

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SZ DJI TECHNOLOGY CO., LTD.,
Petitioner,

v.

SYNERGY DRONE LLC,
Patent Owner.

Case IPR2018-00204
Patent 8,200,375 B2

Before PATRICK R. SCANLON, FRANCES L. IPPOLITO, and
TIMOTHY J. GOODSON, *Administrative Patent Judges*.

GOODSON, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Petitioner filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–10 of U.S. Patent No. 8,200,375 B2 (Ex. 1001, “the ’375 patent”) on the following grounds:

Ground	References	Basis	Claim(s) Challenged
1	Thornberg-983 ¹ and Thornberg-1995 ²	§ 103	1–6
2	Thornberg-983, Thornberg-1995, and Kotake ³	§ 103	7
3	Thornberg-983, Thornberg-1995, and Karem ⁴	§ 103	8
4	Thornberg-983, Thornberg-1995, and Rivers ⁵	§ 103	9, 10
5	Muramatsu, ⁶ Karem and, optionally, Thornberg-983	§ 103	1–5, 8
6	Muramatsu, Karem, and Thornberg-983	§ 103	6
7	Muramatsu, Karem, Kotake, and, optionally, Thornberg-983	§ 103	7
8	Muramatsu, Karem, Rivers, and, optionally, Thornberg-983	§ 103	9, 10

¹ U.S. Patent No. 5,552,983, issued Sept. 3, 1996, Ex. 1006.

² Christopher A. Thornberg & James P. Cycon, *Sikorsky Aircraft’s Unmanned Aerial Vehicle, Cypher: System Description and Program Accomplishments*, Ex. 1012.

³ JP Patent Pub. No. H08-10451, published Jan. 16, 1996, Ex. 1009.

⁴ U.S. Patent No. 6,584,382 B2, issued June 24, 2003, Ex. 1008.

⁵ U.S. Patent App. Pub. No. US 2005/0127242 A1, published June 16, 2005, Ex. 1010.

⁶ JP Patent Pub. No. P2001-209427 A, published Aug. 3, 2001, Ex. 1007.

See Pet. 4. Patent Owner did not file a Preliminary Response.

We instituted an *inter partes* review on all claims and all grounds asserted in the Petition. See Paper 8 (“Dec. on Inst.”). After institution of trial, Patent Owner filed a Patent Owner Response (Paper 18, “PO Resp.”), Petitioner filed a Reply (Paper 23, “Reply”), and Patent Owner filed a Sur-Reply (Paper 25, “Sur-Reply”). To support its arguments, Petitioner relies on the testimony of Dr. John Hansman (*see* Ex. 1003), while Patent Owner relies on testimony from Dr. Edmond J. Murphy (*see* Ex. 2005). A transcript of the hearing is included in the record. See Paper 43 (“Tr.”).

We have authority under 35 U.S.C. § 6. Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must prove unpatentability by a preponderance of the evidence. See 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). 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 1–10 of the ’375 patent — i.e., all of the challenged claims, which are also all of the claims in the patent — are unpatentable. See 35 U.S.C. § 316(e).

A. Related Matters

Patent Owner is asserting the ’375 patent against Petitioner in *Synergy Drone, LLC v. SZ DJI Technology Co.*, Case No. 1:17-cv-00242 in the U.S. District Court for the Western District of Texas. Pet. 73; Paper 21, 2.

At the Board, four *inter partes* reviews are pending that challenge patents related to the ’375 patent: Case IPR2018-00205, challenging U.S.

Patent 8,380,368; Case IPR2018-00206, challenging U.S. Patent No. 8,649,918; Case IPR2018-00207, challenging U.S. Patent No. 9,079,116; and Case IPR2018-00208, challenging U.S. Patent No. 9,568,913. Pet. 73; Paper 21, 2.

B. The '375 Patent

The '375 patent is directed to methods for using a radio controlled aircraft and remote controller. *See* Ex. 1001, [54]. The '375 patent seeks to simplify the control of RC aircraft, to address the difficulty arising from the need for a user to consider the perspective of the aircraft when operating the remote control. *Id.* at 1:15–26. For example, in known remote control devices, “[t]he same commands that would make the aircraft turn right when the aircraft is moving toward the user, make the aircraft turn left when traveling away from the user.” *Id.* at 1:23–24.

Figure 2 of the '375 patent is reproduced below:

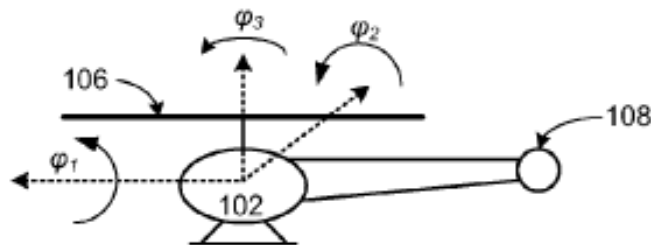


FIG. 2

Figure 2 illustrates a coordinate system aligned from the perspective of remote controlled aircraft 102, which describes the orientation of aircraft 102 in terms of angular displacements roll, pitch, and yaw. *Id.* at 2:31–40. Specifically, in Figure 2, φ_1 denotes rotation about the roll axis, φ_2 denotes

rotation about the pitch axis, and φ_3 denotes rotation about the yaw axis through the shaft of main rotor 106. *Id.* at 2:41–51.

In operation, a user generates command data from a remote control device in a different coordinate system, such as a user coordinate system that corresponds to the orientation of the user. *Id.* at 2:64–67. This command data can be transformed into control data in the aircraft's coordinate system, thus allowing control of RC aircraft 102 based on its orientation to the user, rather than the orientation of an imaginary pilot. *Id.* at 3:1–4.

Figures 3 and 4 are reproduced below:

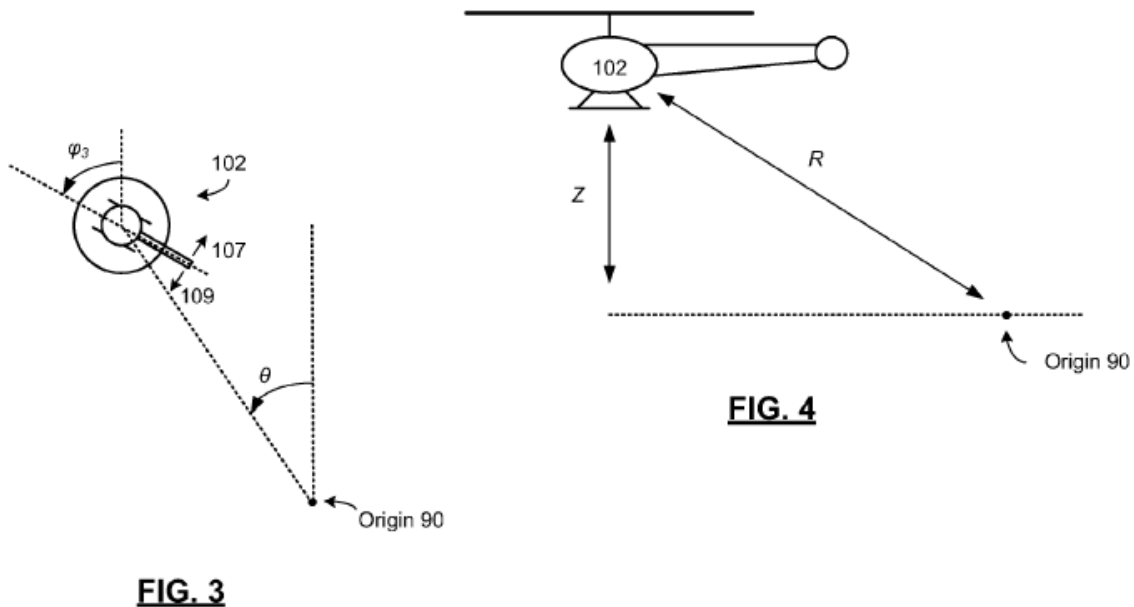


Figure 3 shows a yaw-axis from the perspective of radio controlled aircraft 102 and an angular orientation with respect to a user coordinate system. *Id.* at 1:52–56, 3:8–11. Figure 4 illustrates distance and altitude coordinates of radio controlled aircraft 102 with respect to the user coordinate system. *Id.* at 1:57–60, 3:12–15. Referring to Figures 3 and 4, the '375 patent teaches that origin 90 indicates the placement of the origin of a polar coordinate system that corresponds to the perspective of the user. *Id.* at 3:25–27. The

altitude of aircraft 102 relative to origin 90 is represented by Z, R represents the distance from aircraft 102 to origin 90, and θ represents the angular displacement of aircraft 102. *Id.* at 3:28–32. Thus, “the position of the RC aircraft 102 in three dimensional space can be represented in terms of (R, θ , Z) and the orientation of the aircraft can be represented in terms of (φ_1 , φ_2 , φ_3).” *Id.* at 3:33–35.

Figure 5 is reproduced below:

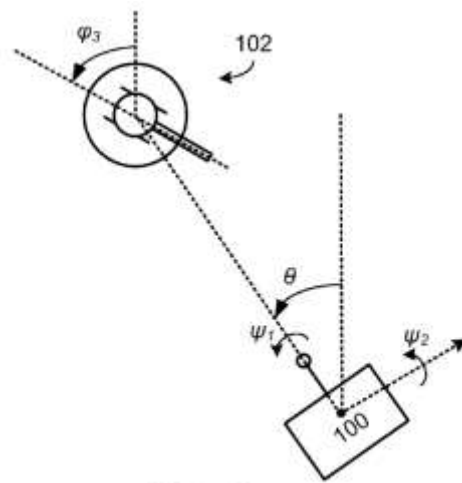


FIG. 5

Figure 5 illustrates the perspective of RC aircraft 102 with respect to remote control device 100. *Id.* at 3:36–38. The '375 patent teaches that remote control device 100 generates command data 104 that includes orientation commands Ψ_1 , Ψ_2 . *Id.* at 3:53–55. RC aircraft 102 can determine position parameters such as θ and φ_3 based on motion data generated by on-board motion sensors. *Id.* at 3:55–57. The '375 patent teaches that RC aircraft 102 transforms the orientation commands into control data such as roll axis and pitch axis controls, as follows:

$$\varphi_1 = \Psi_1 \cos (\varphi_3 - \theta) + \Psi_2 \sin (\varphi_3 - \theta)$$

$$\varphi_2 = \Psi_2 \cos (\varphi_3 - \theta) - \Psi_1 \sin (\varphi_3 - \theta)$$

Id. at 3:61–63. “In this fashion, when a user commands the RC aircraft 102 to pitch forward, the RC aircraft will pitch forward from the perspective of the user, regardless of the actual orientation of the RC aircraft.” *Id.* at 3:64–67.

With regard to remote control device 100, the ’375 patent teaches that it can include “spring-loaded interface devices [having] a return position that is returned to when no force is applied. In this implementation, the remote control device 100 commands the RC aircraft to hover or substantially hover when no force is applied to each of the plurality of spring-loaded interface devices.” *Id.* at 5:64–6:3.

C. Challenged Claims

Petitioner challenges claims 1–10, which are all of the claims in the ’375 patent. Ex. 1001, 8:60–10:32. Claim 1 is the only independent claim, and it is reproduced below with bracketed labels as added by Petitioner for ease of reference:

1. [a] A radio controlled (RC) helicopter system comprising:
an RC helicopter, wherein the RC helicopter includes:
[b] a receiver that is coupled to receive an RF signal
containing command data in accordance with a first
coordinate system, wherein the first coordinate system is
from a perspective of the remote control device;
[c] a motion sensing module, that generates motion
data based on the motion of the RC helicopter;
[d] a processing module, coupled to the motion
sensing module and the receiver, that transforms the
command data into control data, based on the motion data,
and in accordance with a second coordinate system,
wherein the second coordinate system is from a
perspective of the RC helicopter, and [e] wherein the
control data commands the RC helicopter from the
perspective of a user, independent of a yaw-orientation of
the RC helicopter; and

[f] a plurality of control devices, coupled to the processing module, that control the motion of the RC helicopter based on the control data;

[g] a remote control device, in wireless communication with the RC helicopter, that includes a plurality of spring-loaded interface devices, each of the plurality of spring loaded interface devices having a return position that is returned to when no force is applied, [h] wherein the remote control device generates the RF signal and command data that commands the RC helicopter to substantially a hovering state when no force is applied to each of the plurality of spring-loaded interface devices.

Id. at 8:60–9:21 (bracketed labels added).

II. ANALYSIS

A. Claim Construction

Under the version of our rules applicable to this *inter partes* review,⁷ claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b) (2016); *Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). Under that standard, a claim term generally is given its ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

⁷ The claim construction standard to be employed in *inter partes* reviews has changed for proceedings in which the petition was filed on or after November 13, 2018. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (to be codified at 37 C.F.R. pt. 42). The Petition in this proceeding was filed in November 2017.

We determine that “motion data” is the only term requiring construction in order to resolve the disputed issues in this proceeding. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of an *inter partes* review).

We also note that this claim construction dispute is case dispositive. All of Patent Owner’s rebuttal arguments against the obviousness challenges depend on its proposed construction of “motion data.” *See* PO Resp. 7–14; Sur-Reply 3–10. At the hearing, Patent Owner agreed that if we decline to adopt Patent Owner’s proposed construction, that determination would be case dispositive. Tr. 103:1–8.⁸

Limitation [c] of claim 1 recites that a motion sensing module “generates motion data based on the motion of the RC helicopter” and limitation [d] recites that a processing module “transforms the command data into control data, based on the motion data.” Ex. 1001, 8:66–9:3. The Petition did not propose a construction for “motion data” and our Decision on Institution did not adopt a construction. *See* Pet. 12–16; Dec. on Inst. 7–8.

In its Patent Owner Response, Patent Owner proposes that “motion data” should be construed to mean “data indicative of a change in position.”

⁸ The question and answer in the cited portion of the hearing transcript refer to “cases in chief,” but unlike the related co-pending IPR proceedings, there is no motion to amend in this proceeding, so the case in chief is the entire case.

PO Resp. 3. Patent Owner supports this proposed construction with dictionaries defining “motion” to include a change in position. *Id.* at 3–4 (citing Ex. 2002; Ex. 2003). Patent Owner also cites the Specification of the ’375 patent and the testimony of Dr. Murphy. *Id.* at 3–6 (citing Ex. 1001, 3:16–35, 3:42–52, 4:14–20, 7:16–21, Fig. 3; Ex. 2005 ¶¶ 49–68). According to Patent Owner, “[a] change in orientation is different from a change in position. Orientation describes a *direction*.” *Id.* at 4. Patent Owner urges that data indicative only of orientation is not motion data. *Id.* at 6. In its Sur-Reply, Patent Owner clarifies its position that “motion data is properly construed as explicitly requiring data indicating a change in position, but use of orientation data in this transformation as well is not prohibited” Sur-Reply 5.

Petitioner argues that “motion data only needs to be based on the motion of the RC aircraft and can reflect, for example, data indicative of the aircraft’s orientation, the aircraft’s position, or both the aircraft’s orientation and the aircraft’s position.” Reply 5. To support its position, Petitioner relies on the Specification, including dependent claims 3 and 5, as well as the testimony of Dr. Hansman and the cross examination testimony of Dr. Murphy. *Id.* at 3–5 (citing Ex. 1001, 3:32–35, 4:51–65, 7:4–6; Ex. 1023 ¶¶ 33–36, 39; Ex. 1019, 63:8–13, 89:19–21, 96:6–15).

The disputed claim construction issue is whether “motion data” is satisfied by data indicative of the aircraft’s orientation, as Petitioner contends, or whether that term requires data indicative of a change in the aircraft’s position, as Patent Owner contends. The emphasis in the Patent Owner Response on the distinction between a change in orientation and a change in position suggests that Patent Owner does not consider orientation

to be motion data. *See* PO Resp. 4. But Patent Owner’s subsequent briefing and arguments at the hearing clarify that Patent Owner does not dispute that an aircraft’s orientation is one type of “motion data.” *See* Tr. 77:20–78:4 (answering a question of whether motion data includes information as to whether an object is spinning about its own axis by responding that “angular motion would be included. Rotation is part of but it’s only an aspect of motion data. Motion data also requires position data, the change in position to be reflected as part of the motion data in these patents”); Sur-Reply 5 (arguing that “‘Yaw-axis motion data’ could indeed include data indicative of a change in orientation” and that claim 1 “encompasses transformations based on a change in orientation so long as they also include transformation based on data indicative of a change in position”) (emphasis omitted).

Thus, the parties agree that “motion data” as that term is used in the ’375 patent includes data indicative of the aircraft’s orientation. *See id.*; Reply 5; Tr. 30:7–9. The intrinsic record supports that view, because the Specification explains that yaw angle ϕ_3 represents the aircraft’s orientation, Ex. 1001, 3:34–35, 3:16–20, Fig. 3, and further describes that ϕ_3 is motion data. *Id.* at 4:64–65 (referring to “motion data 124 such as θ , ϕ_3 ”); *see also id.* at 9:28–29, 10:5–6 (dependent claims 3 and 5 reciting that “motion data includes yaw-axis motion data”). The testimony of both parties’ experts further supports that data indicating the vehicle’s orientation is motion data. *See* Ex. 1019, 61:16–19, 63:11–13, 89:19–21, 96:12–15; Ex. 1023 ¶¶ 33–35.

The only question, then, is whether orientation data can suffice by itself to qualify as “motion data,” as Petitioner contends, or whether data indicating a change in the vehicle’s position is essential, as Patent Owner argues. On that question, we agree with Petitioner that orientation data is

sufficient. The Specification describes that motion sensing module 122 generates motion data 124 based on the motion of the aircraft and that

motion sensing module 122 includes **one or more** axes of accelerometers **or** gyroscopes **or** other devices that alone, or with further processing by processing module 126, can generate data that represents θ , ϕ_3 , **and/or** other motion parameters such as R, Z, etc., that can be used in transforming the command data 104 to control data 128.

Ex. 1001, 4:54–59 (emphases added). This disclosure supports a broad understanding of “motion data” as any data generated by the sensing module that represents a position, orientation, or motion parameter.

Looking at the first portion of the block quote, as Dr. Hansman observes, “[m]otion sensing module 122 is not limited to any specific technology and can therefore include gyroscopes that measure changes in orientation or accelerometers used to measure change in position.” Ex. 1023 ¶ 32. The Specification’s description that the “motion sensing module 122 includes **one or more** axes of accelerometers **or** gyroscopes **or** other devices” indicates that some embodiments include only gyroscopes, which are devices that provide information about orientation. Ex. 1001, 4:54–55 (emphases added).

Turning to the second portion of the passage block quoted above — i.e., that motion sensing module 122 includes devices that “can generate data that represents θ , ϕ_3 , and/or other motion parameters such as R, Z, etc., that can be used in transforming the command data 104 to control data 128” (Ex. 1001, 4:54–59) — we find persuasive Dr. Hansman’s testimony that an ordinarily skilled artisan would understand this passage to signify that “the motion data generated by motion sensing module 122 can be data reflecting any one, or several, or all of the mentioned parameters.” Ex. 1023 ¶ 32.

Because ϕ_3 , which represents the aircraft's orientation, is one of the mentioned parameters, this means that motion data can reflect orientation data alone. Ex. 1001, 3:34–35, 3:16–20, 4:56. We also note that Dr. Murphy's testimony was in accord when he testified during cross-examination that “[m]otion data could be position data, it could be orientation data, or it could be a combination of position and orientation” and that he understands his own declaration to “say[] the same thing.” Ex. 1019, 96:12–15; *see also id.* at 61:18–19 (“Motion could be a change in only Phi 3. Yes. That's correct.”).

We have considered the other intrinsic and extrinsic evidence cited by Patent Owner, but that evidence does not persuade us that a narrower understanding of “motion data” is appropriate. *See* PO Resp. 3–6; Sur-Reply 3–6. Patent Owner points out that transformation equations disclosed in the '375 patent include θ , which reflects a change in position, and that the transformation makes the RC aircraft more user-friendly for unskilled operators. PO Resp. 5–6. However, the claims do not require the use of the particular transformation equations set forth in the Specification. The paragraph in which the transformation equations appear begins with “[i]n an embodiment of the present invention” (Ex. 1001, 3:53), signaling that the use of these transformation equations is not a requirement.

For the foregoing reasons, we construe “motion data” to include data indicative of an aircraft's orientation, position, or a combination thereof.

B. Legal Standards for Obviousness

In *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966), the Supreme Court set out a framework for assessing obviousness under § 103 that requires consideration of four factors: (1) the “level of ordinary skill in

the pertinent art,” (2) the “scope and content of the prior art,” (3) the “differences between the prior art and the claims at issue,” and (4) “secondary considerations” of non-obviousness such as “commercial success, long felt but unsolved needs, failure of others, etc.” *Id.* at 17–18. “While the sequence of these questions might be reordered in any particular case,” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 407 (2007), the Federal Circuit has “repeatedly emphasized that an obviousness inquiry requires examination of all four *Graham* factors and that an obviousness determination can be made only after consideration of each factor.” *Nike, Inc. v. Adidas AG*, 812 F.3d 1326, 1335 (Fed. Cir. 2016).

We note that, with respect to the fourth *Graham* factor, the record in this proceeding does not include any argument or evidence directed to secondary considerations of nonobviousness. The analysis below addresses the first three *Graham* factors.

C. Level of Ordinary Skill in the Art

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus. Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986); *Orthopedic Equip. Co. v. U.S.*, 702 F.2d 1005, 1011 (Fed. Cir. 1983).

For the purposes of our Decision on Institution, and based on the record at that preliminary stage, we adopted Petitioner’s proposal that an ordinarily skilled artisan at the time of the invention of the ’375 patent would have had the following education and experience:

[A] Bachelor’s degree from an accredited institution in electrical engineering, mechanical engineering, aeronautical or

astronautical engineering, robotics, computer science, or any other discipline covering principles of design, operation, and/or control of unmanned aerial vehicles, including remote-controlled vehicles, and would have a working knowledge of the design, development, implementation, or deployment of such technologies. Additional education could substitute for experience, and significant experience could substitute for formal education.

Dec. on Inst. 9 (citing Pet. 12; Ex. 1003 ¶ 28). Patent Owner does not dispute Petitioner’s proposed level of ordinary skill in the art. *See* Tr. 77:3–6. Based on our review of the complete record, we find that the evidence supports the level of ordinary skill in the art set forth above. Thus, we adopt Petitioner’s proposed level of ordinary skill in the art and apply it in our analysis below.

D. Obviousness Grounds Led by Thornberg-983

Thornberg-983 is the primary reference in each of Petitioner’s first four grounds. In particular, Petitioner contends that claims 1–6 would have been obvious based on the combination of Thornberg-983 in view of Thornberg-1995. Pet. 31–46. In challenging dependent claim 7, Petitioner adds Kotake to that base combination. *See id.* at 47–48. In challenging dependent claim 8, Petitioner relies on Thornberg-983 in view of Thornberg-1995 and Karem. *See id.* at 49–50. And in challenging dependent claims 9 and 10, Petitioner relies on Thornberg-983 in view of Thornberg-1995 and Rivers. *See id.* at 51–52.

1. Summary of Thornberg-983

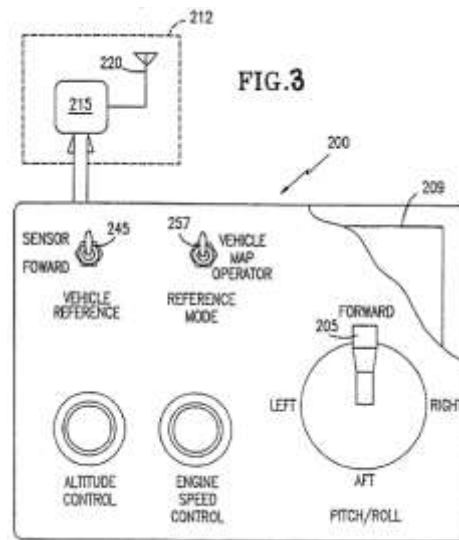
Thornberg-983 teaches a variable referenced control system for remotely operated vehicles. Ex. 1006, at (54). Thornberg-983 seeks to address the problem of “non-intuitive control of a remotely operated

vehicle,” which is a result of the differences between the operator’s frame of reference and the vehicle’s frame of reference. *Id.* at 1:48–2:9.

The system of Thornberg-983 “provides for the referencing of vehicle commands based on an operator frame of reference so that control commands provided by the operator remain intuitive and independent of the orientation of the vehicle with respect to the operator.” *Id.* at 3:41–44.

Thornberg-983 teaches that the variable referenced control system allows the operator to select various frames of reference for controlling an unmanned aerial vehicle (UAV), which allows the operator to tailor the UAV control to the specific mission or operational requirements, and provides for a simplified, intuitive control. *Id.* at 5:3–8.

Figure 3 of Thornberg-983 is reproduced below:



As shown in Figure 3, control panel 200 includes a joy stick or control stick 205 for providing control inputs to control the operation of the UAV. *Id.* at 4:30–33. Control stick 205 is shown as being a two axis control stick in which forward and aft movement of the control stick relates to pitch, and side-to-side movement relates to roll. *Id.* at 4:33–36. Control panel computer 209 receives control commands provided by the control stick 205

and converts them into signals to be transmitted via communications equipment 212. *Id.* at 4:36–39. Communications equipment 212 includes transmitter 215 for receiving the control commands provided from control panel computer 209 and for transmitting the control commands via control panel antenna 220. *Id.* at 4:39–43.

When control signals are transmitted by the control panel via antenna 220, the signals are received by the UAV antenna 42 and provided to UAV communications equipment 40. *Id.* at 4:43–47. The received signals are decoded and provided to flight control computer 38 and avionics equipment 34, which process the incoming control signals to thereby provide the appropriate control surface commands to the UAV control surfaces to perform the desired maneuvers. *Id.* at 4:47–56.

The flight control computer includes stick transformation function 400, which allows the operator to select between a variety of control references for controlling the remotely operated vehicle. *Id.* at 5:9–12. “[S]tick transformation function 400 is responsive to control signals received from the control panel and vehicle heading information for controlling the vehicle in accordance with the desired mode and reference.” *Id.* at 5:19–22. Among the inputs to the transformation function is the transformation angle, which is determined based on the true heading of the vehicle as determined by the navigation system 36 and the desired vehicle reference and vehicle reference mode. *Id.* at 5:30–35.

Reference mode switch 257 on control panel 200 allows the user to choose among different reference modes. *Id.* at 6:1–5. “In a vehicle reference mode, the vehicle’s reference axis is used for purposes of controlling the vehicle from the control panel.” *Id.* at 6:5–7. In a map

reference mode, an earth reference, such as North, is used for control of the vehicle. *Id.* at 6:7–9. “In an operator reference mode, the orientation of the operator upon activation of the operator mode is used as the reference axis.” *Id.* at 6:9–11. Thornberg-983 also describes a variable operator reference mode, in which the operator reference changes based on changes in the orientation of the operator control panel. *Id.* at 7:31–35.

2. *Summary of Thornberg-1995*

Thornberg-1995 describes an unmanned vertical take-off and landing system that is intended to meet a variety of civil and military mission requirements. Ex. 1012, 804. Thornberg-1995 recognizes as a challenge of vehicle control “the traditional problem of an operator needing to continually place himself in the vehicle’s reference system to determine the appropriate vehicle commands.” *Id.* at 809. Thornberg-1995 describes an algorithm that alleviates that problem by “continually keep[ing] track of the vehicle’s heading with respect to the operator’s reference system and determin[ing] the appropriate aircraft commands to move the vehicle according to the operator’s earth-referenced command.” *Id.* at 808. The operator maintains control of the aircraft “through a conventional hand-held control unit” having two joysticks: a right one that is spring-centered in both axes and controls pitch and roll, and a left one that is spring-centered in the lateral axis and controls yaw and collective. *Id.* at 809. Returning the joystick to its center position maintains the vehicle in a hover. *Id.* at 808.

Thornberg-1995 states on its face that it was “[p]resented at the American Helicopter Society 51st Annual Forum, Fort Worth, TX, May 9–11, 1995.” Ex. 1012, 804. Petitioner submits evidence that Thornberg-1995 was published by the American Helicopter Proceedings and was publicly

accessible from the British Library by August 4, 1995. *See* Ex. 1013 ¶¶ 18–19.

3. *Summary of Kotake, Karem, and Rivers*

Kotake describes a helicopter remote control device having control sticks 14, 15. Ex. 1009, at (54), Fig. 2. In Kotake, an automatic hovering control forces the helicopter to stay in a hovering state when the operator releases control sticks 14, 15. *Id.* at (57). In one application, the helicopter can be used for applying chemicals over agricultural fields, and the automatic hovering control operation can assist in positioning and maintaining the helicopter at a desired altitude despite changes in the helicopter’s payload. *Id.* ¶ 11.

Karem seeks to simplify control of complex machines, such as helicopters, to reduce the skill and training required for operation. Ex. 1008, 1:13–21. Relevant to Petitioner’s challenges, Karem teaches two methods for controlling fuselage azimuth, one of which “uses foot pedals (like the ones in regular aircraft or rotorcraft) to proportionally control the rate of change of the fuselage azimuth.” *Id.* at 8:9–14.

Rivers is directed to a payload dispensing system for unmanned vehicles that communicates with a ground control system. Ex. 1010, at (54), ¶ 10. Rivers describes that the ground control station can command the release of the payload when the unmanned vehicle has conveyed the payload to a designated site. *Id.* ¶ 22.

4. *Claim 1*

Petitioner contends that Thornberg-983 teaches each limitation of claim 1, except for limitation [h] and certain aspects of limitation [g]. Petitioner asserts that Thornberg-1995 supplies the features of claim 1 not

taught in Thornberg-983, and that an ordinarily skilled artisan would have been motivated to incorporate those features from Thornberg-1995 into Thornberg-983.

The only aspect of Petitioner’s contentions that Patent Owner contests is whether Thornberg-983 discloses transforming command data into control data based on motion data, as recited in limitation [d]. *See* PO Resp. 7–12; Sur-Reply 6–8. Patent Owner’s arguments regarding this limitation are premised on its proposed construction of “motion data,” which we do not adopt for the reasons discussed in Section II.A. *See id.*; *see also* Tr. 103:1–8 (Patent Owner agreeing that a determination not to adopt Patent Owner’s proposed construction of “motion data” would be case dispositive because all of Patent Owner’s arguments flow from that proposed construction). The remaining aspects of Petitioner’s obviousness arguments are uncontested. “The Board is ‘not required to address undisputed matters’ or arguments about limitations with which it was never presented.” *LG Elecs., Inc. v. Conversant Wireless Licensing S.A.R.L.*, 759 F. App’x 917, 925 (Fed. Cir. 2019) (quoting *In re Nuvasive, Inc.*, 841 F.3d 966, 974 (Fed. Cir. 2016)). Nevertheless, to provide a complete record, we set forth our findings on each limitation below.

a. Limitation [a]: “A radio controlled (RC) helicopter system comprising: an RC helicopter, wherein the RC helicopter includes”

We find persuasive Petitioner’s contentions that Thornberg-983 teaches limitation [a]. *See* Pet. 31–32. Thornberg-983 primarily focuses its description on an unmanned aerial vehicle, but also discloses that the invention described therein can be applied to other remotely operated vehicles, of which helicopters are a known type. Ex. 1006, 3:54–61, 1:17–

19. Thornberg-983 also teaches that the vehicle is controlled remotely via signals sent and received by antennas. *Id.* at 4:39–50. We credit Dr. Hansman’s testimony that an ordinarily skilled artisan would understand this disclosure to mean that the transmitted control signals “are radio frequency (RF) signals, as antennas were most commonly used to send and receive RF electromagnetic waves.” Ex. 1003 ¶ 88.

b. Limitation [b]: “a receiver that is coupled to receive an RF signal containing command data in accordance with a first coordinate system, wherein the first coordinate system is from a perspective of the remote control device”

We are persuaded by Petitioner’s argument that Thornberg-983’s pitch and roll commands received by communications equipment 40 from control panel 200 disclose “command data” as claimed. *See* Pet. 32–33 (citing Ex. 1006, 4:29–50, Fig. 3). As Petitioner notes, in Thornberg-983’s OPERATOR frame of reference, control commands are given from the remote control’s perspective based on the orientation of control panel 200. *See id.* at 33–34 (citing Ex. 1006, 7:19–43).

c. Limitation [c]: “a motion sensing module, that generates motion data based on the motion of the RC helicopter”

We find persuasive Petitioner’s argument that Thornberg-983’s navigation equipment 36 discloses a motion sensing module that generates motion data based on the motion of the vehicle. *See* Pet. 34–35. Thornberg-983 discloses that “[t]he vehicle’s true heading is provided from the navigation equipment 36 on the vehicle, e.g., a ring laser gyro or an inertial navigation system.” Ex. 1006, 5:32–43. As Petitioner points out, gyroscopes are among the devices that the ’375 patent teaches the motion sensing module includes to generate motion data. *See* Ex. 1001, 4:51–59. The vehicle’s true heading in Thornberg-983 indicates its orientation, and

we have construed “motion data” to include data indicative of an aircraft’s orientation. *See supra* § II.A.

- d. *Limitation [d]: “a processing module, coupled to the motion sensing module and the receiver, that transforms the command data into control data, based on the motion data, and in accordance with a second coordinate system, wherein the second coordinate system is from a perspective of the RC helicopter”*

We are persuaded by Petitioner’s argument that Thornberg-983’s flight control computer 38 discloses the claimed “processing module.” *See* Pet. 35–36. Thornberg-983’s flight control computer 38 is coupled to navigation system 36 and communications equipment 40. Ex. 1006, 4:12–16, Figs. 5–6. Flight control computer 38 receives roll and pitch commands from communications equipment 40 and transforms those commands into transformed pitch stick signal (TPSS) and transformed roll stick signal (TRSS). *Id.* at 4:44–52, 5:9–12, 5:20–23, 6:17–28. These transformations are “based on the motion data” as claimed because they use the transformation angle θ determined from the true heading measured by navigation system 36. *Id.* at 5:30–35, 6:22, 6:27. Thornberg-983 also discloses that the control data can be in a coordinate system that is from the vehicle’s perspective, as claimed, because in one mode of operation, “the vehicle reference for purposes of vehicle control is the forward reference position on the aircraft.” *Id.* at 5:56–59; Ex. 1003 ¶¶ 98–99.

Patent Owner argues that Thornberg-983 does not disclose transforming command data into control data based on motion data. PO Resp. 7–12; Sur-Reply 6–8. Patent Owner agrees that in Thornberg-983, transformation uses transformation angle θ , which is determined based on the vehicle’s true heading. PO Resp. 8. But Patent Owner contends that

transformation angle θ is not “motion data” because it is solely an indication of orientation. *Id.* (citing Ex. 2005 ¶¶ 74–75). The distinction Patent Owner urges between Thornberg-983 and the claimed subject matter is based on Patent Owner’s proposed construction of “motion data” as requiring data indicative of a change in position. *See id.*; *see also* Tr. 103:1–12. For the reasons discussed in Section II.A., we decline to adopt Patent Owner’s proposed construction. Under the construction we have adopted, Thornberg-983’s transformation angle θ is motion data because, as both parties agree, it indicates the vehicle’s orientation.

e. Limitation [e]: “wherein the control data commands the RC helicopter from the perspective of a user, independent of a yaw-orientation of the RC helicopter”

We find that Thornberg-983 teaches limitation [e] because it describes that the operator frame of reference allows the operator’s commands to “remain intuitive and independent of the orientation of the vehicle with respect to the operator.” Ex. 1006, 3:40–45; *see also* Pet. 36–37.

f. Limitation [f]: “a plurality of control devices, coupled to the processing module, that control the motion of the RC helicopter based on the control data”

We are persuaded by Petitioner’s argument that Thornberg-983’s pitch flight control system and roll flight control system disclose the claimed “control devices” because they are coupled to flight control computer 38 and they control the pitch and roll motion of the vehicle based on the transformed TPSS and TRSS data. *See* Pet. 37 (citing Ex. 1006, 6:16–28; Ex. 1003 ¶ 103).

g. Limitation [g]: “a remote control device, in wireless communication with the RC helicopter, that includes a plurality of spring-loaded interface devices, each of the plurality of spring loaded interface devices having a return position that is returned to when no force is applied”

We are persuaded by Petitioner’s arguments that the cited combination teaches limitation [g], and that an ordinarily skilled artisan would have been motivated to combine the references as claimed and would have had a reasonable expectation of success in doing so. *See* Pet. 38–41. Thornberg-983 describes that control panel 200 is in wireless communication with the vehicle and includes joy stick 205 (Ex. 1006, 4:28–36, Fig. 3), but Petitioner acknowledges that Thornberg-983 does not expressly state that the joy stick is spring-loaded. Pet. 38. However, Petitioner presents evidence that spring-loaded remote controls for aerial vehicles were known for at least a decade before the filing date of the ’375 patent. *See* Ex. 1003 ¶ 106; Ex. 1014, 1:5–30. Further, Thornberg-1995’s hand-held control unit has two spring-centered joysticks, one for pitch and roll control and the other for lateral axis and yaw control. *See* Ex. 1012, 809.

We further find that Petitioner has shown that an ordinarily skilled artisan would have been motivated to combine the references as claimed. *See* Pet. 38–41. We are persuaded that an ordinarily skilled artisan would have been motivated to use Thornberg-1995’s spring-loaded joysticks for Thornberg-983’s control stick 205 and altitude input controls because “[d]oing so would have facilitated ease of controlling the horizontal and vertical motions of the RC helicopter, which is a goal of both references.” *Id.* at 39 (citing Ex. 1012, 807; Ex. 1006, 2:63–67). As an additional reason to combine, we are persuaded by Petitioner’s argument that the proposed

combination would also “have allowed easy implementation of hovering thereby reducing undesired vehicle motion, which is a concern in Thornberg-983.” *Id.* at 40 (citing Ex. 1006, 1:47–52). Still further, the combination would “improve stability to the vehicle’s true heading and, therefore, provide more precise control data for the vehicle.” *Id.* (citing Ex. 1003 ¶ 110).

h. Limitation [h]: “wherein the remote control device generates the RF signal and command data that commands the RC helicopter to substantially a hovering state when no force is applied to each of the plurality of spring-loaded interface devices”

We find persuasive Petitioner’s argument that the combination teaches limitation [h] to an ordinarily skilled artisan. *See* Pet. 41–42. Thornberg-1995 teaches that releasing the right joystick commands the vehicle to hover, and releasing the left joystick causes the vehicle to maintain its current heading. Ex. 1012, 809. Petitioner also submits evidence that it was known in the prior art to command an RC helicopter to hover upon release of both spring-loaded joysticks. *See* Ex. 1003 ¶ 113; Ex. 1016, 26; Ex. 1017 ¶ 11. Thornberg-983 teaches that its system can be applied to any remotely operated vehicle and describes applications such as inspection, repair, and surveillance that would typically require hovering. Ex. 1006, 1:18–24, 3:54–61, 7:46–51. We agree with Petitioner that an ordinarily skilled artisan would have been motivated to incorporate the hovering feature into an RC helicopter to perform surveillance, as taught by Thornberg-983. *See* Pet. 42; Ex. 1003 ¶ 115.

i. Conclusion Regarding Claim 1

We determine that Petitioner has proven by a preponderance of the evidence that claim 1 would have been obvious based on the combination of Thornberg-983 and Thornberg-1995.

5. Claims 2–10

Claims 2–10 depend from claim 1. Petitioner argues that claims 2–6 would have been obvious based on the same combination of Thornberg-983 and Thornberg-1995 on which Petitioner bases its challenge of claim 1. *See* Pet. 43–46. Petitioner adds further references to that base combination in its challenges to claims 7–10. *See id.* at 47–52. Patent Owner does not dispute Petitioner’s contentions regarding these dependent claims separate from its arguments concerning claim 1. *See* PO Resp. 7–12 (arguing only claim 1); *see also LG Elecs.*, 2019 WL 343152, at *4 (“The Board is ‘not required to address undisputed matters’ or arguments about limitations with which it was never presented.”). We are persuaded by Petitioner’s uncontested evidence and arguments regarding these claims, as discussed in greater detail below.

a. Claims 2–6

We find that Thornberg-983 discloses the subject matter of claims 2 and 4 because it describes that roll and pitch commands received from the control panel are used by flight control computer 38 to generate TRSS data and TPSS data. *See* Ex. 1006, 5:9–35, 6:16–28; *see also* Pet. 43, 44.

We find that Thornberg-983 discloses the subject matter of claims 3 and 5 because Thornberg-983’s transformation angle θ is “yaw-axis motion data” and flight control computer 38 uses transformation angle θ to generate

TRSS data and TPSS data. *See* Ex. 1006, 6:16–28; Ex. 1003 ¶ 118; *see also* Pet. 43–45.

We find that Thornberg-983 discloses the subject matter of claim 6 because it describes that switch 257 can be used to select an OPERATOR mode, in which command data in the operator’s frame of reference is transformed into control data in the vehicle’s frame of reference, or a VEHICLE mode, in which command data is in the vehicle’s frame of reference and the control data is proportional to the command data. *See* Ex. 1006, 7:19–43, 5:51–6:36; Ex. 1003 ¶ 124; *see also* Pet. 45–46.

b. Claim 7

We are persuaded by Petitioner’s argument that Kotake teaches the subject matter added by claim 7. *See* Pet. 47–48. Kotake teaches a remote control helicopter that maintains a hovering state when the operator releases the control sticks, and that can maintain a desired altitude as it delivers chemical spray over a farm field. Ex. 1009, Abstract, ¶¶ 1, 4–6, 10–11. We are persuaded by Petitioner’s argument that an ordinarily skilled artisan would understand that Kotake’s automatic hovering state takes the weight of the helicopter into account so that the hovering state can be maintained even as the onboard weight changes as chemical spray is dispersed. *See* Pet. 47–48 (citing Ex. 1003 ¶ 128).

We are also persuaded by Petitioner’s argument that an ordinarily skilled artisan would have been motivated to incorporate this feature of Kotake into Thornberg-983 so that the vehicle could maintain a hovering state against weight changes, which would be useful in ordinance delivery and other applications Thornberg-983 contemplates. *Id.* at 48 (citing Ex. 1003 ¶ 130).

c. Claim 8

We are persuaded by Petitioner’s argument that Karem discloses the subject matter added by claim 8. *See* Pet. 49–50. Petitioner equates Karem’s “fuselage azimuth” to yaw angle, such that rate of change of fuselage azimuth is yaw velocity. *Id.* at 49 (citing Ex. 1008, 8:10–20; Ex. 1003 ¶ 131). Dr. Hansman’s testimony supports Petitioner’s argument that the foot pedal Karem describes for controlling rate of change of fuselage azimuth is a conventional method of controlling yaw velocity. *See id.* at 49–50; Ex. 1003 ¶ 132.

We also find persuasive Petitioner’s argument that an ordinarily skilled artisan would have incorporated Karem’s yaw velocity control into Thornberg-983 because doing so would provide stability to the vehicle’s true heading used for generating control data, and because Karem’s conventional foot-pedal yaw velocity control would make it unnecessary to retrain operators already familiar with such conventional controls. Pet. 50 (citing Ex. 1003 ¶¶ 133–134).

d. Claims 9 and 10

We are persuaded by Petitioner’s argument that Rivers teaches the subject matter added by claims 9 and 10. *See* Pet. 51–52. Rivers’ payload dispenser 60, which releases a payload upon command from a ground control station, corresponds to the “launch module” recited in claim 9. *See id.* at 51 (citing Ex. 1010 ¶ 22). Rivers also discloses that the launched object includes a parachute, as recited in claim 10. *Id.* at 52 (citing Ex. 1010, Fig. 4).

We also find persuasive Petitioner’s argument that an ordinarily skilled artisan would have been motivated to incorporate the launch module

of Rivers into Thornberg-983 because Thornberg-983 teaches the use of unmanned aerial vehicles to deliver ordinance or supplies. *Id.* (citing Ex. 1006, 1:25–34; Ex. 1003 ¶ 137).

e. Conclusion Regarding Claims 2–10

We determine that Petitioner has proven by a preponderance of the evidence that claims 2–6 would have been obvious based on the combination of Thornberg-983 and Thornberg-1995; that claim 7 would have been obvious based on Thornberg-983, Thornberg-1995, and Kotake; that claim 8 would have been obvious based on Thornberg-983, Thornberg-1995, and Karem; and that claims 9 and 10 would have been obvious based on Thornberg-983, Thornberg-1995, and Rivers.

E. Obviousness Grounds Led by Muramatsu

In Petitioner’s fifth, sixth, seventh, and eighth proposed grounds of unpatentability, Muramatsu is the primary reference. Specifically, Petitioner contends that claims 1–5 and 8 would have been obvious based on the combination of Muramatsu in view of Karem and, optionally, Thornberg-983. Pet. 53–67. Petitioner contends that dependent claim 6 would have been obvious based on Muramatsu, Karem, and Thornberg-983. *Id.* at 67–69. In challenging dependent claim 7, Petitioner adds Kotake to the base combination of Muramatsu and Karem and, optionally, Thornberg-983. *See id.* at 69–71. In challenging dependent claims 9 and 10, Petitioner relies on Muramatsu in view of Karem and, optionally, Thornberg-983, and further in view of Rivers. *See id.* at 71–72.

In a final decision, the Board is required to address the patentability of all claims challenged in a petition. *See* 35 U.S.C. § 318(a) (providing that the Board “shall issue a final written decision with respect to the

patentability of any patent claim challenged by the petitioner and any new claim added” by amendment during the proceeding); *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1354 (2018) (“[W]hen § 318(a) says the Board’s final written decision ‘shall’ resolve the patentability of ‘any patent claim challenged by the petitioner,’ it means the Board *must* address *every* claim the petitioner has challenged.”); Guidance on the Impact of SAS on AIA Trial Proceedings (Apr. 26, 2018)⁹ (“[I]f the PTAB institutes a trial, the PTAB will institute on all challenges raised in the petition The final written decision will address, to the extent claims are still pending at the time of decision, all patent claims challenged by the petitioner and all new claims added through the amendment process.”).

However, we are not aware of any requirement that once all challenged claims have been determined unpatentable, the Board must go on to analyze additional grounds challenging the same claims.¹⁰ In some cases,

⁹ Available at www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials/guidance-impact-sas-aia-trial.

¹⁰ We note that in *Adidas AG v. Nike, Inc.*, 894 F.3d 1256 (Fed. Cir. 2018), the Federal Circuit remanded to the Board to consider a second ground when the Board’s final decision had only addressed a first ground covering the same claims. *Id.* at 1258. But in *Adidas*, the Board’s final decision held that the challenged claims were not unpatentable based on the first ground. *Id.* at 1257. Thus, unlike the circumstances here, the Board’s decision in *Adidas* was not dispositive of the petitioner’s challenges. Similarly, in *AC Technologies S.A. v. Amazon.com, Inc.*, 912 F.3d 1358 (Fed. Cir. 2019), the Federal Circuit held that the Board properly considered a ground on which it did not initially institute, when the originally non-instituted ground challenged claims that were not shown unpatentable based on the originally instituted grounds. *Id.* at 1364–65. The reasoning of *AC Technologies* is that SAS requires the Board to address all claims challenged by a petitioner, so a final decision holding that some challenged claims were not shown unpatentable without addressing all of the grounds presented in the petition

doing so is an inefficient use of the Board’s resources, in that it may detract from the time and attention that is available to analyze and explain our reasoning for the dispositive issues. In this regard, an early Federal Circuit decision concerning the International Trade Commission explained that an administrative agency “is at perfect liberty” to reach a decision based on a single dispositive issue because doing so “can not only save the parties, the [agency], and [the reviewing] court unnecessary cost and effort, it can greatly ease the burden on [the agency] faced with a . . . proceeding involving numerous complex issues and required by statute to reach its conclusion within rigid time limits.” *Beloit Corp. v. Valmet Oy*, 742 F.2d 1421, 1423 (Fed. Cir. 1984).

Returning to the context of the Board’s decisions, in final written decisions both before and after SAS, the Board has declined to reach grounds challenging claims that were already held unpatentable. *See, e.g., Sure-Fire Elec. Corp. v. Yongjiang Yin*, Case IPR2014-01448, slip op. at 25 (PTAB Feb. 22, 2016) (Paper 56), *aff’d*, 702 F. App’x 981 (Fed. Cir. 2017); *SK Hynix Inc. v. Netlist, Inc.*, Case IPR2017-00692, slip op. at 40 (PTAB July 5, 2018) (Paper 25). Similarly, the Federal Circuit generally declines to reach additional grounds of unpatentability when it affirms determinations of unpatentability for the same claims. *See, e.g., Trading Technologies Int’l, Inc. v. IBG LLC*, No. 2017-2323, ___ F.3d ___, 2019 WL 1907236, at *5 (Fed. Cir. Apr. 30, 2019) (“In light of this conclusion [that claims 1–22 are ineligible], we need not address Petitioners’ separate ground that claims 12–

would violate the statutory scheme. *Id.* But we do not understand *AC Technologies* to require the Board to address grounds that challenge claims that have already been held unpatentable on other grounds.

22 are directed to non-statutory subject matter.”); *Victaulic Co. v. Iancu*, 753 F. App’x 895, 901–02 (Fed. Cir. 2018) (“We discern no error in the Board’s analysis and affirm its conclusion that claims 2 and 10 would have been obvious in view of Lewis and Lane. We thus do not reach the question of whether claims 2 and 10 would have been obvious in view of Vieregge and Lane.”); *Cole Kepro Int’l, LLC v. VSR Indus., Inc.*, 695 F. App’x 566, 570 n.2 (Fed. Cir. 2017) (“Because we determine that the Board did not err in concluding that claims 1–14 of the ’814 [patent] are unpatentable as obvious in view of Runte, we do not address the other instituted grounds analyzed by the Board.”); *In re Gleave*, 560 F.3d 1331, 1338 (Fed. Cir. 2009) (not reaching obviousness after finding anticipation).

Here, the grounds led by Muramatsu (i.e., grounds 5–8) challenge claims we have already determined are unpatentable based on the grounds led by Thornberg-983 (i.e., grounds 1–4). In addition, Petitioner’s Muramatsu-led challenges hinge on the same issue as the grounds already addressed, because Patent Owner’s sole argument against the Muramatsu-led challenges is based on its proposed construction for “motion data.” See PO Resp. 13–14; see also Tr. 103:1–8 (Patent Owner agreeing at the hearing that the claim construction of “motion data” is dispositive of all disputed issues).

Accordingly, in the circumstances of this case, we decline to address the challenges presented in Petitioner’s grounds 5–8.

III. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–10 of the ’375 patent have been shown to be unpatentable; and

FURTHER ORDERED that parties to the proceeding seeking judicial review of this Final Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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