

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SZ DJI TECHNOLOGY CO., LTD.,
Petitioner,

v.

DRONE-CONTROL, LLC,
Patent Owner.

Case IPR2018-00207
Patent 9,079,116 B2

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

IPPOLITO, *Administrative Patent Judge*.

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

I. INTRODUCTION

SZ DJI Technology Co., LTD. and Parrot Inc. filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–15 of U.S. Patent No. 9,079,116 B2 (Ex. 1001, “the ’116 patent”). Patent Owner did not file a Preliminary Response. On June 13, 2018, we entered our Decision on Institution (Paper 7, “Dec.” or “Decision”) instituting *inter partes* review of all challenged claims under all asserted grounds. Dec. 23–24. Patent Owner did not file a Patent Owner Response. Patent Owner filed a Contingent Motion to Amend (Paper 15, “Mot. Amend”). Petitioner subsequently filed an Opposition to Patent Owner’s Contingent Motion to Amend (Paper 21, “Opp. Amend.”). Patent Owner filed a Reply to Petitioners’ Opposition (Paper 23, “PO Reply Amend.”).

Oral argument was held on February 27, 2019 in San Jose, California. See Paper 43 (“Tr.”).

After the oral argument, Petitioner Parrot Inc. and Patent Owner requested the panel’s authorization to file a joint motion to terminate Parrot Inc. from this proceeding due to settlement between Parrot Inc. and Patent Owner. Following our authorization, Petitioner Parrot Inc. and Patent Owner filed a Joint Motion to Terminate Parrot Inc. in this proceeding on March 7, 2019. Paper 39. We granted the joint motion on March 11, 2019 and terminated Petitioner Parrot Inc.’s participation in this *inter partes* review. Paper 42. SZ DJI Technology Co., LTD. remains as the sole Petitioner in this matter. Accordingly, references to “Petitioner” hereinafter are to SZ DJI Technology Co., LTD.

We have jurisdiction under 35 U.S.C. § 6(b). This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). Having reviewed the

arguments of the parties and the supporting evidence, we find that Petitioner has demonstrated by a preponderance of the evidence that all challenged claims 1–15 of the '116 patent are unpatentable.

In addition, we deny Patent Owner's Contingent Motion to Amend to replace claims 1–15 with substitute claims 16–30.

A. Related Matters

According to Petitioner, the '116 patent is the subject of *Synergy Drone, LLC v. SZ DJI Tech. Co.*, Case No. 1:17-cv-00242, and *Synergy Drone, LLC v. Parrot S.A.*, Case No. 1:17-cv-00243, both in the U.S. District Court for the Western District of Texas. Pet. 66; *see also* Paper 4, 2.

At the Board, Petitioner has petitioned for *inter partes* review of patents related to the '116 patent in the following proceedings: Case IPR2018-00204, challenging U.S. Patent 8,200,375; Case IPR2018-00205, challenging U.S. Patent No. 8,380,368 B2; Case IPR2018-00206, challenging U.S. Patent No. 8,649,918 B2; and Case IPR2018-00208, challenging U.S. Patent No. 9,568,913. Pet. 66; Paper 4, 2.

B. The '116 Patent

The '116 patent is directed to methods for using a radio controlled aircraft and remote controller. *See* Ex. 1001, [54]. Figure 2 of the '116 patent is reproduced below:

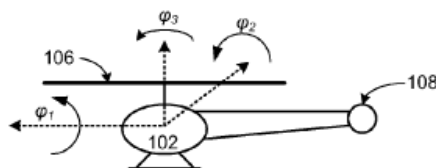


FIG. 2

Figure 2 illustrates three axes which are generally used to describe a coordinate system for the movements of remote controlled aircraft. In Figure 2, ϕ_1 denotes rotation about the roll axis for RC aircraft 102, ϕ_2 denotes rotation about the pitch axis, and ϕ_3 denotes rotation about the yaw axis. Ex. 1001, 3:1–11. 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. Ex. 1001, 3:24–27. According to the '116 patent, this command data can be transformed into control data in the coordinate system of the aircraft so that the RC aircraft 102 can be controlled based on its orientation to the user, rather than the orientation of an imaginary pilot. Ex. 1001, 3:26–31.

For example, Figures 3 and 4 are reproduced below.

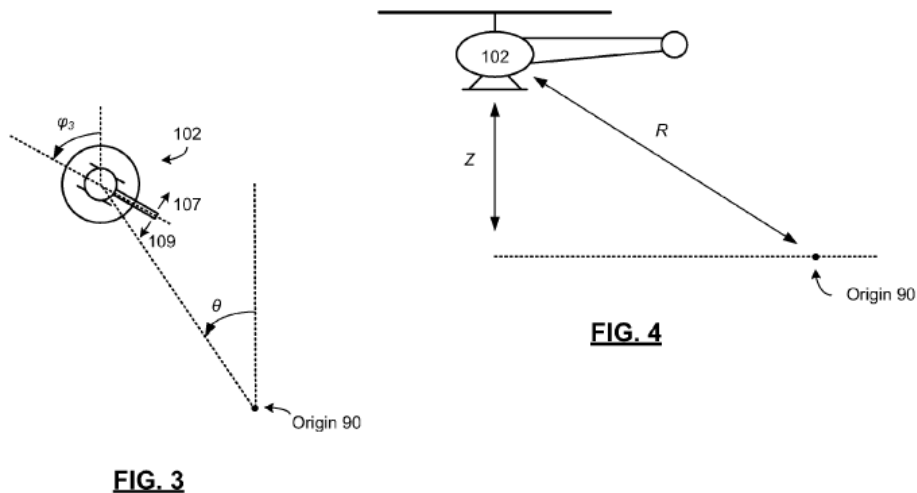


Figure 3 shows a graphical representation of roll, pitch, and yaw from the perspective of radio controlled aircraft 102. Ex. 1001, 2:12–15. Figure 4 illustrates distance and altitude coordinates of radio controlled aircraft 102 with respect to the user coordinate system. *Id.* at 2:17–19. Referring to Figures 3 and 4, the '116 patent teaches that origin 90 indicates the placement of the origin of a polar coordinate system that corresponds to the

perspective of the user. Ex. 1001, 3:52–54. Z represents the altitude of aircraft 102, R represents the distance from aircraft 102 to origin 90, and θ represents the angular displacement of aircraft 102. Ex. 1001, 3:55–59. The position of aircraft 102 is represented in terms of (R, θ , Z) and the orientation of aircraft 102 is represented in terms of (ϕ_1 , ϕ_2 , ϕ_3). *Id.* at 3:59–62.

Figure 5 is reproduced below:

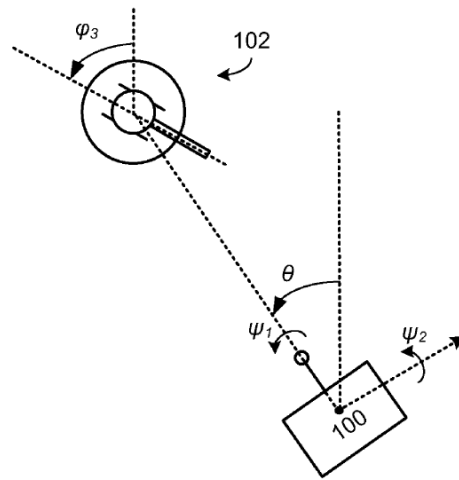


FIG. 5

Figure 5 illustrates the perspective of RC aircraft 102 with respect to remote control device 100. *Id.* at 2:21–24. Referring to Figure 5, the '116 patent further teaches that remote control device 100 generates command data 104 that includes orientation commands Ψ_1 , Ψ_2 . RC aircraft 102 is capable of determining position parameters such as θ , ϕ_3 based on motion data generated by on-board motion sensors. Ex. 1001, 4:15–18. RC aircraft 102 transforms the orientation commands into control data such as roll-axis and pitch axis controls, as follows:

$$\phi_1 = \Psi_1 \cos (\phi_3 - \theta) + \Psi_2 \sin (\phi_3 - \theta)$$

$$\phi_2 = \Psi_2 \cos (\phi_3 - \theta) - \Psi_1 \sin (\phi_3 - \theta)$$

Id. at 4:18–24. “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 4:25–28.

C. Challenged Claims

Petitioner challenges claims 1–15, which are all of the claims in the ’116 patent. Claims 1, 6, and 11 are the only independent claims. Claims 1 and 11 are reproduced below:

1. A method for use with a radio controlled (RC) aircraft, the method comprising:
 - receiving an RF signal from a remote control device that includes command data to control motion of the RC aircraft;
 - generating motion data from at least one sensor of the RC aircraft based on motion of the RC aircraft; and
 - controlling the RC aircraft based on the command data and the motion data, wherein the command data correspond to user commands in a first coordinate system from a perspective of the remote control device and the command data are transformed into control data in a second coordinate system that is from a perspective of the RC aircraft.

11. A method for use with a radio controlled (RC) aircraft, the method comprising:
 - generating an RF signal from a remote control device that includes command data that indicates user commands to control motion of the RC aircraft, wherein the user commands to control the motion of the RC aircraft are in a first coordinate system from a perspective of the remote control device;
 - generating a mode control signal that indicates one of: a first mode of operation and a second mode of operation;
 - wherein the RC aircraft is controlled based on the RF signal and motion data generated by at least one sensor of the RC

aircraft that indicates motion of the RC aircraft, and wherein the control of the RC aircraft includes:

when the mode control signal indicates the first mode of operation:

the user commands indicated by the command data are transformed into transformed commands in a second coordinate system that is from a perspective of the RC aircraft; and

the RC aircraft is controlled based on the transformed commands; and

when the mode control signal indicates the second mode of operation:

the RC aircraft is controlled directly based on the user commands indicated by the command data in the first coordinate system.

D. Instituted Grounds

We instituted an *inter partes* review on all of Petitioner's requested grounds as more specifically shown below:

Reference(s)	Basis	Claims Challenged
Thornberg '983 ¹	§ 102 / § 103	1, 3–6, 8–11, 13–15
Thornberg '983 in view of Karem ²	§ 103	2, 7, 12
Muramatsu ³ alone, or optionally in view of Thornberg '983	§ 102 / § 103	1, 3–5, 8–10, 13–15
Muramatsu in view of Thornberg '983	§ 103	6, 11
Muramatsu in view of Karem and optionally Thornberg '983	§ 103	2

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

² U.S. Patent No. 6,584,382 B2, issued June 24, 2003, Ex. 1008.

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

Reference(s)	Basis	Claims Challenged
Muramatsu in view of Thornberg '983 further in view of Karem	§ 103	7, 12

Pet. 4. In addition to the references listed above, Petitioner relies on the Declarations of Dr. R. John Hansman. Ex. 1003; Ex. 1023.

II. ANALYSIS

A. Claim Construction

For petitions filed before November 13, 2018, we use the broadest reasonable interpretation in light of the specification to interpret the claims of an unexpired patent that will not expire before issuance of a final written decision. *See* 37 C.F.R. § 42.100(b) (2017); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Consistent with the broadest reasonable construction standard, the challenged claims are presumed to be given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). We shall construe only terms that are in controversy and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs.* in the context of an *inter partes* review).

In this proceeding, Petitioner proposes constructions for “coordinate system . . . from a perspective of the RC aircraft,” “coordinate system from a perspective of the remote control device,” and “a hovering state.” Pet. 12–14. Patent Owner has not filed a Preliminary Response or a Patent Owner

Response in this proceeding.⁴ For purposes of this Final Written Decision, based on the complete record, we see no need to construe expressly any claim terms to resolve the dispute between the parties.

B. Principles of Law

1. Anticipation

“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 art reference.” *Verdegaal Bros. Inc. v. Union Oil Co.*, 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.”).

2. 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

⁴ We note that the records in related proceedings IPR2018-00204, IPR2018-00205, IPR2018-00206, and IPR2018-00208 differ from the instant proceeding. For example, Patent Owner filed a Patent Owner Response in each of those proceedings, which included a proposed construction for “motion data.” *See, e.g.*, IPR2018-00204, Paper 16, 3–6.

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. “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, 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).

Petitioner contends that an ordinarily skilled artisan at the time of the invention of the ’116 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.

Pet. 12 (citing Ex. 1003 ¶ 28).

Patent Owner did not file a Patent Owner Response and has not otherwise disputed Petitioner's proposed level of skill. *See* Tr. 77:1–6.

We find, based on our review of the complete record, that the evidence of record supports a level of ordinary skill in the art consistent with Petitioner's definition. Our findings are supported by the level of ordinary skill in the art reflected by the prior art of record and the '116 patent. *See* Ex. 1001, 1:36–37 (“This invention relates generally to radio controlled toys such as airplanes and helicopters.”); Ex. 1006, 1:8–10 (“The present invention relates to the control of remotely operated vehicles, and more particularly to a variable reference for the control of a remotely operated vehicle.”), *see id.* at 3:41–44 (“The system 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.”). Thus, we adopt Petitioner's proposed level of ordinary skill in the art and apply it to our discussion below.

D. Anticipation Challenge Based on Thornberg '983

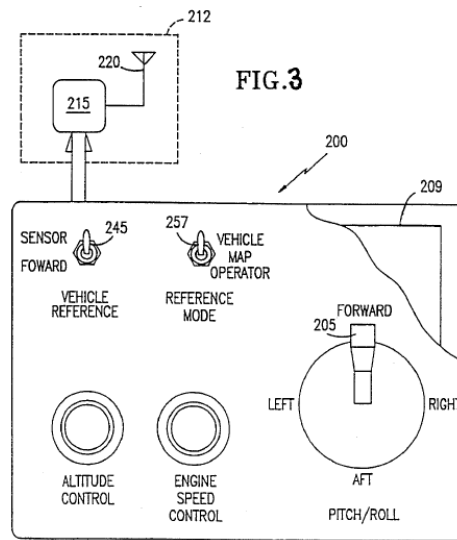
Petitioner asserts that Thornberg '983 anticipates claims 1, 3–6, 8–11, and 13–15. Pet. 26–42. Patent Owner did not file a Preliminary Response or a Patent Owner Response.

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. Claim 1

Petitioner contends that Thornberg ’983 discloses each limitation of claim 1.

Claim 1 is generally directed to a “method for use with a radio controlled (RC) aircraft” that includes the step of “receiving an RF signal from a remote control device that includes command data to control motion of the RC aircraft.”

For these limitations, Petitioner asserts that Thornberg ’983 teaches a remotely-operated vehicle that is radio controlled through operator control panel 200, which sends signals from antenna 220 to the remote-operated vehicle. Pet. 26–27. Petitioner contends that Thornberg ’983’s pitch and roll commands received by communications equipment 40 from control panel 200 correspond to the claimed “command data.” Pet. 27. Petitioner notes that “[t]he pitch and roll commands from the control stick 205 are converted into the RF signals that the control panel 200 transmits to UAV [(unmanned aerial vehicle)] 100.” *Id.* at 28 (citing 4:36–56, Fig. 5). Petitioner further asserts that “[a] POSITA would understand the signals transmitted from the control panel to the vehicle are radio frequency (RF) signals, as antennas are most commonly used for [RF signals].” Pet. 26–27 (citing Ex. 1003 ¶ 402).

Petitioner’s position is persuasive. Consistent with Petitioner’s arguments, we find that Thornberg ’983 discloses a remote controlled unmanned aerial vehicle (UAV). Ex. 1006, 4:29–30. Referring to Figure 4, Thornberg ’983 teaches that control panel 200 for remote operation of the UVA includes transmitter 215 for receiving control commands provided by control panel computer 209 and for transmitting the control commands via control panel antenna 220. *See id.* at 4:28–43. Thornberg ’983 further teaches that

when control signals are transmitted by the control panel via the antenna 220, *the signals are received by the UAV antenna 42 and thereafter provided to the UAV communications equipment 40.* The communications equipment comprises a receiver 46 and a demodulator/decoder 48 for receiving and decoding the received signals transmitted by the control panel. Thereafter, the demodulated and decoded control signals are provided to the flight control computer 38 and avionics equipment 34. The flight control computer 38 and avionics equipment 34 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 4:44–56 (emphasis added). We further credit Dr. Hansman’s testimony that a person of ordinary skill in the art would understand radio frequency signals were commonly used to transmit signals to antennas. Ex. ¶¶ 402–405. Dr. Hansman’s testimony is not disputed, and is, in our view, consistent with the disclosure in Thornberg ’983 discussed above.

Claim 1 further recites the step of “generating motion data from at least one sensor of the RC aircraft based on motion of the RC aircraft.”

For this limitation, Petitioner asserts that Thornberg ’983 discloses that the UAV includes a navigation system 36 that generates motion data based on the motion of the vehicle. Pet. 28 (citing Ex. 1006, 3:55–61, 4:11–16, 5:32–43, 7:51–54, Fig. 6 (Navigation 36)). Petitioner argues that “[a] POSITA would recognize the claimed ‘sensor’ may correspond to either the navigation system 36 or the sensors within the navigation system used to generate motion data based on motion of the vehicle.” Pet. 28.

Petitioner’s position is supported by the disclosure in Thornberg ’983. Thornberg ’983 teaches that navigation equipment 36 (i.e., sensor) provides the vehicle’s true heading. Ex. 1006, 5:36–37. Thornberg ’983 further teaches that navigation equipment 36 may be a ring laser gyro or an inertial

navigation system. *Id.* at 5:36–38. Thornberg ’983’s “true heading signal” indicates the orientation of a fixed point on the aircraft with respect to true north. *Id.* at 5:38–40. In this regard, we find that Thornberg ’983’s described navigation system teaches a sensor that generates motion data in the form of orientation data (e.g., true heading) for the vehicle.

Claim 1 further requires

controlling the RC aircraft based on the command data and the motion data, wherein the command data correspond to user commands in a first coordinate system from a perspective of the remote control device and the command data are transformed into control data in a second coordinate system that is from a perspective of the RC aircraft.

For these limitations, Petitioner argues that Thornberg ’983 teaches providing the user commands “in a first coordinate system from a perspective of the remote control device” because in “the OPERATOR frame of reference” mode, the received pitch and roll commands are from the perspective of the remote control or the vehicle operator. Pet. 30–31 (citing Ex. 1006, 2:41–49 (“based on the orientation of the vehicle operator”), 7:19–26 (“based on the orientation of the operator control panel”)). Additionally, Petitioner argues that Thornberg ’983’s transformed pitch stick signal (TPSS) and transformed roll stick signal (TRSS) constitute “control data in a second coordinate system that is from a perspective of the RC aircraft” as claimed because this data is generated based on both command data and motion data. Pet. 29–30 (citing Ex. 1006, 4:52–56, 5:20–35, 6:8–28). Petitioner adds that Thornberg ’983’s flight control computer 38 includes a transformation function 400 that generates TPSS and TRSS control data to control the motion of the RC aircraft based on the received pitch and roll commands and a transformation angle θ determined from the

true heading measured by navigation system 36. Pet. 29 (citing Ex. 1006, 6:8–28, 5:20–35).

We turn first to Figure 6 of Thornberg '983, reproduced below.

FIG. 6

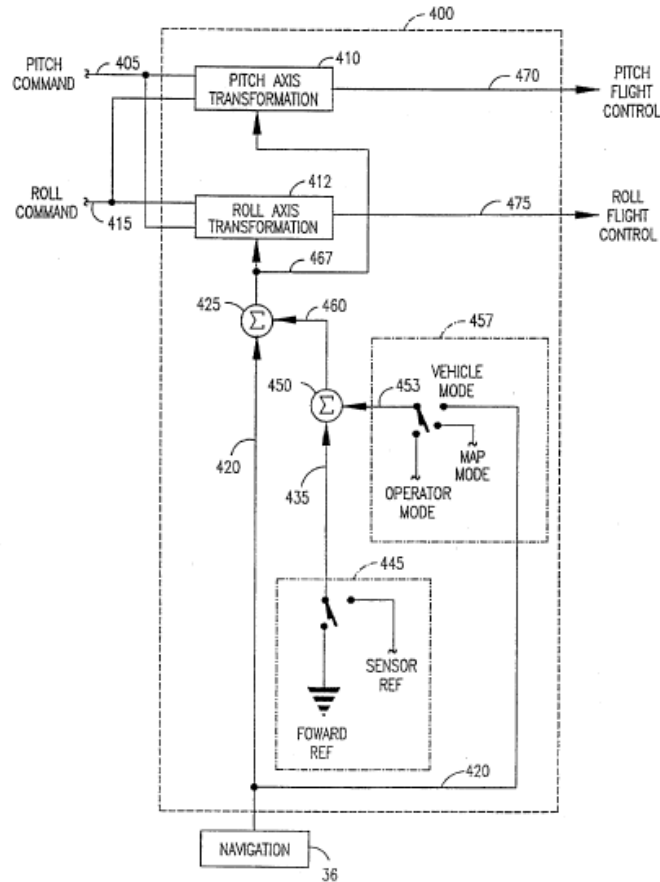


Figure 6 is a block diagram showing the command transformation utilized by a flight control computer of a remotely operated vehicle shown in Figure 3 of Thornberg '983. Ex. 1006, 3:30–32. Referring to Figure 6, Thornberg '983 teaches the flight control computer includes stick transformation function 400, which 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 5:19–23. With regard to control signals, Thornberg '983 further teaches

[t]he pitch command (provided from the control panel via the vehicle communications equipment) is provided on a line 405 to a pitch axis transformation function 410 and a roll axis transformation function 412. Similarly, the roll command is provided on a line 415 to the pitch axis transformation function 410 and the roll axis transformation function 412.

Ex. 1006, 5:22–29. We further observe that once the disclosed pitch/roll commands (i.e., command data) are provided to the pitch axis and roll axis transformation functions, the pitch axis transformation 410 and roll axis transformation 412 use transformation equations to determine a transformed pitch stick signal (TPSS) and a transformed roll stick signal (TRSS). *See* Ex. 1006, 6:17–28. In other words, the flight control computer transforms received command pitch/roll data into TPSS and TRSS commands.

In performing this transformation, the pitch axis transformation function 410 and the roll axis transformation function 412 also receive a transformation angle (θ) input. *Id.* at 5:30–32. Thornberg '983 teaches that the transformation angle θ 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 5:31–35. As discussed above, we find that the true heading of the vehicle as determined by navigation system 36 provides motion data generated by a sensor.

Thornberg '983 teaches that the transformations into TPSS and TRSS take into account transformation angle (θ), which Thornberg '983 teaches is determined based on the true heading (i.e., motion data) of the vehicle and the control data (pitch/roll commands) received from control panel 200 of the remote operator control. *See* Ex. 1006, 4:29–33, 5:23–25, 5:36–38.

Further, in the operator reference mode, the orientation of the operator/remote control upon activation of the operator mode is used as the reference axis (i.e., operator's coordinate system). Additionally, as noted in the Petition (*see* Pet. 30–31), Thornberg '983 teaches a variable operator reference mode in which the operator reference changes based on changes in the orientation of the operator control panel. Ex. 1006, 7:32–35.

Based on the disclosure discussed above, we find that the pitch and roll commands received at lines 405, 415 in the *operator mode* teach command data in “a first coordinate system from a perspective of the remote control device” as recited in claim 1. Moreover, we find that Thornberg '983 teaches that the received pitch/roll command data is transformed into control data in “a second coordinate system that is from a perspective of the RC aircraft.” Specifically, Thornberg '983 teaches that the transformation equations 1 and 2 transform the pitch command and roll command based on the difference between the aircraft heading and the reference heading. *See* Ex. 1066, 7:9–11, 7:19–24. Further, Dr. Hansman testifies that TPSS and TRSS control data control the vehicle in the vehicle's coordinate system, which is from the perspective of the vehicle. Ex. 1003 ¶ 411. We credit Dr. Hansman's undisputed testimony in this regard because this testimony is consistent with the disclosure of Thornberg '983, which teaches, among other things, that “[t]he system 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.” Ex. 1006, 3:41–44.

After reviewing Petitioner's arguments concerning claim 1 and the evidence cited therein, we conclude that Petitioner shows, by a

preponderance of the evidence, that Thornberg '983 anticipates independent claim 1 under 35 U.S.C. § 102.

3. Claims 6 and 11

Petitioner relies primarily on arguments discussed above with respect to independent claim 1, with minor variations, in its challenge of independent claims 6 and 11. *See* Pet. 32–34. We note, however, claim 6 further recites:

in a first mode of operation: the user commands indicated by the command data are transformed into transformed commands in a second coordinate system that is from a perspective of the RC aircraft; and the RC aircraft is controlled based on the transformed commands; and

in a second mode of operation: the RC aircraft is controlled directly based on the user commands indicated by the command data in the first coordinate system.

Ex. 1001, 9:62–10:6. Similarly, claim 11 recites:

generating a mode control signal that indicates one of: a first mode of operation and a second mode of operation . . .

when the mode control signal indicates the first mode of operation:

the user commands indicated by the command data are transformed into transformed commands in a second coordinate system that is from a perspective of the RC aircraft; and the RC aircraft is controlled based on the transformed commands; and

when the mode control signal indicates the second mode of operation:

the RC aircraft is controlled directly based on the user commands indicated by the command data in the first coordinate system.

Id. at 10:32–33, 38–50.

For these limitations, Petitioner asserts that Thornberg '983 teaches “various different frames of reference for controlling the UAV.” Pet. 35 (citing Ex. 1006, 5:3–8). According to Petitioner, Thornberg '983 discloses switch 257 on control panel 200 that the vehicle operator uses to select a VEHICLE, MAP, or OPERATOR frame of reference for the pitch and roll commands. *Id.* (citing Ex. 1006, 2:56–60, 2:63–67, 6:2–11, Fig. 3 (switch 257), Fig. 6 (switch 457)). Petitioner asserts that the position of switch 257 is transmitted to the vehicle to set the corresponding value of switch 457. *Id.*; *see also id.* at 38–39 (“A signal indicating the position of switch 257 is transmitted from the control panel 200 to the vehicle to set the corresponding value of switch 457.”) (citing Ex. 1006, 6:2–5).

In the operator reference mode, Petitioner contends that the OPERATOR frame of reference provides a frame of reference with respect to the vehicle operator. Pet. 35 (citing Ex. 1006, 2:41–49, 7:19–26). Petitioner adds that Thornberg '983 teaches that the OPERATOR frame of reference may vary with the orientation of the operator's control panel 200, in which case Thornberg '983 refers to the mode as a variable operator reference mode, which Petitioner argues teaches the claimed first mode of operation. Pet. 35–36, *see id.* at 40.

For the second mode of operation, Petitioner contends that Thornberg '983 teaches VEHICLE reference mode “with the vehicle reference defined as the forward vehicle axis (i.e., switch 245 in Fig. 3 set to FORWARD), the transformation angle θ is zero, and the pitch command data 405 and roll command data 415 received by the UAV are directly provided as the control data 470 and 475, with no transformation.” Pet. 36–37 (citing Ex. 1006, Fig.

3 (switch 257 showing “VEHICLE” reference mode), Fig. 6 (switch 457 showing “VEHICLE” mode), 6:2–7, 6:17–49); *see id.* at 40.

Having reviewed the complete record, we determine that Petitioner has mapped disclosures in Thornberg ’983 to each of the limitations of independent claims 6 and 11, and has persuasively argued how these disclosures teach each limitation. *See* Pet. 32–41. For example, Thornberg ’983 teaches three reference modes:

In a vehicle reference mode, the vehicles reference axis is used for purposes of controlling the vehicle from the control panel. In a map reference mode, an earth reference, such as North, is used for control of the vehicle. In an operator reference mode, the orientation of the operator upon activation of the operator mode is used as the reference axis.

Ex. 1006, 6:5–11 (emphasis added). As discussed with respect to claim 1, Thornberg ’983 teaches that, in the operator reference mode, the received pitch/roll command data is transformed into control data TPSS and TRSS in a second coordinate system that is from a perspective of the RC aircraft. *See* Ex. 1066, 7:9–11, 7:19–24; Ex. 1003 ¶ 411. However, in the vehicle reference mode, “the transformation function should not make any change in the pitch command 405 and roll command 415 being provided to the lines 470 and 475, i.e., TPSS = pitch command and TRSS = roll command.”

Ex. 1006, 6:32–36. Additionally, Thornberg ’983 teaches that a reference mode switch is used to select which reference mode (e.g., vehicle reference mode or operator reference mode) is used for operation of the vehicle. *Id.* at 6:2–5.

Accordingly, Petitioner has demonstrated, by a preponderance of the evidence, that claims 6 and 11 are anticipated by Thornberg ’983.

4. Claims 3, 8, and 13

Claim 3, 8, and 13 depend from claims 1, 6, and 11, respectively. Dependent claims 3, 8, and 13 similarly recite that the command data includes roll-axis and pitch-axis data, and that the motion data includes yaw-axis data. Ex. 1001, 9:40–42, 10:11–13, 54–56.

Petitioner argues that Thornberg ’983 teaches control panel 200 transmits roll and pitch commands, and motion data in the form of the vehicle’s true heading (i.e., yaw-axis motion data) measured by navigation system 36. Pet. 40–41 (citing Ex. 1006, 5:9–35, 6:11–28, 7:3–43, Figs. 5–6).

Based on the complete record, Petitioner’s position is persuasive. As shown in Figure 6 of Thornberg ’983, the pitch command and roll command are provided on lines 405 and 415, respectively. Ex. 1006, 5:23–27. Further, the vehicle’s true heading, which is “indicative of the orientation of a fixed point on the aircraft,” is provided on line 420 by navigation system 36. *See id.* at 5:36–50. We find that the orientation data disclosed in Thornberg ’983 discloses “motion data” as recited in the challenged claims.

Accordingly, Petitioner has demonstrated by a preponderance of the evidence that claims 3, 8, and 13 are anticipated by Thornberg ’983.

5. Claims 4, 9, and 14

Claims 4, 9, and 14 depend, respectively, from claims 3, 8, and 13 (discussed above). These claims similarly require that “the control data includes roll-axis control data generated as a function of the roll-axis command data, pitch-axis command data and the yaw-axis motion data” (claim 4) and “wherein the transformed commands include roll-axis data

generated as a function of the roll-axis command data, pitch-axis command data and the yaw-axis motion data” (claims 9 and 14).

Petitioner argues Thornberg ’983’s TRSS data is roll-axis control data generated as a function of the roll-axis and pitch-axis command data received from control panel 200 and the transformation angle θ , which is a function of the vehicle’s true heading (i.e., “yaw-axis motion data”). Pet. 41 (citing Ex. 1006, 6:23–28).

Based on the complete record, we find that Thornberg ’983 teaches that TRSS (transformed roll stick signal) is determined by equation (2), which is roll command “ $\ast \cos (\theta) + \text{pitch command} \ast \sin (\theta)$.” Ex. 1006, 6:23–28. In this equation, “roll command” is the input on line 415 and “pitch command” is the input on line 405, both of which are provided from the control panel of vehicle communication equipment. *Id.* at 5:23–29. The transformation angle θ “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 5:32–35. As discussed above, we find that the true heading information provided by navigation system 36 teaches orientation motion data.

Accordingly, Petitioner has demonstrated by a preponderance of the evidence that claims 4, 9, and 14 are anticipated by Thornberg ’983.

6. *Claims 5, 10, and 15*

Dependent claims 5, 10, and 15 recite similar limitations directed to control data (claim 5) or “transformed commands” (claims 10 and 15) that “include pitch-axis data generated as a function of the roll-axis command data, pitch-axis command data and yaw-axis motion data.”

Here, Petitioner reiterates that Thornberg '983 discloses control data including TPSS data (i.e., “pitch-axis control data”) as a function of the roll-axis and pitch-axis command data received from the control panel 200 and the transformation angle θ , which is a function of the vehicle’s true heading (i.e., “yaw-axis motion data”). Pet. 42 (citing Ex. 1006, 6:17–22).

Thornberg '983 teaches transformation equation 1 as “TPSS = pitch command * $\cos(\theta)$ - roll command * $\sin(\theta)$.” Ex. 1006, 6:22. TPSS or transformed pitch stick signal is generated based on the pitch and roll commands on lines 405 and 415, and the transformation angle θ . *Id.* Thus, we are persuaded that Petitioner’s reasoning and evidence demonstrate, by a preponderance of the evidence, that claims 5, 10, and 15 are anticipated by Thornberg '983.

E. Obviousness Challenges Based on Thornberg '983

Petitioner asserts that claims 1, 3–6, 8–11, and 13–15 are unpatentable under 35 U.S.C. § 103 over Thornberg '983. Pet. 26–42.

For this obviousness challenge based on Thornberg '983, Petitioner relies primarily on the arguments discussed above with respect to Petitioner’s challenge based on anticipation by Thornberg '983. *See* Pet. 26–42. Petitioner asserts that, to the extent Thornberg '983 is found not to disclose radio control signals, it would have been obvious to an ordinarily skilled artisan that the control panel 200 would transmit RF signals to the vehicle to provide the necessary range for controlling a remotely-operated aircraft. *Id.* at 27 (citing Ex. 1006, 4:36–50; Ex. 1003 ¶ 403). Petitioner asserts that Thornberg '983’s operator control panel 200 sends signals from antenna 220 to the remotely operated vehicle, and that the vehicle receives

the signals at its antenna 42, and then demodulates and decodes the received signals. *Id.* at 26–27 (citing Ex. 1006, 4:39–50, Figs. 3, 5).

Relying on the testimony of Dr. Hansman, Petitioner further argues that a POSITA would have understood the signals transmitted from the control panel to the vehicle are radio frequency (RF) signals, as antennas are most commonly used for transmitting RF signals. *Id.* at 26–27 (citing Ex. 1003 ¶¶ 402–403). Dr. Hansman testifies that “RF signals provide the necessary range for controlling a remotely-operated aircraft. I believe the POSITA also would have recognized Thornberg’s communication equipment 212 and 40 (illustrated in Figs. 3 and 5 respectively) were conventional RF circuitry.” Ex. 1003 ¶ 403 (citing Ex. 1006, 4:36–50). Based on the complete record, we credit Dr. Hansman’s undisputed testimony, which is supported by and consistent with the disclosure in Thornberg ’983, which Petitioner has identified above. Ex. 1003 ¶¶ 402–405; *see* Ex. 1006, 4:39–50, Figs. 3, 5.

Based on the complete record, we determine that Petitioner has shown by a preponderance of the evidence that it would have been obvious to use RF signals in Thornberg ’983’s system. Accordingly, Petitioner has demonstrated by a preponderance of the evidence that claims 1, 3–6, 8–11, and 13–15 would have been obvious over Thornberg ’983.

F. Obviousness Challenge Based on Thornberg ’983 and Karem

Petitioner asserts that claims 2, 7, and 12 are unpatentable under 35 U.S.C. § 103 over the combination of Thornberg ’983 and Karem. Pet. 42–45.

1. Summary of Karem

Karem is directed to a control machine/operator interface and a method for controlling complex machines or moving vehicles. Ex. 1008, Abstract [57]. Referring to Figure 1B, Karem teaches man-machine interface 100 that allows a vehicle operator to control the magnitude and direction of the velocity of a remotely-operated rotorcraft. Ex. 1008, 7:3–8. According to Karem, control unit 100 includes a right control stick 110 and left controller 112. *Id.* at 7:9–39. The right control stick 110 provides horizontal velocity control and is spring-loaded to return to a center position when no force is applied. *Id.* at 7:9–17. The left-hand controller 112 provides vertical (altitudinal) velocity control of the rotorcraft and has an indent at its center position. *Id.* at 7:24–36. Releasing both the right and left controllers to their center positions provides “a complete rotorcraft hover,” i.e., with zero horizontal or vertical velocity. *Id.* at 7:21–23, 7:36–39.

2. Claims 2, 7, and 12

With respect to claims 2, 7, and 12, Petitioner asserts that Thornberg ’983 does not expressly teach “wherein the user commands includes lift command data and controlling the RC aircraft includes controlling the RC aircraft to a hovering state in response to the lift command data,” which is recited in these claims. Pet. 42–43. Rather, Petitioner asserts that “[i]t would have been obvious to a POSITA that the ability to hover in response to lift command data would be implemented in a remotely-operated vehicle adapted, e.g., to perform airborne surveillance as *Thornberg* teaches, in view of *Karem*.” Pet. 43. Petitioner adds that Karem discloses controlling a rotorcraft in a “complete rotorcraft hover,” which Petitioner asserts indicates that Karem’s operator’s control unit 100 sends lift command data to instruct

the rotorcraft to enter the hovering state. Pet. 44 (citing Ex. 1008, 7:13–23, 32–39; Ex. 1003 ¶ 441). Petitioner further argues that

[a] POSITA would have been motivated to modify *Thornberg*’s control panel 200 to “control” the UAV 100 in a hovering state, i.e., by sending appropriate lift command data to the vehicle when the operator releases the input controls as *Karem* teaches, in order to facilitate aerial tasks that may involve a hovering state, such as airborne surveillance, inspection, maintenance, and repair, that *Thornberg* teaches were “well known” uses of UAVs. Ex. 1006, 1:15-24; Ex. 1003, ¶443.

Pet. 45.

We are persuaded that Petitioner’s rationale and evidence demonstrate by a preponderance of the evidence that claims 2, 7, and 12 would have been obvious in view of *Thornberg* ’983 and *Karem*. For example, Petitioner’s arguments are supported by the disclosure of *Karem*, which teaches a remotely-operated vehicle in a hovering state (Ex. 1008, 7:13–23, 32–39, and *Thornberg* ’983 teaches remotely operated vehicles include helicopters (Ex. 1006, 1:14–17). Further, Petitioner’s arguments are supported by Dr. Hansman’s undisputed testimony that a POSITA would have been motivated to modify *Thornberg* ’983’s control panel 200 to control UAV 100 in a hovering state, i.e., by sending appropriate lift command data to the vehicle when the operator releases the input controls as *Karem* teaches, in order to facilitate aerial tasks that may involve a hovering state, such as airborne surveillance, inspection, maintenance, and repair. Ex. 1003 ¶ 443. This testimony is supported by *Thornberg* ’983’s teaching that (1) airborne surveillance, inspection, maintenance, and repair were well known uses of UAVs; and (2) remote operation of UAVs apply to remotely operated helicopters. See Ex. 1006, 1:15–24.

G. Conclusion Regarding Grounds Led by Thornberg '983

We determine that Petitioner has shown, by a preponderance of the evidence, that each of claims 1, 3–6, 8–11, and 13–15 are anticipated by Thornberg '983, and, separately would have been obvious over Thornberg '983. Additionally, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that claims 2, 7, and 12 would have been obvious in view of Thornberg '983 and Karem.

H. Other Grounds Led by Muramatsu

The remaining instituted grounds of unpatentability rely on Muramatsu as the primary reference. These grounds are as follows:

References	Basis	Claims Challenged
Muramatsu alone, or optionally in view of Thornberg '983	§ 102/ § 103	1, 3–5, 8–10, 13–15
Muramatsu in view of Thornberg '983	§ 103	6, 11
Muramatsu in view of Karem and optionally Thornberg '983	§ 103	2
Muramatsu in view of Thornberg '983 further in view of Karem	§ 103	7, 12

Pet. 45–65.

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)⁵ (“[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.⁶ In some cases,

⁵ Available at www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials/guidance-impact-sas-aia-trial.

⁶ 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 would violate the statutory scheme. *Id.* But we do not understand AC

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 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 has affirmed determinations of unpatentability for the same claims. *See, e.g., Trading Techs. Int’l, Inc. v. IBG LLC*, 921 F.3d 1378, 1386 (Fed. Cir. 2019) (“In light of this conclusion [that claims 1–22 are ineligible], we need not address Petitioners’ separate ground that claims 12–22 are directed to non-statutory subject matter.”); *Victaulic Co. v. Iancu*, 753 F. App’x 895, 901–02 (Fed. Cir. 2018) (“We

Technologies to require the Board to address grounds that challenge claims that have already been held unpatentable on other grounds.

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, Petitioner’s Muramatsu-led grounds challenge claims 1–15, which we have already determined are unpatentable under grounds based on Thornberg ’983 alone and also based on Thornberg ’983 in combination with Karem. In addition, Petitioner’s challenges based on Muramatsu present many of the same issues already discussed. *See* Pet. 45–60.

Accordingly, in the circumstances of this case, we decline to address the challenges presented in Petitioner’s grounds of unpatentability based on Muramatsu alone, or Muramatsu in combination with Thornberg ’983 and/or Karem.

III. CONTINGENT MOTION TO AMEND

In its Motion to Amend, Patent Owner requests that we cancel claims 1–15 of the ’116 patent and replace these with proposed, substitute claims 16–30. Mot. Amend 1. This Motion is contingent on our determination that claims 1–15 are unpatentable under §§ 102(b) and/or 103(a). *Id.*

In reviewing a motion to amend, we consider whether the motion meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. *Lectrosonics, Inc. v. Zaxcom, Inc.*, Case

IPR2018-01129 (PTAB Feb. 25, 2019) (Paper 15) (precedential). That is, the patent owner must demonstrate the following: (1) the amendment responds to a ground of unpatentability involved in the trial; (2) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter; (3) the amendment proposes a reasonable number of substitute claims; and (4) the proposed claims are supported in the original disclosure of the patent. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121; *see also Lectrosonics, Inc.*, slip op. at 4–8. The patent owner, however, “does not bear the burden of persuasion to demonstrate the patentability of [the proposed] substitute claims.” *Lectrosonics, Inc.*, slip op. at 4 (citing *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290 (Fed. Cir. 2017); *Bosch Auto. Serv. Sols. LLC v. Iancu*, 878 F.3d 1027 (Fed. Cir. 2017)). “Rather, as a result of the current state of the law and [U.S. Patent and Trademark Office] rules and guidance, the burden of persuasion will ordinarily lie with the petitioner to show that any proposed substitute claims are unpatentable by a preponderance of the evidence.” *Lectrosonics, Inc.*, slip op. at 4.

A. Reasonable Number of Substitute Claims

Initially, we determine that Patent Owner proposes a single substitute claim for each cancelled claim, and therefore meets this requirement. Ex. 2005. *See* 37 C.F.R. § 42.121(a)(3) (establishing a rebuttable presumption that one substitute claim is needed to replace each challenged claim). A table showing the proposed substitute claims and replaced claims is as follows:

Original Claim	Substitute Claim
1	16

Original Claim	Substitute Claim
2	17
3	18
4	19
5	20
6	21
7	22
8	23
9	24
10	25
11	26
12	27
13	28
14	29
15	30

B. Proposed Substitute Independent Claim 16

In its Motion to Amend, Patent Owner requests that we cancel independent claim 1 and replace it with proposed substitute independent claim 16. Mot. Amend. 2–3. Patent Owner asserts that proposed substitute claim 16 does not enlarge the scope of the originally issued claims 1–15, is supported by the original specification, and is responsive to the grounds of unpatentability involved in the proceeding. *Id.* at 5–8; *see id.* at 5 (“Substitute Claims 16–30 do not enlarge the scope of original Claims 1–15.”).

Proposed, substitute independent claim 16 is reproduced below with annotations showing amendments:

16. A method for use with a radio controlled (RC) aircraft, the method comprising:

receiving ~~[[an]]~~ a radio frequency (RF) signal from a remote control device~~[[, that includes]]~~ the RF signal including command data to control motion of the RC aircraft, wherein the remote control device is configured to visually indicate an operating mode of the RC aircraft, the visual indication of the operating mode distinct from a switch;

generating motion data at the RC aircraft from at least one sensor of the RC aircraft based on detected motion of the RC aircraft; and

controlling the RC aircraft based on the command data and the motion data, wherein the command data corresponds to user commands in a first coordinate system from a perspective of the remote control device and the command data are transformed into control data in a second coordinate system that is from a perspective of the RC aircraft.

Ex. 2005, 2.

1. New Matter

In the Motion, Patent Owner asserts that these limitations are supported by the original disclosure of U.S. Patent Application No. 14/102,995⁷ (“the ’995 Application”), from which the ’116 patent issued. Patent Owner contends that “FIG. 7 and page 11, lines 15–16” of the ’995 Application provide written description support. Mot. Amend 6–7. In its Reply to Petitioner’s Opposition, Patent Owner adds that “detected” was

⁷ Patent Owner did not submit the ’995 Application in the proceeding. Nonetheless, a copy of the disclosure of the originally filed ’995 Application is available at Exhibit 3001.

only added as clarifying language and that support is provided on page 6, lines 15–21 of the '995 Application. Reply Amend 1 n. 1.

Based on our review of the entirety of the record, we find that the original claim language of cancelled claim 1 provides support for the step of generating motion data from at least one sensor of the RC aircraft based on motion of the RC aircraft, which is consistent with the disclosure on page 6, lines 15–17 of the '995 Application that teaches motion data generated by the RC aircraft's on-board motion sensors. Thus, we determine that proposed substitute claim 16 meets the written description support requirement.

2. Enlarging Claim Scope

As stated in 35 U.S.C. § 316(d)(3), an “amendment . . . may not enlarge the scope of the claims of the patent.” *See also* 37 C.F.R. § 42.121(a)(2)(ii) (“A motion to amend may be denied where . . . [t]he amendment seeks to enlarge the scope of the claims of the patent.”). “A substitute claim will meet the requirements of § 42.121(a)(2)(i) and (ii) if it narrows the scope of at least one claim of the patent, for example, the challenged claim it replaces, in a way that is responsive to a ground of unpatentability involved in the trial. *Lectrosonics Inc.*, slip op. at 6–7. We determine that this requirement has been satisfied because substitute claim 16 narrows the scope of original cancelled claim 1 by requiring the remote control device to be “configured to visually indicate an operating mode of the RC aircraft, the visual indication of the operating mode distinct from a switch.”

3. Responding to a Ground of Unpatentability

37 C.F.R. § 42.121(a)(2)(i) states that “[a] motion to amend may be denied where . . . [t]he amendment does not respond to a ground of unpatentability involved in the trial.”

Based on the entirety of the record, including Patent Owner’s Reply, we determine that the amendment of a visual indication of the operating mode distinct from a switch is responsive to grounds of unpatentability, including those based on Thornberg ’983. Mot. Amend 8; Reply Amend 5–6. We note that Patent Owner’s amendment of “detected” motion data is not responsive to a ground of unpatentability, which Patent Owner added as “clarifying language.” Opp. Amend 1 n.1. Be that as it may, Rule 42.121(a)(2)(i) does not require that every word added to or removed from a claim in a motion to amend be solely for the purpose of overcoming an instituted ground. *Lectrosonics, Inc.*, slip op. 5–6 (“Additional modifications that address potential 35 U.S.C. § 101 or § 112 issues, for example, are not precluded by rule or statute.”).

4. Obviousness of Proposed Substitute Claim 16 over Thornberg ’983 and Karem

Petitioner asserts that the newly added limitations “wherein the remote control device is configured to visually indicate an operating mode of the RC aircraft, the visual indication of the operating mode distinct from a switch,” would have been obvious over Thornberg ’983 in view of Karem. Opp. Amend 11–12. Petitioner argues that Thornberg ’983’s control panel 200 is a “remote control device” that includes input controls such as stick 205 for controlling pitch and roll of the RC aircraft, knobs to control the aircraft’s altitude and engine speed, and switch 257 that sets an operating mode of the RC aircraft to VEHICLE, MAP, or variable OPERATOR mode.

Id. at 11 (citing Ex. 1006, 4:29–36, 6:2–11, 7:31–43, Fig. 3). Petitioner asserts that the position of switch 257 visually indicates an operating mode of the RC aircraft as claimed. Opp. Amend. 11 (citing Ex. 1023 ¶ 146). Petitioner further argues it would have been obvious to a POSITA to implement its input controls in ways “distinct from a switch” because a POSITA would have understood this implementation to be a conventional and well-known design choice, of which there were a finite number of predictable options that could be used with a reasonable expectation of success. *Id.* at 12 (citing Ex. 1023 ¶¶ 147–50). As an example of conventional and well-known design choices, Petitioner asserts that Karem’s control unit 100 includes left and right control sticks, but “instead of a stick, other input controls or controllers and input devices may be used, as for example a computer mouse or *a touch screen*.” Opp. Amend. 12 (citing Ex. 1008, 7:9–39, 18:7–11, Figs. 1A–B).

According to Petitioner, a POSITA would have understood the reference-mode switch 257 on Thornberg ’983’s control panel 200 could be implemented as a touchscreen display, to provide a “visual indication of the operating mode distinct from a switch” as claimed. Opp. Amend. 12 (citing Ex. 1023 ¶ 150). Petitioner adds that a POSITA would have been motivated to do so in light of Karem’s teachings, to accommodate the operator’s preference and, in the case of a touch screen display, provide additional flight-related feedback to the operator. *Id.*

Patent Owner responds that Karem describes replacing a control stick with a computer mouse or a touch screen, but does not teach adding a visual indication of a selected operating mode that is distinct from a switch. Reply

Amend. 6. Patent Owner adds that Thornberg '983 only teaches a switch.
See id. at 5–6.

Having reviewed the entire record, we note first that the parties do not dispute that Thornberg '983's control panel 200 indicates the selected operation mode via a physical switch. Opp. Amend 11–12; Sur-Reply Amend. 6; Reply Amend. 5. Thornberg '983 teaches that “control panel 200 is provided with a joy stick or control stick 205 for providing control inputs to control the operation of the UAV.” Ex. 1006, 4:29–33. Further, Figure 3 of Thornberg '983, reproduced below, shows switch 257 for selection of the reference mode. Ex. 1006, Fig. 3.

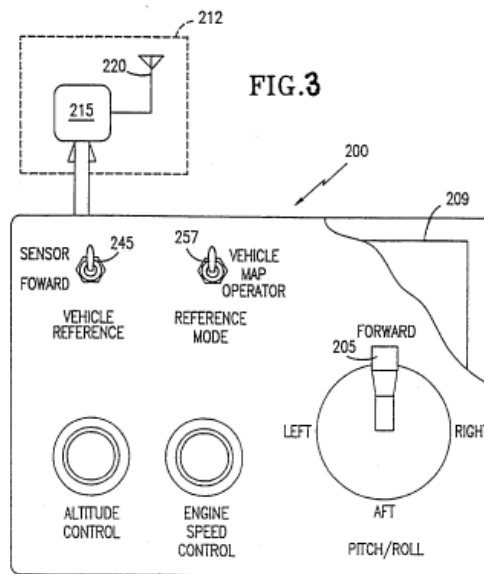


Figure 3 shows a remotely operated vehicle having a variable referenced control system. *Id.* at 3:20–22.

We observe also that Karem teaches first control column 110 (e.g., “stick”) and second control column 112 as shown in Figure 1A of Karem for controlling the movement of the rotorcraft. *See* Ex. 1008, 7:9–39. Karem further states:

Although the present invention has been described and illustrated with respect to various exemplary embodiments thereof, it is to be understood that it is not so limited, since changes and modifications may be made therein which are within the full intended scope of this invention as herein after claimed. For example, the windows in the various screens may be arranged differently and/or labeled differently than disclosed herein without effecting the scope of the present invention. Furthermore, the left stick may be made to have the functions of the right stick and *vice versa*. Moreover, *instead of a stick, other input controls or controllers and input devices may be used, as for example a computer mouse or a touch screen. As such, the terms “input control” and “input controller” as used herein should be interpreted to encompass all types of different input devices.*

Ex. 1008, 17:64–18:11 (emphasis added). We understand Karem to expressly teach that input controls such as a touch screen can be used instead of “sticks” or controllers. In this regard, we credit Dr. Hansman’s testimony that a POSITA would have understood that the use of a touch-screen display instead of switch 257 on Thornberg ’983’s control panel 200 would be a conventional and well-known design choice because this testimony is well-supported by Karem’s express disclosure provided above. *See id.*; Ex. 1023 ¶¶ 79–80.

In addition to the above, Petitioner further argues that Thornberg ’983 teaches “generating motion data at the RC aircraft from at least one sensor of the RC aircraft based on detected motion of the RC aircraft.” Opp. Amend. 12–13. Petitioner argues that Thornberg ’983’s navigation system 36 is a sensor that provides orientation motion data based on the motion of the vehicle. *Id.* at 13 (citing Ex. 1006, 5:32–43).

We agree with Petitioner’s position. As discussed with regard to the original limitations of cancelled claim 1, we determine that Thornberg

'983's true heading signal provides orientation motion data. Further, Thornberg '983's navigation system 36 provides the vehicle's true heading (i.e., orientation data), which is provided from the navigation equipment 36 on the vehicle, e.g., a ring laser gyro or an inertial navigation system (i.e., sensor). Ex. 1006, 3:55–61, 7:51–54, Fig. 6, 4:11–16.

Having considered the entirety of the record, we determine that Petitioner has provided the necessary articulated reasoning supported by evidentiary underpinnings, which establish that one of ordinary skill in the art would have been aware of Thornberg '983 and Karem and would have had the requisite technical knowledge and motivation to combine these references to include a “remote control device . . . configured to visually indicate an operating mode of the RC aircraft, the visual indication of the operating mode distinct from a switch,” and generate “motion data at the RC aircraft from at least one sensor of the RC aircraft based on detected motion of the RC aircraft.” Petitioner has shown, by a preponderance of the evidence, that the proposed substitute independent claim 16 would have been obvious over the combination of Thornberg '983 and Karem.

5. Summary

In sum, Petitioner has shown by a preponderance of the evidence that the proposed substitute independent claim 16 would have been obvious over the combination of Thornberg '983 and Karem. We deny Patent Owner's Motion to Amend as to proposed substitute claim 16.

C. Proposed Substitute Dependent Claim 17

In its Motion to Amend, Patent Owner requests that we cancel claim 2 and replace it with proposed, substitute dependent claim 17. Mot. Amend. 9.

Proposed, substitute dependent claim 17 is reproduced below with annotations reflecting amendments:

17. The method of [[claim 1]] claim 16 [[wherein the user commands includes lift command data and controlling the RC aircraft includes controlling the RC aircraft to a hovering state in response to the lift command data]] further comprising:

generating first position data indicating a first position of the RC aircraft at a first time; and

generating second position data indicating a second position of the RC aircraft at a second time, wherein the RC aircraft is further controlled based on the first position data and the second position data.

Ex. 2005, 2.

1. New Matter

Patent Owner argues that the steps of “generating first position data indicating a first position of the RC aircraft at a first time” and “generating second position data indicating a second position of the RC aircraft at a second time, wherein the RC aircraft is further controlled based on the first position data and the second position data” are supported by the disclosure of the '995 Application. Patent Owner specifically cites “page 5, lines 25–30; page 6, lines 15–21; page 8, lines 6–12; and page 12, lines 6–10.” Mot. Amend. 9–10.

Petitioner argues that the '116 patent does not teach or suggest generating control data based on motion data and further based on additional first and second position data. Opp. Amend 4–5 (citing Ex. 1001, 4:17–24, 5:24–26).

Based on the complete record, we agree with Patent Owner that the claim amendments do not add new matter. *See* Ex. 3001, 5:25–30, 6:14–21, 8:6–12 (“[M]otion 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.”), 12:8–9 (“Pressing the reference button, such as reference button 152, in this position establishes initial conditions: $R = R_{ref}$, $\theta = 0$, $Z = 0$, $\phi_1 = 0$, $\phi_2 = 0$, $\phi_3 = 0$.”), 12:9–13 (“As the RC aircraft 102 is subsequently moved in operation, the relative motion of the RC aircraft, reflected by motion data 124, can be used to determine a position and orientation of the RC aircraft 102 from the origin established by the position of remote control 100 during setup.”).

2. Enlarging Claim Scope

Petitioner asserts that by deleting all the limitations of the original claim 2, Patent Owner impermissibly broadened the scope of the substitute claims. Opp. Amend 5. Petitioner cites to several Board decisions for the proposition that a proposed substitute claim may never remove a claim feature. *Id.* at 6 (citing *Western Digital Corp. v. SPEX Techs., Inc.*, Case IPR2018-00082, 00084 (PTAB Apr. 25, 2018) (Paper 13); *MRSI Sys., LLC v. Palomar Techs., Inc.*, Case IPR2016-00043 (PTAB Mar. 29, 2017) (Paper 29); *Microsoft Corp v. Proxyconn, Inc.*, Case IPR2012-00026 (PTAB Feb. 19, 2014) (Paper 73); *American Megatrends, Inc. v. Kinglite Holdings Inc.*, Case IPR2015-01094 (PTAB Nov. 4, 2016) (Paper 48)).

We disagree with Petitioner’s per se reading of this requirement to proscribe removal of any claimed features. Our precedential decision in *Lectrosonics, Inc.* instructs that

[a] patent owner may not seek to broaden a challenged claim in any respect that enlarges the scope of the claims of the patent, for example, in the name of responding to an alleged ground of

unpatentability. Likewise, a proposed substitute claim may not remove a feature of the claim in a manner that broadens the scope of the claims of the challenged patent. *A substitute claim will meet the requirements of § 42.121(a)(2)(i) and (ii) if it narrows the scope of at least one claim of the patent, for example, the challenged claim it replaces, in a way that is responsive to a ground of unpatentability involved in the trial.*

Lectrosonics, Inc., slip op. 6–7 (emphasis added). Here, substitute claim 17 depends from substitute independent claim 16, which we have determined to be narrower in scope than originally issued claim 1. Claim 17 depends from claim 16 and includes all the limitations recited in substitute claim 16. Thus, substitute claim 17 is, at least, narrower in scope than originally issued claim 1. Additionally, we note that substitute claim 17 further recites the steps of “generating first position data indicating a first position of the RC aircraft at a first time” and “generating second position data indicating a second position of the RC aircraft at a second time, wherein the RC aircraft is further controlled based on the first position data and the second position data,” which were not required in original claim 1. Thus, a method of using *motion data* (e.g., orientation data), without a first and second position data, for control of the RC aircraft would be encompassed under original claim 1, but not under proposed substitute claim 17.

Accordingly, substitute claim 17 meets the requirements of § 42.121(a)(2)(i) and (ii) because it narrows the scope of at least one claim of the patent.

3. Responding to a Ground of Unpatentability

Based on the entirety of the record, including Patent Owner’s Reply, we determine that the amendments of generating a first and second position

data are responsive to grounds of unpatentability including those based on Thornberg '983. Mot. 10–11; *See* Reply Amend 6–9.

4. *Obviousness of Proposed Substitute Claim 17 over Thornberg '983 and Karem*

Petitioner asserts that the newly added limitations “generating first position data indicating a first position of the RC aircraft at a first time” and “generating second position data indicating a second position of the RC aircraft at a second time, wherein the RC aircraft is further controlled based on the first position data and the second position data,” would have been obvious over Thornberg '983 in view of Karem. Opp. Amend 13–17.

Petitioner argues that, according to Thornberg '983, it was conventional to operate a UAV by having the operator face the UAV as shown in Figure 2 of Thornberg '983. *See id.* at 14. Petitioner asserts that Thornberg '983 discloses generating “first position data” corresponding to an initial position of the UAV when the operator is facing the UAV and the operator initially sets the switch 257 to the OPERATOR mode at a first time (“initial operator reference”). *Id.* In the variable operator reference mode, Petitioner contends that the operator’s frame of reference is thereafter determined from an angular displacement between the operator’s initial reference direction (i.e., corresponding to a first position of the UAV when switch 257 is set to OPERATOR mode) and the operator’s current reference direction (i.e., corresponding to a second position of the UAV). *Id.* at 14–15 (citing Ex.1023 ¶¶ 154–156; Ex. 1006, 7:31–43).

Referring to Figure 6 of Thornberg '983, Petitioner asserts that a POSITA would understand the signals generated on line 453, at a first time (initialization) and a second time (current time), respectively correspond to the operator’s orientation, and are also position data indicating the position

of the UAV at the first and second times. Opp. Amend 14 (citing Ex. 1023 ¶¶ 60, 155). Petitioner further asserts that the reference heading signal on line 460 is also position data indicating the UAV's position at the first and second times, because line 460 is generated by adding the operator's orientation on line 453 to the vehicle's forward reference direction at each of those times. *Id.* at 14–15 (citing Ex. 1023 ¶¶ 60, 155; Ex. 1019, 120:17–122:17).

Additionally, Petitioner argues that GPS receivers such as those in Thornberg-1995⁸ or “Rios”⁹ were known to track the position of the UAV, and that a POSITA would have been motivated to combine a GPS receiver with Thornberg '983 because “*Thornberg '983 does not explicitly disclose how its UAV position is determined* and it would have been obvious to implement the positioning using conventional technology like GPS to determine its position at first and second times as claimed.” Opp. Amend 16 (citing Ex. 1023 ¶¶ 62–64) (emphasis added).

In response, Patent Owner argues that Thornberg '983 only teaches controlling the UAV based on orientation data because Thornberg '983 describes creating TPSS and TRSS data based on pitch commands, roll

⁸ Thornberg, *Sikorsky Aircraft's Unmanned Aerial Vehicle, Cypher: System Description and Program Accomplishments*, Proceedings of American Helicopter Society 51st Annual Forum, Fort Worth, Texas, May 9–11, 1995, at 804-811 (“Thornberg-1995”). Petitioner and Patent Owner refer to Thornberg-1995 as Exhibit 1012. However, the title “Exhibit 1012” has not been used for an exhibit in this record. See Paper 42, 1 (“Petitioner's Updated Exhibit List”). Nonetheless, because both parties have substantively discussed and cited to the contents of Thornberg-1995 in this proceeding (Opp. Amend 23–24; Reply Amend 10–11; Ex. 1003, vi “List of Exhibits”), we include this reference as Exhibit 3002.

⁹ U.S. Patent No. 6,694,228 B2, issued Feb. 17, 2004 (Ex. 1025).

commands, and a transformation angle (θ). Reply Amend 7 (citing Ex. 1006, 5:30–32, 6:17–27). Patent Owner adds that there is no disclosure in Thornberg '983 that the transformation angle (θ) is indicative of anything other than orientation. *Id.* (citing 5:32–35, 5:38–40). Further, Patent Owner asserts that the orientation of the operator control panel in variable operator reference mode is not the same as determining the position of the vehicle. Reply Amend 8.

Patent Owner also argues that Dr. Hansman's testimony is speculative and entitled to little weight. Patent Owner contends that there is no support for Dr. Hansman's testimony that Thornberg '983 teaches the same transformation as the '116 patent, where θ in Thornberg '983 is the angular difference between the operator's and aircraft's orientations which corresponds to $(\phi_3 - \theta)$ in the '116 patent. According to Patent Owner, this is because Thornberg '983 is silent on (1) whether the orientation of the operator control panel is provided to the vehicle or is used to perform calculations at the operator control panel; and (2) any operations performed with the orientation measurement, such as transmission of the orientation measurement to the vehicle. Reply Amend 4–5.

To start, we find that in the operator reference mode, Thornberg '983 teaches that “the reference axis for purposes of transformation is based on the *orientation* of the operator control panel upon activation of the operator reference mode.” Ex. 1006, 7:21–24 (emphasis added). In the variable operator reference mode, the “operator reference changes based upon changes in the *orientation* of the operator control panel.” *Id.* at 7:29–35 (emphasis added). Thornberg '983 further teaches that the operator control panel may be provided with a position indicator or mounted on a pedestal

with a servo or gyro signal indicative of the change in the position of the control panel with respect to the initial operator reference. *Id.* at 7:35–38. In this respect, the operator reference mode in Thornberg ’983 tracks the *orientation* and *position* of the operator control panel.

Additionally, we understand Petitioner’s arguments rely on a manner of operation in which the operator (and operator control panel) directly faces the remotely operative vehicle. In this way, Petitioner asserts that the operator’s frame of reference corresponds to the angular position of the vehicle and is determined from an angular displacement from the operator’s initial reference direction. Opp. Amend 14. In other words, when the operator control panel is directly facing the vehicle, the orientation of the control panel provides angular position data for the vehicle. Thornberg ’983’s Figure 2 shows this method of operation in which a remotely operated vehicle and operator control panel with “opposing frames of reference” are directly facing. Ex. 1006, 3:16–19.

With this manner of operation in mind, we turn to the question of whether the orientation of the control panel in Thornberg ’983 indicates a position of the vehicle when the control panel is directed towards the vehicle. We first consider Dr. Hansman’s testimony. Referring to Figure 5 of the ’116 patent, Dr. Hansman testifies that the ’116 patent teaches that angular displacement θ of an aircraft relative to the operator’s origin point provides position data. Ex. 1023 ¶ 46. Figure 5 of ’116 patent is reproduced below.

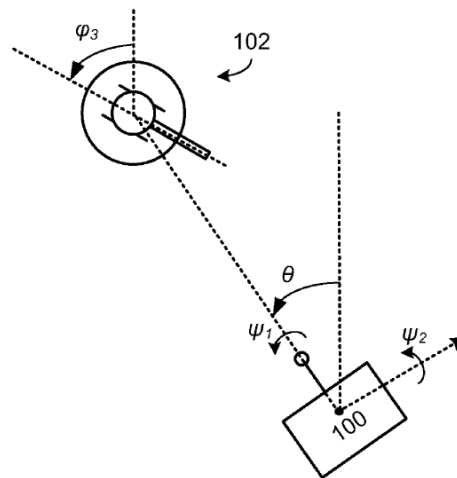


FIG. 5

Figure 5 shows the perspective of radio controlled aircraft 102 with respect to remote control device 100. Ex. 1001, 3:63–66. Dr. Hansman testifies that

θ is the angle between a reference line (dashed vertical line) and the line drawn from the user to the aircraft, therefore representing the user's orientation. At the same time, θ is also the angular displacement of the aircraft and is part of the position data (R , θ , Z) representing the aircraft's position in three-dimensional space defined with the user at the origin.

Ex. 1023 ¶ 46.

In the same manner described in the '116 patent, we find that the orientation of the control panel in Thornberg '983 indicates the angular displacement (i.e., position data) of the vehicle relative to the operator mode reference axis because the control panel is directed toward the vehicle. Thornberg '983's Figure 2 discloses that the control panel is directly facing the remotely operated vehicle, which is nearly identical to placement of the remote control device and RC aircraft in Figure 5 of the '116 patent. Ex. 1001, 3:67–4:2, Fig. 5; Ex. 1006, Fig. 2.

We find that Thornberg '983 further describes that when the operator reference mode is activated, “the reference axis for purposes of

transformation is based on the orientation of the operator control panel upon activation of the operator reference mode.” Ex. 1006, 7:21–24. As an example, Thornberg ’983 discloses that in the operator reference mode, “if the operator is facing North upon activation of the operator mode, *the North reference will be provided on the line 453.*” Ex. 1006, 7:24–26 (emphasis added). When operated in the manner shown in Figure 2 (i.e., “opposing frames of reference”), the control panel would be facing North, which would also be directly facing the remotely operated vehicle. Thus, the orientation of the control panel would also indicate the angular displacement (e.g., “first position data”) of the vehicle at the initialization, which we determine teaches the step of “generating first position data indicating a first position of the RC aircraft at a first time” upon the activation of the operator mode.

Additionally, we find in the variable operator reference mode, the operator reference changes based on the changes in the orientation of the operator control panel. Ex. 1006, 7:32–35. Thornberg ’983 explains that this may be accomplished by mounting the operator control panel on a pedestal and providing a servo or gyro signal indicative of the change in the position of the control panel with respect to the initial operator reference. *Id.* at 7:35–38. Continuing with the operation shown in Figure 2 of Thornberg ’983, the operator control panel’s orientation continues to correspond to the angular displacement position of the aircraft in that the control panel continues to be directly facing the remotely operated vehicle subsequent to initialization. We find this post-initialization angular displacement position data discloses “generating *second position data* indicating a second position of the RC aircraft at a second time” as recited in substitute claim 17.

Thornberg '983 further teaches “the RC aircraft is further controlled based on the first position data and the second position data” because the orientation of the operator control panel, which corresponds to the angular position of the remotely operated vehicle, is used to control the vehicle in the operator reference mode, as described above. Patent Owner argues that the orientation of the operator control panel is not used in the transformation process described in Thornberg '983. See Reply Amend 4–5. However, the amendments presented in the instant proceeding for substitute claim 17 do not require a transformation based on the position data. All that is recited is the generation of the position data and the controlling of the aircraft using the position data, which we determine is disclosed in Thornberg '983.

5. Summary

In sum, Petitioner has shown by a preponderance of the evidence that the proposed substitute independent claim 17 would have been obvious over the combination of Thornberg '983 and Karem. Thus, we deny Patent Owner's Motion to Amend as to substitute claim 17.

D. Proposed Substitute Dependent Claim 18

Proposed substitute dependent claim 18 is reproduced below with annotations reflecting amendments:

18. The method of [[claim 1]] claim 17 wherein the [[command data includes roll-axis command data and pitch-axis command data, and the motion data includes yaw-axis motion data]] first position data indicates the first position of the RC aircraft in three-dimensional (3-D) space.

Ex. 2005, 3.

Based on the entirety of the record, including arguments and evidence presented by Patent Owner, we determine that proposed substitute claim 18 does not enlarge the scope of the originally issued claims, is supported by

the '995 Application, and is responsive to the grounds of unpatentability involved in the proceeding. *See* Ex. 3001, 5:25–30, 8:6–12; Mot. Amend 9–11. We further observe that substitute claim 16 narrows the scope of at least originally issued claim 1, and claim 18 depends from claim 16, which is sufficient to satisfy the requirements of §§ 42.121(a)(2)(i) and (ii).

Petitioner argues that substitute claim 18 would have been obvious over the combination of Thornberg '983 and Karem because Thornberg '983 discloses generating first position data that corresponds to the UAV's initial position when the operator is facing the UAV and initially sets the switch 257 to the OPERATOR mode at a first time. Opp. Amend. 18 (citing Ex. 1023 ¶ 161; Ex. 1006, Abstract, 7:31–38, 6:2–5, 6:8–11). Petitioner asserts this “first position data” is the initial position angle that indicates the UAV's first position in 3D space when the operator initially switches to the variable operator mode. Ex. 1023 ¶ 161.

Patent Owner relies on arguments made for independent claim 16 and claim 17 that are discussed above. *See* Mot. Amend 12. For the same reasons discussed with respect to substitute claim 17, we determine that Thornberg '983 discloses the orientation of the control panel at initialization that corresponds to the angular displacement (i.e., position in three-dimensional space) of the remotely operated vehicle. Accordingly, we deny Patent Owner's Motion to Amend as to claim 18.

E. Proposed Substitute Dependent Claim 19

Proposed, substitute dependent claim 19 is reproduced below with annotations:

19. The method of [[claim 3]] claim 16 wherein the command data includes roll-axis command data and pitch-axis command data, wherein the motion data includes yaw-axis

motion data, and wherein the control data includes roll-axis control data generated as a function of the roll-axis command data, the pitch-axis command data, and the yaw-axis motion data.

Ex. 2005, 3.

Based on the entirety of the record, including arguments and evidence presented by Patent Owner, we determine that proposed substitute claim 19 does not enlarge the scope of the originally issued claims, is supported by the '995 Application, and is responsive to the grounds of unpatentability involved in the proceeding. *See* Mot. Amend 10–11; Ex. 3001, 12:26–30.

Petitioner argues that substitute claim 19 is unpatentable over Thornberg '983 because Thornberg '983 teaches roll and pitch commands received from control panel 200 correspond to the claimed roll-axis and pitch-axis command data, and the vehicle's true heading corresponds to the claimed yaw-axis motion data. Opp. Amend 18 (citing Ex. 1006, 5:30–40, 6:17–22; Ex. 1023 ¶¶ 162–163).

We find that Thornberg '983 teaches TRSS (transformed roll stick signal) is determined by equation (2), which is *roll command* * $\cos(\theta)$ + *pitch command* * $\sin(\theta)$.” Ex. 1006, 6:23–28 (emphasis added). Additionally, Thornberg '983 teaches transformation equation (1) as “TPSS = *pitch command* * $\cos(\theta)$ - *roll command* * $\sin(\theta)$.” Ex. 1006, 6:22 (emphasis added). Further, Thornberg '983 teaches that transformation angle θ “is determined based on the true heading (i.e., orientation motion data) of the vehicle as determined by the navigation system 36 and the desired vehicle reference and vehicle reference mode.” *Id.* at 5:32–35. Thus, Petitioner has shown, by a preponderance of the evidence, that the

combination of Thornberg '983 and Karem teaches all the limitations of proposed substitute dependent claim 19

Accordingly, we deny Patent Owner's Motion to Amend as to substitute claim 19.

F. Proposed Substitute Dependent Claim 20

Proposed, substitute dependent claim 20 is reproduced below with annotations:

20. The method of [[claim 3]] claim 16 wherein the command data includes roll-axis command data and pitch-axis command data, wherein the motion data includes yaw-axis motion data, wherein the RC aircraft is a helicopter, and wherein the control data includes pitch-axis control data generated as a function of the roll-axis command data, the pitch-axis command data, and the yaw-axis motion data.

Ex. 2005, 3.

Based on the entirety of the record, including arguments and evidence presented by Patent Owner, we determine that proposed substitute claim 20 does not enlarge the scope of the originally issued claims, is supported by the '995 Application, and is responsive to the grounds of unpatentability involved in the proceeding. *See* Mot. Amend 9–11; Ex. 3001, 3:24–26, 4:23–26, 12:30–13:3.

Petitioner asserts that the limitations of claim 20 are disclosed in the prior art, including Thornberg '983, which teaches that its invention is applicable to helicopters and “may be applied to any remotely operated vehicle provided that the vehicle contains a navigation system or other means for determination changes in vehicle orientation with respect to an operator or fixed frame of reference.” Opp. Amend 19 (citing Ex. 1006, 3:54–61, Title, 1:8–10, 1:17–19, 7:46–51). Petitioner further asserts that

Thornberg '983 also discloses roll and pitch commands received from control panel 200 corresponding to the claimed roll-axis and pitch-axis command data, and the vehicle's true heading corresponding to the claimed yaw-axis motion data. Opp. Amend 19 (citing Ex. 1006, 5:30–40, 6:17–22).

As discussed previously, Thornberg '983 teaches $TRSS = roll\ command * \cos(\theta) + pitch\ command * \sin(\theta)$, and $TPSS = pitch\ command * \cos(\theta) - roll\ command * \sin(\theta)$. Ex. 1006, 6:22–28. Further, Thornberg '983 teaches that transformation angle θ “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 5:32–35. Additionally, Thornberg '983 teaches that

[t]here are a variety of uses for remotely operated vehicles including military, industrial and entertainment/recreation applications. For entertainment/recreation applications, remotely operated model airplanes, *helicopters*, automobiles, ships and sail boats are well known.

Ex. 1006, 1:16–18 (emphasis added).

We conclude that Petitioner has shown, by a preponderance of the evidence, that the combination of Thornberg '983 and Karem teaches all the limitations substitute claim 20. Accordingly, we deny Patent Owner's Motion to Amend as to claim 20.

G. Proposed Substitute Independent Claim 21

In its Motion, Patent Owner proposes to replace cancelled claim 6 with substitute independent claim 21. See Mot. Amend. 3–4. Proposed substitute independent claim 21 is reproduced below with annotations:

21. A method for use with a radio controlled (RC) aircraft, the method comprising:

receiving ~~[[an]]~~ a radio frequency (RF) signal from a remote control device that includes command data that indicates user commands to control motion of the RC aircraft;

generating motion data from at least one sensor of the RC aircraft that indicates motion of the RC aircraft, wherein the motion data is distinct from the command data;

generating first position data indicating a first position of the RC aircraft at a first time;

generating second position data indicating a second position of the RC aircraft at a second time;

controlling the RC aircraft based on the RF signal, the first position data, the second position data, and the motion data, wherein the user commands to control the motion of the RC aircraft are in a first coordinate system from a perspective of the remote control device and,

in a first mode of operation:

the user commands indicated by the command data are transformed into transformed commands in a second coordinate system that is from a perspective of the RC aircraft; ~~[[and]]~~

the RC aircraft is controlled based on the transformed commands; and

in a second mode of operation:

the RC aircraft is controlled directly based on the user commands indicated by the command data in the first coordinate system.

Ex, 2005, 3–4.

Based on the entirety of the record, including arguments and evidence presented by Patent Owner, we determine that proposed substitute claim 21 does not enlarge the scope of the originally issued claims, is supported by the '995 Application, and is responsive to the grounds of unpatentability involved in the proceeding. *See* Mot. 5, 7–8; Ex. 3001, 8:6–12, 12:8–13.

For its obviousness arguments, Petitioner asserts that the limitations of substitute claim 21 are disclosed in the prior art, including Thornberg '983, which teaches that true heading data (i.e., motion data) provided by navigation system 36 on Thornberg '983's UAV is distinct from "command data" that the UAV receives in an RF signal transmitted from control panel 200. Opp. Amend 19–20 (citing Ex. 1023 ¶ 168; Ex. 1006, 5:32–43, 4:29–56, Figs. 3, 5, 6; Ex. 1003 ¶¶ 297–302). For the first and second position data limitations, both Patent Owner and Petitioner rely on arguments presented and discussed above for claim 17. Opp. Amend 20; Reply Amend 3–5, 6–9.

Based on the entirety of the record, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that substitute claim 21 is unpatentable over Thornberg '983. We find that Thornberg '983 teaches that the true heading of the remotely operated vehicle is provided on input line 420 as shown in Figure 6 for use in the transformation equations. See Ex. 1006, 5:45–47. Additionally, for the reasons discussed above for substitute claim 17, we find that Thornberg '983 further discloses "generating first position data indicating a first position of the RC aircraft at a first time"; "generating second position data indicating a second position of the RC aircraft at a second time"; and "controlling the RC aircraft based on the RF signal, the first position data, the second position data."

Accordingly, we deny Patent Owner's Motion to Amend as to substitute claim 21.

H. Proposed Substitute Dependent Claim 22

Proposed, substitute independent claim 22 is reproduced below with annotations:

22. The method of [[claim 6]] claim 21 [[wherein the user commands includes lift command data and controlling the RC aircraft includes controlling the RC aircraft to a hovering state in response to the lift command data]] further comprising determining an initial position of the RC aircraft based on the command data including an operation to establish the initial position.

Ex. 2005, 4.

Based on the entirety of the record, including arguments and evidence presented by Patent Owner, we determine that proposed substitute claim 22 does not enlarge the scope of the originally issued claims,¹⁰ is supported by the '995 Application, and is responsive to the grounds of unpatentability involved in the proceeding. For example, page 12, lines 8–9 of the '995 Application discloses “[p]ressing the reference button, such as reference button 152, in this position establishes initial conditions: $R = R_{ref}$, $\theta = 0$, $Z = 0$, $\phi_1 = 0$, $\phi_2 = 0$, $\phi_3 = 0$.”

Petitioner asserts that the limitations of substitute claim 22 are disclosed in the prior art, including Thornberg '983, which teaches activating an operator reference mode and providing an operator reference on line 453 of Figure 6. Opp. Amend 21. Petitioner asserts when the vehicle operator initially sets the position of switch 257 to the OPERATOR reference mode while facing the UAV, Thornberg '983 teaches “determining an initial position of the RC aircraft” corresponding to the initial orientation direction of the operator, which is also the initial position angle of the UAV.

¹⁰ Petitioner asserts that the claim scope has been enlarged because limitations have been removed from original claim 7. Opp. Amend 6. As stated in *Lectrosonics, Inc.*, a substitute claim satisfies the requirement to not enlarge the scope of the claims if it is narrower than at least one of the issued claims. *Lectrosonics, Inc.*, slip op. at 6–7.

Id. (citing Ex. 1023 ¶ 174). Petitioner further argues that Thornberg '983 also teaches “command data including an operation to establish the initial position of the RC aircraft,” as claimed, because a POSITA would have understood the command data from the control panel includes an operation to establish the “initial operator reference” direction corresponding to the vehicle’s initial position when the operator sets switch 257 to the OPERATOR mode. *Id.* at 21–22. Separately, Petitioner argues that the term “operation” is indefinite because data and operation have different meanings. Opp. Amend 20.

Patent Owner contends that Thornberg '983 is silent regarding an operation or command being generated when the switch is changed to the operator reference mode. Reply Amend 11. Further, Patent Owner asserts that when the switch is changed, a reference axis is established based on an *orientation* of the operator control panel, and not the initial position of the vehicle. *Id.* Patent Owner contends also that Thornberg '983 does not teach that the operator control panel must be pointed at the vehicle. *Id.*

Based on the entirety of the record, we determine that Petitioner, has demonstrated by a preponderance of the evidence, that substitute claim 22 is unpatentable over Thornberg '983. As discussed with respect to substitute claim 17, we find that Thornberg '983 teaches that when the operator reference mode is selected, the reference will be provided on line 453. *See* Ex. 1006, 7:24–26 (“[I]f the operator is facing North upon activation of the operator mode, the North reference will be provided on the line **453**.”). If the operator is directly facing the remotely operated vehicle (*see* Ex. 1006, Fig. 2) at initialization, for example directly facing North at the remotely operated vehicle, the orientation of the operator, which is the North

reference provided on line 453, is also the angular position of the remotely operated vehicle. See Ex. 1006, 6:8–11 (“In an operator reference mode, the orientation of the operator upon activation of the operator mode is used as the reference axis.”). Further, we determine that Thornberg ’983 teaches determining an initial position of the remotely operated vehicle “based on the command data including an operation to establish the initial position” because the operator sets switch 257 to operator reference mode. Ex. 1006, 6:2–4 (“The operator of the reference mode switch **457** is dependent upon the position of a control panel reference mode switch **257** on the control panel 200.”). Accordingly, we deny Patent Owner’s Motion to Amend as to substitute claim 22.

I. Proposed Substitute Dependent Claims 23 and 24

In its Motion, Patent Owner also proposes to replace cancelled claim 8 with substitute dependent claim 23, and cancelled claim 9 with substitute claim 24. See Mot. Amend. 9. Proposed, substitute dependent claims 23 and 24 are reproduced below with annotations:

23. The method of [[claim 6]] claim 21 wherein the command data includes roll-axis command data and pitch-axis command data, [[and]] wherein the motion data includes yaw-axis motion data, and wherein the transformed commands include pitch-axis data generated as a function of the roll-axis command data, the pitch-axis command data, and the yaw-axis motion data.

24. The method of [[claim 8]] claim 21 wherein the command data includes roll-axis command data and pitch-axis command data, wherein the motion data includes yaw-axis motion data, and wherein the transformed commands include roll-axis data generated as a function of the roll-axis command data, the pitch-axis command data, and the yaw-axis motion data.

Ex. 2005, 4–5.

Based on the entirety of the record, including arguments and evidence presented by Patent Owner, we determine that proposed substitute claims 23 and 24 do not enlarge the scope of the originally issued claims, are supported by the '995 Application (see Ex. 3001, 12:30–13:3), and are responsive to the grounds of unpatentability involved in the proceeding. See Mot. Amend 5, 9–10.

Petitioner asserts that the limitations of substitute claims 23 and 24 are disclosed in the prior art, including Thornberg '983, for the same reasons discussed for substitute claims 19 and 20. Opp. Amend 18, 19, 22.

We agree that Petitioner's arguments, previously discussed, apply equally to substitute claims 23 and 24. For example, we find that Thornberg '983 teaches $TRSS = roll\ command * \cos(\theta) + pitch\ command * \sin(\theta)$, and $TPSS = pitch\ command * \cos(\theta) - roll\ command * \sin(\theta)$. Ex. 1006, 6:22–28. Further, Thornberg '983 teaches that transformation angle θ "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 5:32–35. As previously discussed above, we find that the true heading information provided by navigation system 36 teaches orientation motion data (i.e., yaw-axis data). Thus, we determine that Petitioner has shown, by a preponderance of the evidence, that substitute claims 23 and 24 are unpatentable over Thornberg '983. Accordingly, we deny Patent Owner's Motion to Amend as to substitute claims 23 and 24.

J. Proposed Substitute Dependent Claim 25

In its Motion, Patent Owner also proposes to replace cancelled claim 10 with substitute dependent claim 25. See Mot. Amend. 3–4. Proposed, substitute independent claim 25 is reproduced below with annotations:

25. The method of ~~[[claim 8]]~~ claim 21 wherein the ~~[[transformed commands include pitch-axis data generated as a function of the roll-axis command data, pitch-axis command data and the yaw-axis motion data]]~~ command data is generated only at the RC aircraft.

Ex. 2005, 5.

Patent Owner cites to page 6, lines 15–19; page 7, lines 22–25; and page 8, lines of the '995 Application to provide support for these amendments. *See* Mot. Amend 10. Patent Owner further asserts that these amendments are additional subject matter responsive to the grounds of unpatentability. *Id.* at 10–11. Patent Owner also asserts that substitute claim 25 does not enlarge the scope of original claims 1–15 because these dependent claims fall within the broader scope of proposed substitute claim 21, which is narrower in scope than original claim 7. *See* Mot. Amend 5, 9.

Petitioner asserts that substitute claim 25 depends from independent substitute claim 21, which recites “receiving a radio frequency (RF) signal from a remote control device that includes command data.” Opp. Amend 5. According to Petitioner, the “command data” as claimed is “from the remote control device” where the command data is generated. *Id.* (citing Ex. 1001, 4:67–2, Fig. 6, Abstract). Petitioner points out that substitute claim 25, however, requires the claimed “command data” be generated only at the RC aircraft, which is not supported by the written description or claims. *Id.*

Petitioner further argues that substitute claim 25 is indefinite because it requires the RC aircraft to both generate the claimed “command data” and receive the same data from a separate remote control device based on the requirements of claim 21. *Id.* at 22 (citing Ex. 1023 ¶¶ 177–78). Petitioner adds that the claim is also indefinite because it would require the RC aircraft

to generate command data “that indicates user commands,” as substitute claim 21 recites, but the user is not physically located at the RC aircraft. *Id.*

In response, Patent Owner acknowledges that there is an error in the amendment, which Patent Owner asserts should have recited “motion” data instead of “command” data. Reply Amend 2. Further, during a pre-hearing conference call on February 20, 2019, Patent Owner requested authorization to submit a revised listing of amended claims to correct a “typographical error” in substitute claim 25. Paper 33, 1. Patent Owner’s request was denied because permitting Patent Owner to change substitute claims at a late stage of the proceeding, just seven (7) days before the oral hearing, would not allow Petitioner a reasonable opportunity to oppose newly introduced amended claims (i.e., briefing an obviousness challenge based on changed claim scope). Paper 33, 2–3. Also, in our order summarizing the conference call discussion, we noted that Patent Owner became aware of the amendment “error” when Petitioner’s Opposition “pointed them out in their oppositions” on December 31, 2018. *Id.* at 1–2. However, Patent Owner did not make its request until months later. *Id.* at 1–3.

With this in mind, we agree that substitute claim 21 as originally submitted is indefinite under 35 U.S.C. § 112 ¶ 2. Substitute claim 21 is directed to a method for use with a radio controlled (RC) aircraft that includes the step of “receiving a radio frequency (RF) signal from a remote control device that includes command data that indicates user commands to control motion of the RC aircraft[.]” Substitute claim 25 depends from substitute claim 21 and refers to the same “command data” recited in substitute claim 21. As written, substitute claim 25 would require the same limitation, “command data” to come from a remote control device, but to be

“generated only at the RC aircraft.” Thus, we find the claim language to be contradictory and unclear as to where the command data comes from. These alternative readings render the claim indefinite because the scope of the claim cannot be ascertained. *See Ex parte McAward*, Appeal 2015-006416, 2017 WL 3669566, at *5 (PTAB Aug. 25, 2017) (precedential).

Accordingly, we deny Patent Owner’s Motion to Amend as to substitute claim 25.

K. Proposed Substitute Independent Claim 26

In its Motion, Patent Owner proposes to replace cancelled claim 11 with substitute independent claim 26. *See* Mot. Amend. 2, 4. Proposed, substitute independent claim 26 is reproduced below with annotations:

26. A method for use with a radio controlled (RC) aircraft, the method comprising:

generating [[an]] a radio frequency (RF) signal from a remote control device that includes command data that indicates user commands to control motion of the RC aircraft, wherein the user commands to control the motion of the RC aircraft are in a first coordinate system from a perspective of the remote control device, wherein the command data includes an operation to establish an initial position of the RC aircraft;

generating a mode control signal that indicates one of: a first mode of operation and a second mode of operation;

wherein the RC aircraft is controlled based on the RF signal and motion data generated by at least one sensor of the RC aircraft that indicates motion of the RC aircraft, and wherein the control of the RC aircraft includes:

when the mode control signal indicates the first mode of operation:

the user commands indicated by the command data are transformed into transformed commands in a second coordinate system that is from a perspective of the RC aircraft; [[and]]

the RC aircraft is controlled based on the transformed commands; and

selection of the second coordinate system is displayed at the remote control device; and

when the mode control signal indicates the second mode of operation:

the RC aircraft is controlled directly based on the user commands indicated by the command data in the first coordinate system; and

selection of the first coordinate system is displayed at the remote control device.

Ex. 2005, 5–6.

Based on the entirety of the record, including arguments and evidence presented by Patent Owner, we determine that proposed substitute claim 26 does not enlarge the scope of the originally issued claims, is supported by the '995 Application, and is responsive to the grounds of unpatentability involved in the proceeding. *See* Mot. 5, 7–8; Ex. 3001, Fig. 7, 4:6–8, 5:1–6, 9:18–26, 10:23–24, 11:1, 12:2–13.

Next, we determine that Petitioner has shown, by a preponderance of the evidence, that Thornberg '983 teaches all of the limitations of proposed substitute independent claim 26.

Petitioner asserts that Thornberg '983 teaches command data that “includes an operation to establish an initial position of the RC aircraft” because when the Thornberg '983 operator selects OPERATOR reference mode, the reference axis for purposes of transformation is based on the orientation of the operator control panel upon activation of the operator reference mode. Opp. Amend 21 (citing Ex. 1006, 6:8–11, 7:19–26). Petitioner adds that in the “variable operator reference mode,” a change in the position of the RC aircraft with respect to the control panel 200 can be

measured by a signal “indicative of the change in the position of the control panel [w]ith respect to the initial operator reference” direction. *Id.* (citing Ex. 1006, 7:27–43). Petitioner also argues that the term “operation” is indefinite because data and operation have different meanings. Opp. Amend 20.

As with substitute claim 22, Patent Owner contends that Thornberg ’983 is silent regarding an operation or command being generated when the switch is changed to the operator reference mode. Reply Amend 11. Patent Owner also asserts that when the switch is changed, a reference axis is established based on an *orientation* of the operator control panel, and not the initial position of the vehicle. *Id.* Patent Owner contends also that Thornberg ’983 does not teach that the operator control panel must be pointed at the vehicle. *Id.*

As discussed with respect to substitute claim 17, we find that Thornberg ’983 teaches that when the operator reference mode is selected, the reference will be provided on line 453. *See* Ex. 1006, 7:24–26. For example, “if the operator is facing North upon activation of the operator mode, the North reference will be provided on the line **453**.” *Id.* If the operator is directly facing the remotely operated vehicle (*see* Ex. 1006, Fig. 2) at initialization, for example directly facing North at the remotely operated vehicle, the orientation of the operator, which is the North reference provided on line 453, is also the angular position of the remotely operated vehicle. *See* Ex. 1006, 6:8–11 (“In an operator reference mode, the orientation of the operator upon activation of the operator mode is used as the reference axis.”). Further, we determine that Thornberg ’983 teaches determining an initial position of the remotely operated vehicle “based on

the command data including an operation to establish the initial position” because the operator sets switch 257 to operator reference mode. Ex. 1006, 6:2–4 (“The operat[or] of the reference mode switch **457** is dependent upon the position of a control panel reference mode switch **257** on the control panel 200.”).

We also agree with Petitioner that Thornberg ’983 teaches “selection of the second coordinate system is displayed at the remote control device” and “selection of the first coordinate system is displayed at the remote control device,” because switch 257 on control panel 200 displays selection of a VEHICLE reference mode using a first coordinate system or an OPERATOR reference mode using a second coordinate system, as claimed. Ex. 1006, 6:2–4.

We find that Thornberg ’983 teaches that mode switch 457 provides a signal to indicate which reference mode is in use by the control panel. Thornberg ’983 teaches that the “operation of the reference mode switch 457 is dependent upon the position of a control panel reference mode switch 257 on the control panel 200 (FIG. 4).” Ex. 1006, 6:2–5. Thornberg ’983’s Figure 6 shows line 453, which provides the input signal from reference mode switch 457. *Id.* at Fig. 6. Thus, when an operator selects the OPERATOR reference mode, switch 457 will be positioned to connect with OPERATOR MODE as shown in Figure 6. *See id.* at 6:2–5, Fig. 6. Thornberg ’983 further teaches that in the OPERATOR MODE, “the reference axis for purposes of transformation is based on the orientation of the operator control panel upon activation of the operator reference mode. Therefore, if the operator is facing North upon activation of the operator

mode, the North reference will be provided on the line 453.” Ex. 1006, 7:21–26.

Accordingly, we deny Patent Owner’s Motion to Amend as to substitute claim 26.

L. Proposed Substitute Claim 27

In its Motion, Patent Owner also proposes to replace cancelled claim 12 with substitute dependent claim 27. See Mot. Amend. 9. Proposed, substitute claim 27 is reproduced below with annotations:

27. The method of [[claim 11]] claim 26 wherein the user commands includes lift command data and controlling the RC aircraft includes controlling the RC aircraft to a hovering state in response to the lift command data, and wherein the remote control device includes a plurality of spring-loaded interface devices, at least one spring-loaded interface device of the plurality of spring-loaded interface devices configured to return to a corresponding particular position, the particular position comprising a center position of multiple axes of operation.

Ex, 2005, 6.

Based on the entirety of the record, including arguments and evidence presented by Patent Owner, we determine that proposed substitute claim 27 does not enlarge the scope of the originally issued claims, is supported by the ’995 Application, and is responsive to the grounds of unpatentability involved in the proceeding. See Mot. Amend 5, 9–11; Ex. 3001, 10:6–17, 11:1–5, Fig. 7.

Petitioner asserts that the limitations of substitute claim 27 are unpatentable over the combination of Thornberg ’983, Kare¹¹, and

¹¹ Petitioner relies on Kare¹¹ for “hovering state” recited in original claim 12.

Thornberg-1995¹². Opp. Amend 23–24. Petitioner asserts that Thornberg-1995 teaches a “conventional hand-held control unit” with a pair of multi-axes “spring-centered” joysticks, the right for pitch/roll control and the left for lateral axis and yaw control. Opp. Amend 24 (citing Ex. 1012,¹³ 809). Petitioner asserts it would have been obvious to a POSITA that Thornberg-1995’s multi-axis spring-centered joysticks could be used for the input controls on Thornberg ’983’s control panel 200, as such an arrangement was conventional, obvious to try, and known to provide advantages. *Id.* (citing Ex. 1003 ¶¶ 107–110). Petitioner further notes that the proposed modifications would have been well within the ability of a POSITA. *Id.* (citing Ex. 1003 ¶ 109).

Patent Owner responds that Thornberg-1995 discloses a left joystick that returns to center in the lateral axis, but stays in the longitudinal direction due to friction. Reply Amend 12. Patent Owner argues that the left joystick controls the collective of the blade helicopter, for which constant adjustment is not needed. *Id.* (citing Ex. 1012,¹⁴ 6). Patent Owner argues “it would not have been ‘obvious to try’ such an arrangement, as Thornberg-[19]95 explicitly states a contrary reasoning for making the second (i.e., left) joystick stay in one position rather than be ‘spring-loaded.’” *Id.* at 12.

¹² Both parties refer to Thornberg-1995 as “Exhibit 1012”; however, we have included this reference as Exhibit 3002 because the title “Exhibit 1012” has not been used for an exhibit in this proceeding. *See* Ex. 1003, vi; Ex. 1023 ¶¶ 181–183; Reply Amend 10–12. We further note that both parties have had notice of and access to Thornberg-1995 as both parties have substantively discussed the contents of the reference in their respective briefs. *See id.*

¹³ Refer to Exhibit 3002.

¹⁴ Refer to Exhibit 3002.

Based on the entirety of the record, we determine that Petitioner has demonstrated by a preponderance of the evidence that substitute claim 27 is unpatentable over Thornberg '983, Karem, and Thornberg-1995.

Thornberg-1995 teaches that

the operator always has positive control of the aircraft through a *conventional* hand-held control unit. The control unit has two joysticks. *The right one is spring-centered in both axes and controls pitch and roll*, which the left is spring-centered in the lateral axis and controls yaw. The left joystick is held by friction in the longitudinal axis and controls collective.

Ex. 3002, 9 (emphasis). Substitute claim 27 requires “*at least one* spring-loaded interface device of the plurality of spring-loaded interface devices configured to return to a corresponding particular position, the particular position comprising a center position of multiple axes of operation.”

Ex. 2005, 6 (emphasis added). Thornberg-1995 teaches *at least one* of the two joysticks is spring-centered in both axes (i.e., right joystick).

We further credit Dr. Hansman’s testimony that a POSITA would have understood Thornberg-1995’s spring-loaded joysticks could be used for the input controls of Thornberg '983, and would have been motivated to use spring-loaded joysticks for Thornberg '983’s controls “based on Thornberg '983’s teaching that such an arrangement is conventional and provides advantageous modes of control for use on a control unit.” Ex. 1003 ¶ 107. Dr. Hansman’s testimony is supported by the disclosure of Thornberg-1995, which teaches the spring-centered joystick as part of a *conventional* hand-held control unit, and that releasing the right joystick to a spring-centered position “has proven very forgiving and safe, as well as easy to fly.”

Ex. 3002, 6.

Accordingly, we deny Patent Owner's Motion to Amend as to substitute claim 25.

M. Proposed Substitute Dependent Claims 28 and 29

In its Motion, Patent Owner also proposes to replace cancelled claim 13 with substitute dependent claim 28, and cancelled claim 14 with substitute claim 29. See Mot. Amend. 9. Proposed, substitute dependent claims 28 and 29 are reproduced below with annotations:

28. The method of [[claim 11]] claim 26 wherein the command data includes roll-axis command data and pitch-axis command data, [[and]] wherein the motion data includes yaw-axis motion data, and wherein the transformed commands include roll-axis data generated as a function of the roll-axis command data, the pitch-axis command data, and the yaw-axis motion data.

29. The method of [[claim 13]] claim 26 wherein the command data includes roll-axis command data and pitch-axis command data, wherein the motion data includes yaw-axis motion data, and wherein the transformed commands include roll-axis data generated as a function of the roll-axis command data, the pitch-axis command data, and the yaw-axis motion data.

Ex. 2005, 6–7.

Petitioner's and Patent Owner's arguments regarding these limitations are nearly identical to those provide for substitute claim 19. See Opp. Amend 24 ("Claims 28 and 29 are identical and therefore are invalid for statutory double patenting under 35 U.S.C. § 101. Claims 28-29 recite the same limitation as Claim 19. Thornberg discloses this limitation for the same reasons in Section II.D."); Mot. to Amend 10–11; Reply Amend 12.

For the same reasons discussed above, we determine that Petitioner has demonstrated by a preponderance of the evidence that substitute claims

28 and 29 are unpatentable over the disclosure in Thornberg '983. For example, Thornberg '983 teaches $TRSS = roll\ command * \cos(\theta) + pitch\ command * \sin(\theta)$, and $TPSS = pitch\ command * \cos(\theta) - roll\ command * \sin(\theta)$. Ex. 1006, 6:22–28. Further, Thornberg '983 teaches that transformation angle θ is determined based on the true heading (i.e., yaw-axis data) of the vehicle as determined by the navigation system 36 and the desired vehicle reference and vehicle reference mode. *Id.* at 5:32–35.

Accordingly, we deny Patent Owner's Motion to Amend as to substitute claims 28 and 29.

N. Proposed Substitute Claim 30

In its Motion, Patent Owner also proposes to replace cancelled claim 15 with substitute dependent claim 30. See Mot. Amend. 9. Proposed, substitute claim 30 is reproduced below with annotations:

30. The method of [[claim 13]] claim 26 wherein the [[transformed commands include pitch-axis data generated as a function of the roll-axis command data, pitch-axis command data and the yaw-axis motion data]] RC aircraft includes a plurality of control devices, and wherein the plurality of control devices includes one or more actuators, one or more gimbals, or both.

Ex. 2005,

Patent Owner cites to page 8, lines 17–19 of the '995 Application to provide support for these amendments. Mot. Amend 10. Patent Owner further asserts that these amendments are additional subject matter responsive to the grounds of unpatentability. *Id.* at 10–11. Patent Owner also asserts that substitute claim 30 does not enlarge the scope of original claims 1–15 because this dependent claim falls within the broader scope of proposed substitute claim 26, which is narrower in scope than original claim 11. See Mot. Amend 5, 9. Based on the entirety of the record, including

arguments and evidence presented by Patent Owner, we determine that proposed substitute claim 30 does not enlarge the scope of the originally issued claims,¹⁵ is supported by the '995 Application, and is responsive to the grounds of unpatentability involved in the proceeding.

Petitioner asserts that Thornberg '983 describes UAV 100 having rotor assembly 60, which a POSITA would understand includes at least one motor (actuator) for rotating the assembly. Opp. Amend 25 (citing Ex. 1006, Fig. 4, 3:62–4:3; Ex. 1023 ¶ 185). Petitioner argues that Thornberg '983's UAV provides control commands (i.e., TRSS and TPSS controls) to the UAV control surfaces to perform the desired maneuvers. *Id.* (citing Ex. 1006, 4:52–56, 6:16–28, Figs. 5–6). Petitioner asserts that “[a] POSITA would have understood the rotor assembly and control actuators in Thornberg [’983] are actuators for controlling the UAV’s pitch and roll using the TPSS and TRSS controls.” *Id.* (citing Ex. 1003 ¶ 103; Ex. 1023 ¶ 186).

Based on the entirety of the record, Petitioner has demonstrated, by a preponderance of the evidence, that Thornberg '983 discloses these claimed features. We find that Thornberg '983 teaches that

[t]he UAV used in the example of the present invention comprises a toroidal fuselage or shroud 20 having an aerodynamic profile, flight/mission equipment 30, a power plant subsystem 50, and a rotor assembly 60. The toroidal fuselage 20 is provided with a plurality of support struts 24 which are attached to the rotor assembly 60 and are operative to support[]

¹⁵ Petitioner asserts enlargement of scope because limitations have been removed from original claim 15. Opp. Amend 5–6. As stated in *Lectrosonics, Inc.*, a substitute claim satisfies the requirement to not enlarge the scope of the claims if it is narrower than at least one of the issued claims. *Lectrosonics, Inc.*, slip op. at 6–7.

the rotor assembly 60 in fixed coaxial relation with respect to the toroidal fuselage 20.

Ex. 1006, 3:62–4:3. Further, we credit Dr. Hansman’s testimony that “a POSITA would understand [rotor assembly 60] includes at least one motor (actuator) for rotating the assembly.” Ex. 1023 ¶ 185. This undisputed testimony is supported by the disclosure of Thornberg ’983, including the portion cited above, and Figure 4.

Accordingly, we deny Patent Owner’s Motion to Amend as to substitute claim 30.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–15 of the ’116 patent are unpatentable;

FURTHER ORDERED that Patent Owner’s Motion to Amend is denied; and

FURTHER ORDERED that because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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