skill in the art adopted in the Decision on Institution.

C. Claim Construction

"In an *inter partes* review proceeding, a claim of a patent . . . shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b)." 37 C.F.R. § 42.100(b) (2020). Under that standard, we generally give claim terms their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1313–14 (Fed. Cir. 2005) (en banc). Although extrinsic evidence, when available, may also be useful when construing claim terms under this standard, extrinsic evidence should be considered in the context of the intrinsic evidence. *See id.* at 1317–19.

Petitioner proposes a claim construction for the phrase "at least one controller . . . adjusts the power" recited in claim 1. Pet. 15–17. Patent Owner addresses Petitioner's proposed claim construction in its Response.

PO Resp. 8–9. Also, in the Decision on Institution, we invited the parties to brief the proper construction of "real-time" during trial. Dec. Inst. 17. We address each of these phrases below.

1. "at least one controller . . . adjusts the power"

In the Decision on Institution, we determined that there was no need to construe explicitly the phrase "at least one controller . . . adjusts the power." Dec. Inst. 11–12 (citing *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017)). Neither party disagrees with this determination. Pet. Reply 7 & n.4; PO Resp. 8–9. Thus, on the full record, there is no controversy between the parties regarding the construction of this phrase. Furthermore, explicitly construing this phrase would have no effect on the analysis below. Accordingly, we need not construe this phrase to resolve the issues in dispute in this proceeding. *See Nidec*, 868 F.3d at 1017; *see also Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms that . . . are in controversy, and only to the extent necessary to resolve the controversy.'") (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

After considering the parties' arguments regarding Patent Owner's proposed claim construction for the phrase "adjusts the power exerted by at least one of the spindle drive system and the feed drive system in real-time based on the real-time determinations," we declined to adopt the proposed construction in the Decision on Institution. Dec. Inst. 13–16 (citing Prelim. Resp. 9–11; Paper 8, 2–4; Paper 9, 2–3). Neither party has addressed this proposed construction in their post-institution briefing. Therefore, on the complete trial record before us, we need not construe this phrase to resolve

the issues in dispute in this proceeding. *See Nidec*, 868 F.3d at 1017; *Realtime Data*, 912 F.3d at 1375.

2. "real-time"

Patent Owner argues that one of ordinary skill in the art "would have understood 'real-time' in the '432 Patent to mean 'during continuous machining operation, with time response constraints sufficient to achieve a desired machining system performance.'" PO Resp. 13 (citing Ex. 2002 ¶ 14). Petitioner argues that "real-time" should be construed as "autonomously during a machining operation and performed quickly enough to achieve a desired machining system performance." Pet. Reply 2. Thus, the parties agree that an action must occur during a machining operation to be in "real-time," but differ on certain aspects of the machining operation. Below, we address the differences in the parties' positions.

a) "autonomously"

As for its contention that "real-time" means *autonomously* during a machining operation, Petitioner argues that the '432 patent describes autonomous machine control and the parties agree that the invention is directed to an autonomous system in which real-time actions are made without human interaction. *Id.* 2–3 (citing Ex. 1001, 3:60–64, 7:16–23; Prelim. Resp. 3; PO Resp. 1, 3, 31–32; Pet. 3). Patent Owner agrees that "real-time" includes autonomous operation. PO Sur-reply 2. Based on the complete record, we determine that the construction of "real-time" should include "autonomously during a machining operation."

b) "continuous"

We turn now to Patent Owner's assertion that the machining operation should be a *continuous* machining operation. In the Response, Patent Owner merely states that "Patent Owner and its expert, Dr. Glancey, agree that a

continuous machining operation is required for achieving 'real-time,'" without explaining why the machining operation has to be continuous.[9] PO Resp. 11 (citing Ex. 2002 ¶ 10).

Petitioner disagrees, arguing that the '432 patent requires that adjustments be made during only a machining operation, not a *continuous* machining operation. Pet. Reply 3 (citing Paper 8, 4–5; Ex. 1001, 5:30–32). Petitioner further argues that Patent Owner "fails to justify adding the term 'continuous' or even provide a clear explanation of what it entails." *Id.* Petitioner notes that "[t]he '432 Patent's only two references to 'continuous' operation state that the 'process ***may*** be performed **continuously** during the entire duration of the machining operation.'" *Id.* (citing 5:7–9, 5:52–54). According to Petitioner, "[t]he specification's use of the permissive 'may' confirms that continuous operation is optional and is not required for a 'real-time' action to be performed 'during [a] machining operation.'" *Id.* (citing *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 913 (Fed. Cir. 2004)) (second alteration in original).

Patent Owner responds by arguing that "the inclusion of the word 'continuous' is necessary to clarify that a real-time operation occurs during an actual machining process, not merely while the machine is operational *in some form*." PO Sur-reply 2. As an example, Patent Owner argues that "omitting the word 'continuous' would suggest that a 'real-time' operation could occur while the machine is powered on but idle, *i.e.* not performing

[9] To the extent that Patent Owner is suggesting that Dr. Stern agrees that "real-time" requires *continuous* operation of the machine, we agree with Petitioner that Dr. Stern has not so agreed. *See* Pet. Reply 3 n.2 (citing PO Resp. 10, 22, 36; Ex. 2003, 19:9–12). Dr. Stern only agreed that "a real-time operation in the context of the '432 patent must occur during the operation of the machine." Ex. 2003, 19:9–12.

machining operations," but the '432 patent did not intend this meaning. *Id.* According to Patent Owner, the '432 patent distinguishes the claimed invention from "a one-time compromise." *Id.* (citing Ex. 1001, 3:55–60).

The cited passage, which pertains to "a typical CNC machine," states: "The human operator is likely to make a single optimization, during the initial setup of a part routine. This optimization will attempt to account for tool wear throughout the production run, however it will be a one-time compromise with minimal real-time compensation for change." Ex. 1001, 3:47–48, 3:55–60. Immediately after this passage, the '432 patent further states that: "Typical CNC equipment has no provision for autonomously correcting qualitative parameters, such as poor surface finish caused by tool vibration (or 'chatter'). In order to make strides in closed-loop control systems, the CNC machine needs additional process inputs." *Id.* at 3:60–64. Thus, the passage cited by Patent Owner merely identifies a perceived drawback to the typical or conventional CNC machines prior to the '432 patent, and does not suggest that the claimed real-time adjustment is a "continuous" operation that does not occur while the machine is powered on but idle. In other words, the cited passage does not support Patent Owner's distinction between a continuous operation and a non-continuous operation.

Patent Owner also points to the '432 patent's disclosure that the adjustment process "may be performed continuously during the entire duration of the machining operation." PO Sur-reply 2 (citing Ex. 1001, 5:7–9). Patent Owner argues that the use of "may" in this passage indicates that adjustments may be made when necessary, rather than constantly, and does not indicate that adjustments during continuous operation are optional. *Id.* at 2–3. We disagree with Patent Owner. As Petitioner notes, the '432 patent twice states that: "This process may be performed continuously

during the entire duration of the machining operation." Ex. 1001, 5:7–9, 5:52–54. In each instance, "[t]his process" refers to using a controller having a feedback loop to adjust one or both of the spindle speed and the feed rate. *Id.* at 4:51–5:5, 5:33–52. Thus, this passage cited by Patent Owner indicates that the *adjustment process* may be performed continuously; it does not suggest that the overall *machining process* is continuous. Furthermore, we are persuaded by Petitioner's argument that the use of "may" conveys that the adjustment process can be—but is not necessarily—performed continuously during the entire duration of the machining operation. *See* Pet. Reply 3.

Accordingly, based on the complete record, we do not include a requirement that the machining operation is continuous.

c) Timing requirement

Next, the parties also agree that the construction of "real-time" requires a timing requirement but disagree as to how this aspect of the construction should be defined. Patent Owner argues that the construction should include "time response constraints sufficient to achieve a desired machining system performance," and Petitioner argues the construction should include "performed quickly enough to achieve a desired machining system performance." PO Resp. 13 (citing Ex. 2002 ¶ 14); Pet. Reply 2 (emphasis omitted).

At the outset, we see little difference between the two proposals. Indeed, Patent Owner and its expert both appear to equate sufficient time response constraints to "quickly enough" or the like. *See, e.g.*, Ex. 2002 ¶¶ 11–12 (Dr. Glancey testifying that hard real-time systems "ensure the response time is predictable and sufficiently small to" prevent chatter "from producing detrimental or damaging results;" a real-time acquisition and

control system "produces outputs within a maximum duration and sufficiently fast to affect the system being controlled and achieve the desired system performance;" and a real-time controller "takes corrective action in sufficient time to change the operation of the machining system in order to quickly prevent chatter or reduce the effects of chatter"); PO Resp. 12–13 (repeating the same testimony); Ex. 1017, 29:17–22 (Dr. Glancey testifying that "time response constraints" means that real-time adjustments must be done "sufficiently quickly" to have the intended beneficial effect such as preventing chatter).

Thus, we note that our findings and conclusions presented in this Final Written Decision would not change under either party's proposal. Nevertheless, on the complete trial record before us, we adopt Petitioner's proposed language for the following reasons.

First, relying on Dr. Glancey's testimony, Patent Owner argues that one of ordinary skill in the art "would have recognized that 'real-time' connoted some degree of contextual time constraints beyond simply occurring during machine operation," and "[t]he use of the phrase 'real-time' in the '432 Patent . . . did, in fact, convey this meaning to a [person having ordinary skill in the art], particularly in view of the examples provided concerning control of 'chatter.'" PO Resp. 13 (citing Ex. 2002 ¶ 13). Dr. Glancey, however, provides no underlying basis for this testimony, particularly how or why the '432 patent conveys to one of ordinary skill in the art that "real-time" necessarily connotes explicit "time response constraints." *See* Ex. 2002 ¶ 13.

Second, we disagree with Patent Owner's argument that its "proposed construction is preferable because it is more specific and less subjective than Petitioner's proposed construction." *See* PO Sur-reply 4. Although

Petitioner's proposed "quickly enough" language is subjective to some extent, we are not persuaded that it is vague or ambiguous. Instead, we determine that "quickly enough to achieve a desired machining system performance" provides one of ordinary skill in the art a reasonable idea of what the time response is. Indeed, claim terms "do[] not require 'absolute or mathematical precision.'" *BASF Corp. v. Johnson Matthey Inc.*, 875 F.3d 1360, 1365 (Fed. Cir. 2017) (quoting *Biosig Instruments, Inc. v. Nautilus, Inc.*, 783 F.3d 1374, 1381 (Fed. Cir. 2015)).

Moreover, we see Patent Owner's proposed "time response constraints" as being at least equally subjective because they must be "sufficient" to achieve the desired machining system performance. Neither Patent Owner nor Dr. Glancey provides adequate explanation as to how one of ordinary skill in the art would determine that a "time response constraint" is "sufficient." At oral hearing, Patent Owner's counsel explained one way to determine the time response constraint would be "to just use the phrase real-time."[10] Tr. 39:22–25. Patent Owner also argues that sufficient time response constraints are implied because the '432 patent uses the explicit phrase "real-time." PO Sur-reply 4. These arguments, however, rely on circular reasoning and fail to explain what a sufficient time response constraint would be. Given this lack of clarity regarding sufficient time response constraints, we determine that Patent Owner's "time response

[10] Patent Owner's counsel explained that another way to determine the time response constraint would be "to state your goal, and state your solution to achieve that goal, and state that the adjustment to the tool is being made within a particular time that achieves that goal." Tr. 39:25–40:2. This explanation, however, is not particularly helpful because it does not indicate how the required "particular time" would be determined and, thus, does not shed light on how to determine a sufficient time response constraint.

constraints" language is more ambiguous than the Petitioner's "quickly enough" language.

d) Conclusion

In summary, we construe "real-time" to mean "autonomously during a machining operation and performed quickly enough to achieve a desired machining system performance."

3. Additional terms

We determine that we need not expressly construe any other claim terms to resolve the parties' disputes because doing so would have no effect on the analysis below. *See Nidec*, 868 F.3d at 1017; *Realtime Data*, 912 F.3d at 1375.

D. Oraby as a Printed Publication

Oraby is a Ph.D. thesis dated September 1989 that was completed by S.E. Oraby while at the University of Sheffield in England. Ex. 1004, 1. Petitioner relies on Oraby in several of the grounds challenging the claims of the '432 patent. *See* Pet. 13.

The critical date of the '432 patent is June 12, 2006. Ex. 1001, code (63). Petitioner argues that Oraby may be used as prior art against the '432 patent because Oraby was "publicly available as of at least 2004" and therefore qualifies as a printed publication. Pet. 5. To support Petitioner's assertion that Oraby was "publicly available," Petitioner provides the Declaration of Fran Abbs, who was the Library Database Manager for University of Sheffield's University Library in 2004 and who later became the library's Metadata Manager in 2014. *Id.* at 5–6; Ex. 1010 ¶ 1. As additional support, Petitioner also provides a collection of four additional references, each of which are dated around 2004 and each of which cite to

Oraby. Pet. 6–8 (citing Ex. 1011; Ex. 1012; Ex. 1014; Ex. 1015 (altogether, the "post-Oraby references")).

Starting with the Abbs Declaration, Petitioner asserts that Ms. Abbs' description of the standard practices at the University of Sheffield's University Library "confirms the public availability of Oraby before the Critical Date." *See* Pet. 5. In the declaration, Ms. Abbs states that "[t]he standard University of Sheffield practice when a student completes a thesis is for a copy of the thesis to be submitted to the University Library." Ex. 1010 ¶ 3. Upon receipt of the thesis copy, the library assigns the thesis an "accession number," which is based on when the thesis was received. *Id.* Based on Oraby's accession number, Ms. Abbs concludes that Oraby was recorded in the library before September 1999. *Id.* ¶¶ 4–6. Furthermore, Ms. Abbs states that, upon receipt of the thesis copy, the library also "record[s] at least the title, author, department, and date in the University Library's database." *Id.* ¶ 7. Once a thesis is recorded, the thesis can be found by electronically searching the University Library index using any of the categories of information listed above. *Id.* According to Ms. Abbs, the library's database has been searchable by the public via the internet and via computer terminals within the library itself since Ms. Abbs started in 2004. *Id.* ¶ 8. On this basis, Ms. Abbs concludes that, "[u]nder the University Library's standard practices, any person who visited the University Library from 1999 to the present or had access to the internet from 2004 to the present would have been able to locate the Oraby Thesis via electronic searches directed to the title, author, department, and/or date." *Id.* ¶ 11.

Turning next to the post-Oraby references, Petitioner argues that the fact these several references cite to Oraby "further confirm[s]" the public accessibility of Oraby. Pet. 6. Notably, as stated above, each of the post-

Oraby references are dated around 2004, which is after Oraby's apparent submission to the University Library prior to September 1999, before the '432 patent's critical date of 2006, and around Ms. Abbs' purported starting date at the University Library of 2004. Furthermore, on one of the four post-Oraby references, S.E. Oraby himself is listed as an author, sharing authorship with one other author, D.R. Hayhurst. *See* Ex. 1015, 2 (listing S.E. Oraby and D.R. Hayhurst as the authors). By contrast, neither S.E. Oraby nor D.R. Hayhurst are listed as authors on the three other post-Oraby references. *See* Ex. 1011, 1 (listing S. Yaldiz and F. Ünsaçar as the authors); Ex. 1012, 1 (same); Ex. 1014, 2 (listing H. Saglam as the sole author).

Patent Owner argues that Oraby is not a printed publication. PO Resp. 14–22; PO Sur-reply 5–8. For the reasons discussed below, however, we determine that Petitioner has provided sufficient evidence to establish by a preponderance of the evidence that Oraby qualifies as a printed publication.

First, the facts here are comparable to those in *In re Lister*, 583 F.3d 1307 (Fed. Cir. 2009). In *Lister*, the disputed reference was a manuscript describing a method for providing handicaps in golf. 583 F.3d at 1309. The manuscript had the descriptive title of "Advanced Handicap Alternatives for Golf." *Id.* The manuscript was stored and indexed in two public databases, each of which allowed users to perform a keyword search of the database by title. *Id.* at 1315. The court began the analysis by first stating that "neither cataloging nor indexing is a necessary condition for a reference to be publicly accessible." *Id.* at 1312. Nevertheless, the court held that the manuscript was publicly accessible, and therefore a printed publication, based on the particular indexing of the manuscript:

> A reasonably diligent researcher with access to a database that permits the searching of *titles* by keyword would be able to attempt several searches using a variety of keyword combinations. We agree with the Board that an individual interested in ways to expedite the game of golf and make it easier for casual players would be inclined to use "handicap" as a search term. . . . [A] reasonably diligent researcher would have searched for "golf" in combination with "handicap." Accordingly, we conclude that the Lister manuscript was publicly accessible as of the date that it was included in either [of the two] databases that permitted keyword searching of *titles*.

Id. at 1315–16 (emphases added).[11]

Like the database in *Lister*, the University of Sheffield's University Library database allowed members of the public, at least as early as 2004, to "electronically search[] the University Library index" via the internet or the library's computer terminals, and using any of the author, department, date, and, most importantly, *title*. *See* Ex. 1010 ¶ 7. Indeed, Ms. Abbs states that, once a thesis such as Oraby is received by the library, "at least the *title*, author, related department, and date of completion are recorded in the University Library's records." *Id.* ¶ 3 (emphasis added). Furthermore, like the manuscript in *Lister*, Oraby has a title that is descriptive of its subject matter—"Mathematical Modelling and In-Process Monitoring Techniques for Cutting Tools" (Ex. 1004, 1)—as Oraby indeed covers "mathematical models which describe the cutting tool-workpiece interaction" and "accurate on-line monitoring of tool-state" (*see id.* at 3). Thus, a reasonably diligent researcher in the field of CNC machining interested in ways to improve the

[11] The court ultimately held, however, that the manuscript did not qualify as prior art because there was insufficient evidence that the aforementioned "date that [the manuscript] was included in either [of the two] databases that permitted keyword searching of titles" had actually antedated the patent's critical date. *Lister*, 583 F.3d at 1316–17.

CNC machining process would be inclined to "electronically search[]" the library's database by title for references disclosing such improvements. Furthermore, given Oraby's title that describes its subject matter covering particular improvements in the CNC machining process, Oraby would have been discovered through such an electronic search. As such, Ms. Abbs' declaration is sufficient evidence to establish by a preponderance of the evidence that Oraby was publicly available before the '432 patent's critical date and therefore qualifies as a printed publication.

Patent Owner disagrees, arguing that "[t]here is nothing in the record explaining how a [person of ordinary skill in the art] in the field of CNC machining would have located [Oraby] through the exercise of reasonable diligence." PO Resp. 16. Addressing Ms. Abbs' declaration, Patent Owner argues that

> [a]t best, Ms. Abbs's testimony suggests that a person could have found Oraby if they *already knew* Oraby's name, title, department, or date. In other words, a person would have had to *already know* about Oraby and the nature of his work in the field of machining in order to find it.

Id. In addition, Patent Owner states "[t]hat a person *might* have been able to locate Oraby through public means is not evidence that it was 'made available to the extent that [a PHOSITA][12] exercising reasonable diligence, can locate it.'" *Id.* at 17 (second alteration in original) (quoting *Bruckelmyer v. Ground Heaters, Inc.*, 445 F.3d 1374, 1378 (Fed. Cir. 2006)). Patent Owner heavily relies on *Acceleration Bay* in making its argument, asserting that the facts here closely resemble the facts there. *See id.* at 16–17.

[12] A "PHOSITA" refers to a "person having ordinary skill in the art."

In *Acceleration Bay*, the disputed reference was a report uploaded to a university library's website. 908 F.3d at 772–73. The website had a search tool that appeared to allow users to search for uploaded reports by using keywords for author, title, and abstract. *Id.* at 773. However, there was substantial evidence showing that the search tool was deficient. *Id.* Particularly, the patent owner had provided evidence that a search for keywords in the title and abstract of the disputed report yielded no results. *Id.* One feature of the website that did work, however, was that reports could be viewed by author or year. *Id.* But the Federal Circuit held that this feature of viewing reports only by author or year was not enough to establish that the disputed report was indexed in a meaningful way and therefore discoverable through reasonable diligence by the interested public. *Id.* The Federal Circuit also specifically distinguished the case from *Lister*, stating:

> Unlike in *Lister*, here the record supports the Board's finding that the CSE Library website's advanced search function did not successfully permit keyword searching of titles, a key feature in *Lister*. The Board's fact finding that, with available reports indexed only by author or year, [the disputed report] was not meaningfully indexed, is supported by substantial evidence.

Acceleration Bay, 908 F.3d at 774 (internal citation omitted); *see also Samsung Elecs. Co. v. Infobridge Pte. Ltd.*, 929 F.3d 1363, 1372 (Fed. Cir. 2019) ("[A] work is not publicly accessible if the only people who know how to find it are the ones who created it.")

Because the University Library database was electronically searchable by title—specifically, as discussed more fully below, by keywords in the title—we do not agree that the facts here resemble *Acceleration Bay*. The crucial fact found in *Acceleration Bay* was that the database there was not searchable using keywords for title, unlike in *Lister*. *See Acceleration Bay*,

908 F.3d at 773. In view of Ms. Abbs' testimony that the library database was electronically searchable by title, this case is distinguished from *Acceleration Bay* and instead aligns with *Lister*.

Patent Owner contends that Ms. Abbs' testimony that the University Library database was electronically searchable by title does not demonstrate that the database had keyword search capability. PO Resp. 19–20 (citing Ex. 1010 ¶¶ 7, 11). According to Patent Owner, the Abbs Declaration merely establishes that the database could be searched by title, not by keywords in a title. *Id.* at 20.

In the Reply, Petitioner argues that Patent Owner mischaracterizes Ms. Abbs' testimony, which actually "confirms that the indexed information was electronically searchable, indicating that the University's database included keyword searching functionality." Pet. Reply 8 (citing Ex. 1010 ¶¶ 3, 7, 10). Petitioner also argues that the University Library database's keyword search functionality is confirmed by Exhibits 1021–1023. *Id.* Specifically, Exhibit 1021 is a declaration from the Records Request Processor at the Internet Archive that describes the Wayback Machine system and authenticates printouts from the Wayback Machine from December 2004. *Id.*; Ex. 2021, 3–13. Petitioner argues that Exhibit 1021 "shows the University of Sheffield Library's homepage in December 2004," including "a link to the 'Star – Library catalogue,' which is the Library's database system."[13] Pet. Reply 8 (citing Ex. 1021, 4–5). Petitioner also argues that Exhibit 1021 shows that the database system included keyword searching capabilities. *Id.* at 8–9 (citing Ex. 1021, 8–13). We agree that the

[13] Ms. Abbs testifies that the University Library database was referred to as the "Star" database system. Ex. 1010 ¶ 8.

printouts attached to Exhibit 1021 show keyword search functionality. Ex. 1021, 8–13. Based on the testimony regarding how the Internet Archive works (*id.* ¶¶ 3–5), we find that the evidence indicates that the University Library database had keyword search capability at least as early as December 2004.

Patent Owner argues that Petitioner's "new evidence . . . fails to show that Oraby, written in 1989, would have been available via those keyword searches at that time."[14] PO Sur-reply 6. We disagree. As discussed above, we are persuaded that Exhibit 2021 shows that the University Library database had keyword search capability at least as early as December 2004. Coupled with Ms. Abbs' testimony that a thesis can be found by electronically searching the University Library database using categories of information such as title, author, department, and date (Ex. 1010 ¶ 7), Exhibit 2021 demonstrates that Oraby could have been found with a suitable keyword search in December 2004. To the extent Patent Owner is arguing that the keyword searches would not have found Oraby *in 1989*, this argument is not persuasive because Petitioner need show only that Oraby was publicly accessible before the critical date of the '432 patent. *See In re Hall*, 781 F.2d 897, 899 (Fed. Cir. 1986).

We also disagree with Patent Owner's argument that, even if the University Library database is searchable by keyword, Petitioner fails to explain what keywords an interested person would have used to find Oraby. *See* PO Resp. 21 (citing *Lister*, 583 F.3d at 1315); *see also* PO Sur-reply 7 ("Petitioner's speculation as to which keywords *might* have been used to

[14] Although referring to Petitioner's reply evidence as "new," Patent Owner does not move to strike or exclude the evidence or otherwise assert that it has been improperly submitted.

locate Oraby do not confirm that they *were* used, or could have been used during the relevant time period."). Relying on Ms. Abbs' testimony, Petitioner contends that, at least as early as 2004, Oraby could have been found via electronic searches directed to the title, author, department, and/or date. Pet. 6 (citing Ex. 1010 ¶ 11). In the Reply, Petitioner further argues that Oraby's title includes several relevant terms that could be useful in a keyword search, such as "cutting tools," "in-process," and "monitoring." Pet. Reply 10 (citing Ex. 1004, 1). Petitioner also asserts that Oraby's "title and department align closely with the agreed education and experience of those with ordinary skill in the art." *Id.* Petitioner thus concludes that the keyword searching capability combined with Oraby's descriptive title confirms that Oraby was publicly accessible. *Id.* at 11 (citing *Lister*, 583 F.3d at 1315; *M&K Holdings, Inc. v. Samsung Elecs. Co.*, 985 F.3d 1376, 1382 (Fed. Cir. 2021)). We find Petitioner's arguments persuasive. As discussed above, we determine that, because Oraby has a title that is descriptive of its subject matter, a reasonably diligent researcher interested in CNC machining processes could have discovered Oraby through a keyword search in the University Library database.

For the above reasons, we determine that, based on the complete trial record, Petitioner has provided sufficient evidence establishing by a preponderance of the evidence that Oraby was publicly accessible before the critical date of the '432 patent and therefore qualifies as prior art.

Next, we reiterate that, "[i]f accessibility is proved, there is no requirement to show that particular members of the public actually received the information." *Jazz Pharms.*, 895 F.3d at 1356 (quoting *Constant*, 848 F.2d at 1569); *see also SRI Int'l, Inc. v. Internet Sec. Sys., Inc.*, 511 F.3d 1186, 1197 (Fed. Cir. 2008) ("[A]ctual retrieval of a publication is not a

requirement for public accessibility."). Thus, given that the Abbs Declaration is sufficient evidence to establish that Oraby was made available to the interested public as discussed above, Petitioner did not need to provide any evidence of actual dissemination or retrieval by others. Nonetheless, Petitioner provides such evidence anyway in the form of the post-Oraby references. *See* Pet. 6.

Patent Owner argues that there is no evidence in the record of how the authors of three post-Oraby references not authored by S.E. Oraby found Oraby. PO Resp. 21; *see also* PO Sur-reply 7–8 (repeating the argument). Patent Owner adds that the three post-Oraby references not authored by S.E. Oraby also cite a separate article by S.E. Oraby, and "[i]t is thus possible that these authors became aware of Oraby through happenstance via a separate article rather than through the exercise of reasonable diligence as required for a finding that Oraby is a printed publication." *Id.* at 21–22 (citing Ex. 1011, 8 n.16; Ex. 1012, 10 n.7; Ex. 1014, 9 n.8).

Patent Owner's argument does not identify a deficiency in Petitioner's position of public accessibility. Although the three post-Oraby references by themselves may not be sufficient evidence that Oraby was publicly available, their existence weighs at least somewhat in favor of a finding of public accessibility in our weighing of the totality of evidence. As such, the three post-Oraby references bolster our determination that Oraby was publicly accessible before the '432 patent's critical date.

Accordingly, based on the totality of the evidence in the complete record, we conclude that Petitioner has established by a preponderance of the evidence that Oraby is a printed publication that was publicly accessible before the critical date of the '432 patent, and that Oraby therefore qualifies as an applicable prior art reference.

E. Ground 1: Asserted Anticipation by Oraby

Petitioner asserts that claims 1, 2, 4, and 6 of the '432 patent are anticipated by Oraby. Pet. 13, 18–56. Patent Owner provides arguments addressing this asserted ground of unpatentability. PO Resp. 22–29. We first summarize the Oraby reference and then address the parties' contentions.

1. Oraby

Oraby is a thesis that describes "[t]he need . . . for mathematical models which describe the cutting tool-workpiece interaction and for accurate on-line monitoring of tool-state." Ex. 1004, 3.[15] The thesis "investigate[s] the state of the tool in turning operations as affected by process variables and conditions, bearing in mind [the] requirements of automated manufacturing and machining optimization." *Id.* at 16.

Chapter 3 describes the experimental design and set-up used for the study. *Id.* at 17. The experimental design uses a strain-gauge dynamometer for measuring tool forces. *Id.* at 44. A microcomputer is used for online data collection through an analog-to-digital converter. *Id.* at 59.

Chapter 7 describes using adaptive control software to implement the developed mathematic models and in-process techniques and establish fully computerized machining systems. *Id.* at 18. Figure 7.1 of Oraby is reproduced below.

[15] We cite to the page numbers added by Petitioner rather than the internal pagination in Oraby.

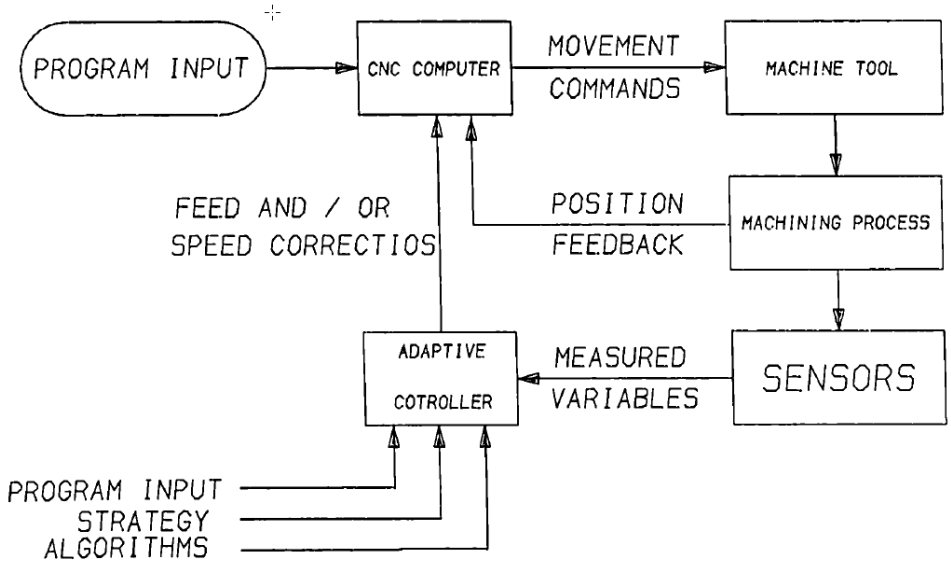

Fig. 7.1 Adaptive Control System for Machine Tools

Ex. 1004, 282. Figure 7.1 is "a schematic view of the basic aspects of adaptive control system in which the operating parameters have automatically been selected for the actual conditions of the process." *Id.* at 265.

2. Independent Claim 1

Petitioner contends that Oraby discloses each limitation of independent claim 1. Pet. 18–55. To support its arguments, Petitioner identifies certain passages and figures in Oraby and explains their significance with respect to the corresponding claim limitation. *Id.* Patent Owner argues that Petitioner has failed to show that Oraby discloses a controller adjusting the power exerted by at least one of the spindle drive system and the feed drive system *in real-time*. PO Resp. 22–28.

a) The "Controller Adjusts the Power" Limitation

Claim 1 recites "wherein the at least one controller adjusts the power exerted by at least one of the spindle drive system and the feed drive system in real-time based on the real-time determinations." Ex. 1001, 8:27–30. In

addressing this limitation, Petitioner argues that Oraby discloses measuring process variables in real-time, followed by adjusting operating parameters online to optimize the performance of the overall system. Pet. 51 (citing Ex. 1004, 264–65).[16] According to Petitioner, Figure 7.1 of Oraby (reproduced above) shows that the adaptive controller and CNC computer make "feed and/or speed corrections," and the "**adaptive control algorithm** enables the machine tool to be operated using the [speeds and feeds] combination . . . [for] maximizing the metal removal . . . [and] minimizing tool wear rate." *Id.* at 51–52 (citing Ex. 1004, 280). Petitioner also argues that Oraby discloses that "**the optimal cutting speed and/or feed can be chosen automatically, and modified** whenever the need arises." *Id.* at 52 (quoting Ex. 1004, 264, with emphasis added by Petitioner). In addition, Petitioner argues that Oraby discloses adjusting these parameters by adjusting the supplied power. *Id.* at 54–55 (citing Ex. 1004, 198–200, 284 (Table 7.1); Ex. 1003 ¶¶ 101–106).

In the Response, Patent Owner argues that "Oraby only describes using the concept of 'real time' to refer to measurement, *not* to adjustment," and "Oraby states only that the adjustment is performed 'on-line.'" PO Resp. 23–24; *see also* PO Sur-reply 8 ("Oraby discloses real-time *measurement*, but Oraby does not use the term 'real-time' in describing *adjustment*."). According to Patent Owner, Oraby uses "on-line" to refer to adjustments made "in-process" or while the machine is in operation. *Id.* at 24 (citing Ex. 1004, 281). Patent Owner asserts that "Oraby refers to

[16] Although the Petition cites to the internal pagination in Oraby, we cite to the page numbers added by Petitioner (as noted above) because several pages of Oraby containing drawings, tables, and plots lack internal pagination.

adjustments made during continuous operation of the machine ('on-line' or 'in-process'), but without the response time limits required with real-time controls (*i.e.*, adjustments)." *Id.* (citing Ex. 2001 ¶ 55; Ex. 2002 ¶¶ 13, 15). Patent Owner also argues that "Oraby does not explain what is meant by 'on-line' in his 'prospective' system, let alone specify that 'on-line' means 'real-time,'" and "Petitioner cannot properly rely on the phrase 'on-line' to prove disclosure of the claim element 'real-time.'" *Id.* at 25 (citing *Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1284 (Fed. Cir. 2017)).

Furthermore, Patent Owner contends that on-line adjustments were known at the time of the '432 patent, but on-line adjustments made in real-time and related to machined part quality and productivity had not yet been invented or developed. *Id.* at 26 (citing Ex. 2001 ¶ 57). Patent Owner argues that on-line adjustments at the time were made periodically during system operation, but not at a response rate sufficient for real-time adjustment or control. *Id.* (citing Ex. 2001 ¶ 57).

Next, noting the Board's statement in the Decision on Institution that "Oraby does not specify that the adjustment of the operating parameters *immediately* follows the measurement of process variables," Patent Owner argues "there could conceivably be *any* amount of delay before the on-line adjustment follows the real-time measurement." *Id.* at 28 (citing Ex. 2002 ¶ 16). Patent Owner contends that Dr. Stern could not testify that an exemplary delay of ten seconds would be a real-time response, and one of ordinary skill in the art would know that such a ten-second delay would be inadequate to control phenomena such as chatter effectively. *Id.* (citing Ex. 2004, 25:6–15; Ex. 2002 ¶ 16).

In the Reply, Petitioner argues that Patent Owner and its expert both agree that Oraby discloses adjusting the feed rate or spindle speed to control

and reduce tool wear. Pet. Reply 14–15 (citing PO Resp. 24; Ex. 1017 33:12–14, 53:7–54:5, 54:17–21). Petitioner points to several disclosures in Oraby that are purported to confirm that Oraby's adjustments are made quickly enough to reduce tool wear. *Id.* at 16–17 (citing Ex. 1004, 264, 266, 268, 276). Petitioner also asserts that Oraby explicitly discloses using *real-time* manufacturing process *control*, which confirms that Oraby's adjustments are made in real-time. *Id.* at 15 (citing Ex. 1004, 210).

In response to the Reply, Patent Owner concedes that Oraby discusses desired performance and that tool wear is a concern, but argues that, instead of tying the timing of its adjustments to these concerns, "Oraby performs adjustments at 'predefined intervals' after a measurement is made." PO Sur-reply 8 (citing Pet. Reply 15); *see also* Prelim. Resp. 18 (arguing that on-line "adjustments were performed at certain predefined intervals or after a certain time period elapsed after a measurement is made" (citing Ex. 2001 ¶ 56)). According to Patent Owner, Oraby does not disclose "that these intervals are calculated based on optimizing tool wear reduction, or that they are calculated based on desired machining operations at all." *Id.* at 9. Patent Owner contends that because Oraby discloses mathematical models for a *prospective* turning system, no timing intervals were likely ever calculated because no actual machine implementing the theoretical model was built. *Id.* (citing Ex. 1004, 262).

Regarding Oraby's disclosure of "real-time manufacturing process control" (*see* Ex. 1004, 210), Patent Owner argues that this disclosure is inconclusive because "[i]n context, it is unclear what is meant by 'control,' and elsewhere Oraby makes clear that 'real-time' is associated only with measurement, *not* adjustment." PO Sur-reply 10.

We disagree with Patent Owner's argument that Oraby does not disclose real-time adjustment. Oraby discloses measuring "process variables in real time, *followed* by on-line adjustment of the operating parameters." Ex. 1004, 264 (emphasis added). Oraby also discloses that "the optimal cutting speed and/or feed [(i.e., operating parameters)] can be chosen *automatically*, and modified whenever the need arises." *Id.* (emphasis added). Although Oraby does not specify the timing of how quickly the operating parameters are adjusted after the measurement of process variables, we find that one of ordinary skill in the art would have inferred that Oraby's operating parameters are adjusted in real-time, directly in response to the measurement of process variables, particularly in view of the disclosure that the operating parameters are chosen automatically. *See, e.g.*, *Eli Lilly & Co. v. Los Angeles Biomed. Res. Inst. At Harbor-UCLA Med. Ctr.*, 849 F.3d 1073, 1074–75 (Fed. Cir. 2017) ("[T]he dispositive question regarding anticipation is whether one skilled in the art would reasonably understand or infer from a prior art reference that every claim element is disclosed in that reference." (citations omitted)).

In particular, Oraby discloses optimizing the operating parameters to reduce tool wear. Ex. 1004, 264; *see also id.* at 276 (discussing a strategy for on-line tool wear monitoring). Thus, in view of Oraby's stated goal of reducing tool wear, we conclude that one of ordinary skill in the art would have "at once envisaged" making the adjustments quickly enough to achieve the desired performance of reducing tool wear, as opposed to inviting unnecessary tool wear by delaying the adjustments.[17] *See Kennametal, Inc.*

[17] Regarding the "autonomously during a machining operation" aspect of our construction of "real-time," Patent Owner concedes that Oraby discloses

v. Ingersoll Cutting Tool Co., 780 F.3d 1376, 1381 (Fed. Cir. 2015) ("[A] reference can anticipate a claim even if it 'd[oes] not expressly spell out' all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would 'at once envisage' the claimed arrangement or combination." (quoting *In re Petering,* 49 CCPA 993, 301 F.2d 676, 681 (1962))).

Furthermore, we are not persuaded by Patent Owner's argument that on-line adjustments made in real-time were not known at the time of invention of the '432 patent, which relies entirely on the testimony of Dr. Glancey. *See* PO Resp. 26 (citing Ex. 2001 ¶ 57). Dr. Glancey testifies that "on-line adjustments *in real-time* related to part quality and productivity had not yet been invented or developed. Rather, 'on-line' adjustments consisted of periodic or delayed adjustments." Ex. 2001 ¶ 57. We do not credit this testimony because Dr. Glancey does not provide the underlying basis for the statements. *See* 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight."); *see also Skky, Inc. v. MindGeek, s.a.r.l.,* 859 F.3d 1014, 1022 (Fed. Cir. 2017) ("[T]he Board was not required to credit Skky's expert evidence simply because Skky offered it.").

Similarly, we do not credit Dr. Glancey's testimony that on-line "adjustments were performed at certain predefined intervals or after a certain time period elapsed after a measurement is made," as this statement is also not supported with underlying facts or data. *See* Ex. 2001 ¶ 56. Accordingly, Patent Owner's argument that Oraby does not disclose real-

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making adjustments during continuous operation of the machine (i.e., on-line or in-process). *See* PO Resp. 24.

time adjustments because the adjustments are made at "predefined intervals" after a measurement is not persuasive. *See* PO Sur-reply 8.

We also are not persuaded by Patent Owner's argument that "there could conceivably be *any* amount of delay before the on-line adjustment follows the real-time measurement." PO Resp. 28 (citing Ex. 2002 ¶ 16). Oraby does not appear to disclose any delay between measuring process variables and adjusting the operating parameters, and Patent Owner does not direct us to any such disclosure. And that a delay may be conceivable does not suggest that one of ordinary skill in the art would see Oraby as teaching or even suggesting a delay. As discussed above, such a delay would impede Oraby's goal of reducing tool wear.

In addition, we are persuaded by Petitioner's argument that Oraby's reference to real-time manufacturing process control indicates that Oraby discloses real-time adjustments in addition to real-time measurement. *See* Pet. Reply 15 (citing Ex. 1004, 210). In this instance, we find that a person having ordinary skill in the art would understand the term "manufacturing process control" as referring to the overall process and would, thus, include both of the measuring process variables and adjusting operating parameters actions. As such, we disagree with Patent Owner that "real-time manufacturing process control" is unclear or ambiguous. *See* PO Sur-reply 10. Oraby also discloses providing "a *quick response* to allow the corrected parameters to be implemented in the process" and optimizing "on-line cutting conditions for an individual machine for each specific operation *as it is being performed*." Ex. 1004, 264, 268 (emphases added). When considering Oraby's disclosure as a whole, we find that these disclosures would at least suggest to one of ordinary skill in the art that Oraby contemplates real-time adjustments.

Based on the full record before us, we determine that Petitioner has met its burden of establishing that Oraby discloses "wherein the at least one controller adjusts the power exerted by at least one of the spindle drive system and the feed drive system in real-time based on the real-time determinations."

b) The "Signal Analyzer" Limitation

Claim 1 also recites "at least one signal analyzer operatively associated with the at least one signal converter." Ex. 1001, 8:14–16. In the Decision on Institution, we indicated that it was not clear as to whether the Petition mapped the "at least one signal analyzer" to Oraby's adaptive control system or to Oraby's adaptive controller or BBC microcomputer. Dec. Inst. 29–30.

In the Reply, Petitioner stated that "[a]s explained in the Petition and by Dr. Stern, Oraby's BBC Microcomputer running the adaptive control/signal analysis program discloses the claimed signal analyzer." Pet. Reply 14 (citing Pet. 36–37, 48–49, 50; Ex. 1003 ¶ 82; Ex. 2003, 53:17–54:14, 56:16–57:357:14–19).

Patent Owner does not dispute Petitioner's assertion that Oraby discloses this limitation. *See generally* PO Resp.

Based on the full record before us, particularly Petitioner's explanation in the Reply, we determine that Petitioner has met its burden of establishing that Oraby discloses "at least one signal analyzer operatively associated with the at least one signal converter."

c) The Remaining Aspects of Petitioner's Contentions

Patent Owner does not offer any arguments specifically addressing the remaining limitations of claim 1. *See generally* PO Resp. We need not set forth formal findings as to the undisputed assertions by Petitioner that Oraby

discloses these limitations. *See LG Elecs., Inc. v. Conversant Wireless Licensing S.A.R.L.*, 759 F. App'x 917, 925 (Fed. Cir. 2019) ("The Board is 'not required to address undisputed matters' or arguments about limitations with which it was never presented." (quoting *In re Nuvasive, Inc.*, 841 F.3d 966, 974 (Fed. Cir. 2016))). Also, we cautioned Patent Owner "that any arguments not raised in the response may be deemed waived." Paper 12, 10; *cf.* 37 C.F.R. § 42.23(a) ("Any material fact not specifically denied may be considered admitted."). Nevertheless, we have reviewed Petitioner's contentions with respect to the remaining limitations of claim 1 and find that Oraby teaches these limitations as set forth by Petitioner. *See* Pet. 18–50.

d) Conclusion

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that Oraby anticipates claim 1.

3. Dependent Claims 2, 4, and 6

For each of claims 2, 4, and 6, Petitioner provides a detailed analysis of Oraby's disclosures that teach every element of each claim. Pet. 55–56. Petitioner also supports its contentions for these claims with the testimony of Dr. Stern. *Id.* (citing Ex. 1003 ¶¶ 107–112). Patent Owner offers no argument disputing Petitioner's contentions with respect to these claims. *See generally* PO Resp.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that Oraby anticipates claims 2, 4, and 6 for the reasons discussed in the Petition and as supported by the testimony of Dr. Stern.

F. Grounds 2 and 3: Asserted Obviousness Based on Oraby and Oraby and Bartow

Petitioner contends claims 1–4 and 6 would have been obvious in view of Oraby. Pet. 56–58. For this ground, Petitioner relies on the same teachings of Oraby relied on in connection with the ground asserting that claims 1, 2, 4, and 6 are anticipated by Oraby, arguing that, "[t]o the extent the Board finds that Oraby does not explicitly disclose any one of the elements of Claims 1, 2, 4, and/or 6, it would have been obvious to a PHOSITA that the element was disclosed by Oraby and/or well known in the art at the time." *Id.* at 56. By way of example, Petitioner argues that "if the Board finds that Oraby's adaptive control system relied upon in Ground 1, above, is not a single embodiment, a PHOSITA would have been motivated to build a machining system according to the principles of an adaptive control machining operation as applied to Oraby's disclosed system." *Id.* at 56–57 (citing Ex. 1003 ¶¶ 113–114).

For claim 3, which depends from claim 1 and recites "wherein the tool is a boring bar," Petitioner argues that one of ordinary skill in the art "reviewing Oraby would have known that a boring bar would be a typical tool used in a 'turning system using the latest advanced machine tools technology,' such as Oraby's lathe system" and "would have been motivated to install a well-known tool, such as a boring bar," "to perform an inside turning (or boring) process." *Id.* at 57–58 (citing Ex. 1004, 183; Ex. 1003 ¶ 116).

Petitioner also contends that claims 4 and 5 would have been obvious over Oraby and Bartow. *Id.* at 58–62. Claims 4 and 5 depend from claims 1 and 2, respectively. Ex. 1001, 8:35–41. Claim 4 recites "wherein the at least one sensor is selected from the group consisting of: fiber optic sensors,

magnetic sensors, and analog electronic strain gauges," and claim 5 recites "wherein the signal received from the tool is an optical signal." *Id.*

Petitioner argues that Bartow discloses using fiber optic Bragg grating strain sensors for measuring tool motion. Pet. 58 (citing Ex. 1007, 2, 11). Petitioner also argues that Bartow's strain sensor "senses the change in wavelength, which is indicative of the 'thermal or mechanical strain in the [optical] fiber.'" *Id.* at 60–61 (citing Ex. 1007, 2). In addition, Petitioner provides reasons, supported by the testimony of Dr. Stern, for why it would have been obvious to one of ordinary skill in the art to combine Oraby and Bartow. *Id.* at 61–62 (citing Ex. 1003 ¶¶ 126–130).

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1, namely, that Oraby does not disclose real-time adjustment. PO Resp. 20–21. Accordingly, on the full record before us, we determine that Petitioner establishes sufficiently that either Oraby alone or the combination of Oraby and Bartow discloses each of these claims. *See LG Elecs.*, 759 F. App'x at 925; Paper 12, 10; 37 C.F.R. § 42.23(a).

G. Ground 4: Asserted Obviousness Based on Oraby and Edie

Petitioner contends claims 7 and 8 would have been obvious over Oraby and Edie. Pet. 62–68. Claim 7 depends from claim 1, and claim 8 depends from claim 7. Ex. 1001, 8:45–53. Claim 7 recites "a portable display device operatively associated with the at least one controller such that the portable display device can inform a user of the adjustments made by the controller," and claim 8 recites "wherein the portable display device is selected from the group consisting of a cellular phone, a PDA, and a tablet PC." *Id.*

Petitioner argues that Edie discloses a CNC machine tool that includes a sensor for sensing a machine operation parameter and outputting signals related to the sensed parameter. Pet. 62 (citing Ex. 1008, 1:9–13, 1:55–57, 2:35–55). Petitioner also argues that signals output by Edie's sensor are used to generate operation-specific data lines, which can be output to a device such as a personal digital assistant (PDA). *Id.* at 62–63 (citing Ex. 1008, 2:43–55, 3:14–49, 9:38–44). Petitioner adds that spindle speed or torque is one of the parameters sensed to provide information about the machining operation. *Id.* at 64 (citing Ex. Ex. 1008, 3:26–49). According to Petitioner, one of ordinary skill in the art "would have appreciated that Edie's display system, when incorporated into Oraby's adaptive control system, would be configured to store and display the sensed parameters—including adjustments to the spindle speed, feed rate, and cutting rate—on a portable device." *Id.* at 64 (citing Ex. 1003 ¶¶ 131–138).

Petitioner also provides reasons, supported by the testimony of Dr. Stern, for why it would have been obvious to one of ordinary skill in the art to combine Oraby and Edie. *Id.* at 65–68 (citing Ex. 1003 ¶¶ 141–145). Specifically, Petitioner argues that one of ordinary skill in the art "building Oraby's adaptive control system would have been interested in the display and storage of the sensed tool forces, vibration, etc., as well as the current and adjusted spindle speed and federate," and "Edie discloses 'a vibration sensor 20 that is configured to sense vibrations in the spindle and output signals related to the vibrations to a processing unit 22.'" *Id.* at 66 (citing Ex. 1004, 267; Ex. 1008, 3:18–22). Petitioner also argues that a person having ordinary skill in the art would have recognized several benefits in combining Oraby and Edie, including optimizing the cutting process, increasing tool life and efficiency, and decreasing costs as well as being able

to recognize minor adjustments made by Oraby's adaptive control system. *Id.* at 66–67. In addition, Petitioner contends that the proposed modification would have been a simple substitution of Oraby's display unit with Edie's PDA, and thus "represents the use of a known technique to improve Oraby's system and would have yielded predictable results." *Id.* at 68 (citing Ex. 1003 ¶¶ 141–145). Petitioner also argues one of ordinary skill in the art would have had a reasonable expectation of success in modifying Oraby to include Edie's portable display system. *Id.* at 67.

Patent Owner first argues that "[t]he approach in Edie, in which operational parameters are measured and displayed so that a human operator can make manual adjustments, is entirely different from the approach of the '432 Patent." PO Resp. 31 (citing Ex. 2002 ¶ 24). This argument is not persuasive because it focuses on "the approach of the '432 Patent" and, thus, is not commensurate with the scope of the claims. To the extent Patent Owner is arguing that Edie is not analogous art, we note that Edie discloses a system and method for machining data management that include gathering vibration and operational data and sending the data to a processing unit to define vibration profiles. Ex. 1008, code (57). As such, we determine that Edie is from the same field of endeavor as the '432 patent and, thus, analogous art. *See In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004) (expressing two tests for defining the scope of analogous art: *"*(1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved").

Patent Owner argues that Edie does not disclose a display device that can inform a user of the adjustments made by the controller, as required by

claim 7. PO Resp. 32. In particular, Patent Owner argues that "display of *measurements* is not the same as [displaying] information relating to *adjustments to the machine operation*." *Id.* at 33 (citing Ex. 2001 ¶ 68). Patent Owner also argues that Edie does not disclose making real-time adjustments or displaying real-time adjustment information. *Id.* (citing Ex. 2001 ¶ 69). According to Patent Owner, "[a]ll Edie teaches is displaying operational data, which is not sufficient to inform a user of any specific adjustments made by a controller." *Id.* at 34 (citing Ex. 2002 ¶ 25).

These arguments are not persuasive. Claim 7 only requires that the display device can *inform* a user of the adjustments made by the controller—it does not require displaying adjustment information. To illustrate this distinction, Petitioner submit the following example:

> consider a machining process programmed with a constant feed rate and a constant spindle speed of 1000 RPM. If a display device—attached to a machining system with the capability of making real-time adjustments, such as Delio or Oraby's systems—showed that the RPMs were increased to 1100 RPM, it would be clear to a PHOSITA that the machining system made an adjustment of 100 RPMs to the spindle speed.

Pet. Reply 24. According to Petitioner, such a display would inform a person having ordinary skill in the art of the adjustments and nothing more is required by claim 7. *Id.* at 24–25.

Patent Owner disagrees, relying on Dr. Glancey's testimony in arguing that "numerous possible machining conditions could result in a change in spindle speed, including 'inherent material property variations within the workpiece' causing spindle speed to increase if the tool encounters a 'softer part of the workpiece.'" PO Sur-reply 17 (quoting Ex. 1017, 95:1–16). Patent Owner further argues that Dr. Glancey testified that one of ordinary skill in the art "could 'certainly not' know what caused

changes to spindle speed simply by looking at the changes in speed themselves." *Id.* (quoting Ex. 1017, 95:17–96:7).

Patent Owner, however, states that Edie discloses displaying information so that a human operator can make manual adjustments. PO Resp. 31 (citing Ex. 2002 ¶ 24). When the operator adjusts the spindle speed, the measured speed will change. This change in the operational parameters would confirm to the user that the adjustment was made, thus informing the user of the adjustment. Patent Owner's assertions regarding Edie's adjustments being made manually are not persuasive because Petitioner relies on Oraby for disclosing adjustments made by the controller. Petitioner merely proposes incorporating Edie's display system into Oraby's adaptive control system—not replacing Oraby's automatic adjustments with Edie's manual adjustments. *See* Pet. 64.

Patent Owner's arguments regarding claim 8 entirely rely on claim 8's dependence from claim 7 and, thus, are not persuasive. *See* PO Resp. 34.

Patent Owner also argues that one of ordinary skill in the art would not have combined the human interfacing approach of Edie with Oraby because Oraby explicitly teaches away from human interfacing. *Id.* at 34–35 (citing Ex. 1004, 111, 264; Ex. 2002 ¶¶ 26–27; *Chemours Co. FC, LLC v. Daikin Indus., Ltd.*, 4 F.4th 1370, 1376 (Fed. Cir. 2021)); *see also* PO Sur-reply 16 (making the same argument). This argument is not persuasive because, as discussed above, Petitioner is not proposing to replace Oraby's automatic adjustments with Edie's manual adjustments. We have reviewed Petitioner's arguments that one of ordinary skill in the art would have been motivated to combine Oraby and Edie, which we describe above, and on the full record find these arguments persuasive.

For the reasons discussed above, we find that the combination of Oraby and Edie discloses all the limitations of claims 7 and 8. We also find that, contrary to Patent Owner's arguments, the Petition demonstrates that one of ordinary skill in the art would have been motivated to combine the references in the manner proposed by Petitioner. Accordingly, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that claims 7 and 8 are unpatentable as obvious over the combination of Oraby and Edie.

H. Ground 5: Asserted Anticipation by Delio

Petitioner asserts that claims 1, 2, and 6 of the '432 patent are anticipated by Delio. Pet. 13, 69–104. Patent Owner provides arguments addressing this asserted ground of unpatentability. PO Resp. 35–40. We first summarize Delio and then address the parties' contentions.

1. Delio

Delio "relates to a method for detecting and controlling chatter or unstable vibrations during cutting operations with a machine tool." Ex. 1005, 1:6–8. Figure 1 of Delio is reproduced below.

Figure 1

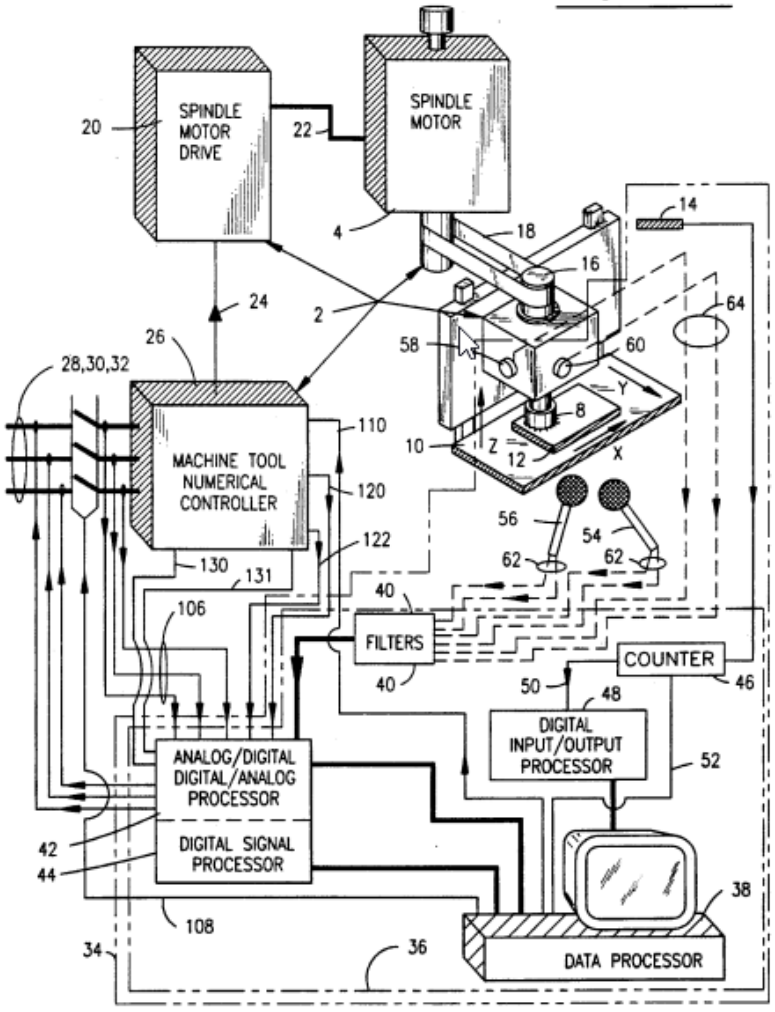

Figure 1 schematically shows "the overall control system hardware and its interface with a typical configuration of a machine tool." *Id.* at 3:6–8. Machine tool 2 includes variable speed spindle motor 4, cutting tool 8, and table 10 for carrying workpiece 12. *Id.* at 3:27–33. Servo drives (not shown) move the milling head in the Z-direction and table 10 in the X- and Y-directions. *Id.* at 3:29–30, 3:33–35. Machine tool numerical controller 26 sends motor drive command signals 24 to spindle motor drive 20, which controls spindle motor 4. *Id.* at 3:41–47. Controller 26 also generates servo signals 28, 30, 32 that cause the servos to manipulate the relative position of cutting tool 8 and workpiece 12. *Id.* at 3:50–58.

The system includes chatter recognition and control (CRAC) system 34 that "is a collection of sensors and processing hardware controlled by an object code computer program residing in the system memory of a microcomputer or microcontroller." *Id.* at 3:65–4:3. The processing and analyzing components of CRAC system 34 are grouped together as chatter analyzer 36. *Id.* at 4:3–6. Chatter analyzer 36 includes data processor 38, filters 40, analog/digital-digital/analog processor 42, and digital signal processor 44. *Id.* at 4:17–41. Filters 40 condition signals received from system sensors and provide output signals to processor 42 for subsequent transmission to data processor 38. *Id.* at 4:63–67. The sensors for detecting chatter include primary vibration sensors in the form of microphones 54, 56 and secondary vibration sensors 58, 60 such as displacement sensors, acceleration sensors, or velocity sensors. *Id.* at 5:30–66.

Chatter analyzer 36 executes two programs simultaneously: a control program that controls the data acquisition, output, and general operation of CRAC system 34, and a chatter recognition program that resides in digital signal processor 44. *Id.* at 8:14–25. In operation, the control program periodically uploads new vibration data to digital signal processor 44, where the chatter recognition program is executing, and digital signal processor 44 produces spectra of the vibration signals as rapidly as possible. *Id.* at 13:32–37. When the vibration spectra exceed a threshold value, the chatter recognition program issues a "stop flag," which causes data processor 38 to issue a feed halt. *Id.* at 13:38–48. With the feed of the machine tool temporarily halted, chatter analyzer 36 modifies rotational speed and feed based on material and tool information and machine specific data previously entered, and the actual rotational speed is adjusted until it reaches the modified output speed. *Id.* at 13:48–56.

2. Independent Claim 1

Petitioner contends that Delio discloses each limitation of independent claim 1. Pet. 69–103. To support its arguments, Petitioner identifies certain passages and figures in Delio and explains their significance with respect to the corresponding claim limitation. *Id.* Patent Owner argues that Petitioner has failed to show that Delio discloses a controller adjusting the power exerted by at least one of the spindle drive system and the feed drive system *in real-time*. PO Resp. 35–39.

a) The "Controller Adjusts the Power" Limitation

As noted above, claim 1 recites "wherein the at least one controller adjusts the power exerted by at least one of the spindle drive system and the feed drive system in real-time based on the real-time determinations." Ex. 1001, 8:27–30. In addressing this limitation, Petitioner argues that Delio discloses:

> "[I]f the operationally generated signal levels exceed the threshold, then [Delio's system] i**nterrupt[s] the feed of the cutting tool** relative to the workpiece, **chang[es] the speed of rotation to an adjusted speed of rotation**, . . . and then **resum[es] the feed and cutting tool engagement** with the workpiece and operating the machine tool at that adjusted speed of rotation."

Pet. 96 (quoting Ex. 1005, 2:37–51, with alterations and emphases added by Petitioner). Petitioner adds that Delio discloses issuing a feed halt by simultaneously issuing servo disconnect/reconnect and feed hold signals. *Id.* at 97 (citing Ex. 1005, 13:40–48). According to Petitioner, "[t]his feed halt operation alone is based on the real-time determination that the tool vibration has exceeded a vibration threshold and represents a real-time adjustment to the power exerted by the feed drive system." *Id.* at 98.

Although Petitioner presents a second theory that Delio's disclosure of changing the spindle speed and feed rate while feed is halted comprises a real-time adjustment (*id.* at 98–103), we agree with Petitioner's argument that Delio's feed halt operation represents a real-time adjustment to the power exerted by the feed drive system. In response to this argument, Patent Owner argues that "[b]ecause the feed halt operation interrupts the operation of the machine, it cannot constitute an adjustment made *during* continuous operation, as once the feed halt operation concludes the machine is no longer in operation." PO Resp. 39; *see also* PO Sur-reply 14 (making similar argument).

Delio, however, discloses monitoring vibration signals and issuing a feed halt when the vibrations exceed a threshold. Ex. 1005, 13:28–48. Halting the feed is necessarily an adjustment to the power exerted by the feed drive system. Furthermore, we find that this is a real-time adjustment because, contrary to Patent Owner's assertion, the adjustment is made autonomously *during* a machining operation. That is, both the spindle and feed drive are in operation at the time the feed halt is issued. The interruption of the feed is the result of the feed halt adjustment and does not occur until after the feed halt is issued. Delio also discloses that the feed halt adjustment is accomplished by *simultaneously* issuing a servo disconnect-reconnect signal and a feed hold signal, thereby performing the adjustment quickly enough to achieve the desired feed halt. Ex. 1005, 13:44–48. Accordingly, Patent Owner's argument that Delio's feed halt operation is not a real-time adjustment is not persuasive.

Based on the full record before us, we determine that Petitioner has met its burden of establishing that Delio discloses "wherein the at least one controller adjusts the power exerted by at least one of the spindle drive

system and the feed drive system in real-time based on the real-time determinations." Because of our determination that Petitioner establishes that Delio discloses this limitation, we do not reach Petitioner's alternate theory with respect to Delio disclosing the limitation. *See Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) (nonprecedential) (stating that the "Board need not address issues that are not necessary to the resolution of the proceeding," such as "alternative arguments with respect to claims [the Board] found unpatentable on other grounds").

b) The Remaining Aspects of Petitioner's Contentions

Patent Owner does not offer any arguments specifically addressing the remaining limitations of claim 1. *See generally* PO Resp. We need not set forth formal findings as to the undisputed assertions by Petitioner that Delio discloses these limitations. *See LG Elecs.*, 759 F. App'x at 925; Paper 12, 10; 37 C.F.R. § 42.23(a). Nevertheless, we have reviewed Petitioner's contentions with respect to the remaining limitations of claim 1 and find that Delio teaches these limitations as set forth by Petitioner. *See* Pet. 69–95.

c) Conclusion

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that Delio anticipates claim 1.

3. Dependent Claims 2 and 6

For both of claims 2 and 6, Petitioner provides a detailed analysis of Delio's disclosures that teach every element of each claim. Pet. 103–04. Petitioner also supports its contentions for these claims with the testimony of Dr. Stern. *Id.* (citing Ex. 1003 ¶¶ 204–210). Patent Owner offers no argument disputing Petitioner's contentions with respect to these claims. *See generally* PO Resp.

We have considered the evidence and arguments of record and determine that Petitioner has demonstrated by a preponderance of the evidence that Delio anticipates claims 2 and 6 for the reasons discussed in the Petition and as supported by the testimony of Dr. Stern.

I. Grounds 6 and 7: Asserted Obviousness Based on Delio and Delio and Bartow

Petitioner contends claims 1–4 and 6 would have been obvious in view of Delio. Pet. 104–07. For this ground, Petitioner relies on the same teachings of Delio relied on in connection with the ground asserting that claims 1, 2, and 6 are anticipated by Delio, arguing that, "[t]o the extent the Board finds that Delio does not anticipate claims 1, 2, and/or 6, they would have been obvious based on Delio alone." *Id.* at 104. Specifically, Petitioner argues that the signal analyzer of claim 1 would have been obvious to one of ordinary skill in the art in view of Delio, but does not address any other claim 1 limitations. *Id.* at 104–05. As for the additional limitations in claims 3 and 4, Petitioner argues that those limitations are disclosed in, or obvious in view of, Delio, thereby also rendering claims 3 and 4 obvious. *Id.* at 106–07.

Petitioner also contends claims 4 and 5 would have been obvious over Delio and Bartow. *Id.* at 108–09. For this ground, Petitioner relies on the same teachings of Delio relied on in connection with the ground asserting that claims 1, 2, and 6 are anticipated by Delio. *Id.* at 108. As for the additional limitations in claims 4 and 5, Petitioner relies on the same teachings of Bartow relied on in connection with the ground asserting that claims 4 and 5 would have been obvious based on Oraby and Bartow (which we discuss above in § II.F). *Id.* Petitioner argues that "[a] PHOSITA would

have been motivated to combine Delio and Bartow," thereby rendering claims 4 and 5 obvious. *Id.* at 108–09.

Patent Owner does not present any arguments for these claims other than those we have already considered with respect to independent claim 1, namely, that Delio does not disclose real-time adjustment. PO Resp. 27–29. Accordingly, on the full record before us, we determine that Petitioner establishes sufficiently that either Delio alone or the combination of Delio and Bartow discloses each of these claims. *See LG Elecs.*, 759 F. App'x at 925; Paper 12, 10; 37 C.F.R. § 42.23(a).

J. Ground 8: Asserted Obviousness Based on Delio and Edie

Petitioner contends claims 7 and 8 would have been obvious over Delio and Edie. Pet. 109–13. For this ground, Petitioner relies on the same teachings of Delio relied on in connection with the ground asserting that claims 1, 2, and 6 are anticipated by Delio. *Id.* at 109. As for the additional limitations in claims 7 and 8, Petitioner relies on the same teachings of Edie relied on in connection with the ground asserting that claims 7 and 8 would have been obvious based on Oraby and Edie (which we discuss above in § II.G). *Id.* Petitioner argues that there similarly exists a motivation to combine Delio and Edie, thereby rendering claims 7 and 8 obvious. *See id.* at 109–13.

Patent Owner disagrees with Petitioner's assertions, relying on essentially the same arguments made in connection with Petitioner's challenge of claims 7 and 8 based on Oraby and Edie. *See* PO Resp. 42–43; PO Sur-reply 16–19. We find these arguments unpersuasive for the reasons discussed above in § II.G. Accordingly, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that claims 7 and 8 are unpatentable as obvious over the combination of Delio and Edie.

III. CONCLUSION[18]

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1, 2, 4, 6	102	Oraby	1, 2, 4, 6	
1–4, 6	103	Oraby	1–4, 6	
4, 5	103	Oraby, Bartow	4, 5	
7, 8	103	Oraby, Edie	7, 8	
1, 2, 6	102	Delio	1, 2, 6	
1–4, 6	103	Delio	1–4, 6	
4, 5	103	Delio, Bartow	4, 5	
7, 8	103	Delio, Edie	7, 8	
Overall Outcome			1–8	

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–8 of U.S. Patent No. 8,136,432 B2 are determined to be 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.

[18] 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 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).

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