

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PARROT S.A., PARROT DRONES, S.A.S., and PARROT INC.,
Petitioner,

v.

QFO LABS, INC.,
Patent Owner.

IPR2018-01690
Patent 9,904,292 B2

Before MEREDITH C. PETRAVICK, HYUN J. JUNG, and
SCOTT C. MOORE, *Administrative Patent Judges*.

JUNG, *Administrative Patent Judge*.

JUDGMENT

Final Written Decision

Determining Some Challenged Claims Unpatentable

Granting Patent Owner's Motion to Amend to Cancel Claims 1–10

Denying Patent Owner's Motion to Amend to Substitute Claims 21–23

35 U.S.C. § 318(a)

I. INTRODUCTION

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 13–17 of U.S. Patent No. 9,904,292 B2 are unpatentable. We grant Patent Owner’s Motion to Amend with respect to its request to cancel challenged claims 1–10 but deny the Motion to Amend with respect to its request to substitute claims 21–23 for claims 1, 6, and 13.

A. Background and Summary

Parrot S.A., Parrot Drones S.A.S., and Parrot Inc. (collectively, “Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting institution of an *inter partes* review of claims 1–10 and 13–17 of U.S. Patent No. 9,904,292 B2 (Ex. 1001, “the ’292 patent”). QFO Labs, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 6. Pursuant to 35 U.S.C. § 314, we instituted an *inter partes* review of the ’292 patent. Paper 7 (“Dec. to Inst.”). In particular, we instituted review of claims 1–10 and 13–17 on all presented challenges. Dec. to Inst. 2, 22, 23.

After institution, Patent Owner filed a Response (Paper 23, “PO Resp.”), to which Petitioner filed a Reply (Paper 29, “Pet. Reply”). Patent Owner thereafter filed a Sur-Reply (Paper 34, “PO Sur-Reply”). Patent Owner also filed a Motion to Amend (Paper 24, “Mot.”), and Petitioner filed an Opposition to Patent Owner’s Motion to Amend (Paper 30, “Opp.”), to which Patent Owner filed a Reply to Petitioner Opposition to Motion to Amend (Paper 35, “PO Reply”). Petitioner further filed a Sur-Reply to Patent Owner’s Motion to Amend (Paper 37, “Pet. Sur-Reply”). An oral hearing in this proceeding was held on November 19, 2019; a transcript of the hearing is included in the record (Paper 39, “Tr.”).

B. Real Parties in Interest

Petitioner states that “Parrot S.A., Parrot Drones S.A.S., and Parrot Inc. are the real parties-in-interest.” Pet. 93. Patent Owner states that “QFO Labs, Inc. is the patent owner and real party-in-interest.” Paper 4, 2.

C. Related Matters

The parties indicate that the ’292 patent is related to the patents challenged in IPR2016-01550, IPR2016-01559, IPR2017-01089, IPR2017-01090, and IPR2017-01400. Pet. 94; Paper 4, 2–3; PO Resp. 9. The application that issued as the ’292 patent is a division of the patent that was challenged in IPR2016-01559 and IPR2017-01090. Paper 4, 2–3. That same application claims priority to the patent that was challenged in IPR2016-01550 and IPR2017-01089. *Id.* at 2. The patent that issued from a continuation of the application that resulted in the ’292 patent was challenged in IPR2017-01400. *Id.* at 3.

We issued Final Written Decisions in IPR2016-01550 (Ex. 2007, “1550 Final Decision” or “1550 Final Dec.”) and IPR2016-01559 (Ex. 2008, “1559 Final Decision” or “1559 Final Dec.”), both of which the Federal Circuit summarily affirmed (Ex. 2012). We denied the petitions in IPR2017-01089, IPR2017-01090, and IPR2017-01400. Paper 4, 2–3.

The parties also indicate that patents related to the ’292 patent are the subject of cases in U.S. District Courts for the Districts of Delaware and Minnesota. Pet. 94; Paper 4, 4–6; PO Resp. 10–11.

D. The ’292 Patent

The ’292 patent issued February 27, 2018, from an application filed July 3, 2015. Ex. 1001, codes (22), (45). The ’292 patent is ultimately related, through two divisional applications and a continuation application, to a national stage entry of a PCT application, filed September 2, 2003,

which claims priority to a provisional application filed on August 30, 2002.¹ *Id.* at code (60), 1:8–22.

The '292 patent relates to a “homeostatic flying hovercraft and to a radio controlled flying saucer toy employing the principals of a homeostatic flying hovercraft.” *Id.* at 1:29–31. Figure 21 of the '292 patent is reproduced below:

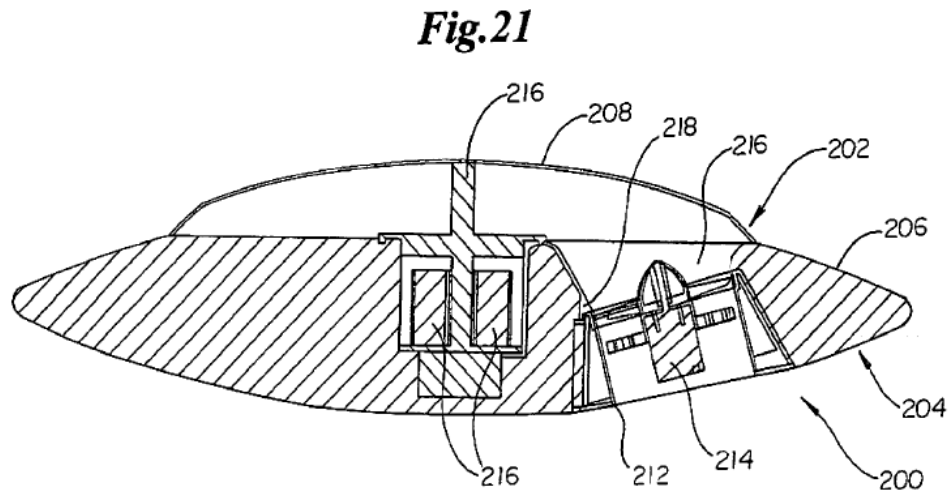


Figure 21 illustrates a “side cutaway view” (*id.* at 9:5–6) of a “preferred embodiment of a homeostatic flying hovercraft” (*id.* at 8:61–63, 9:33–35). Homeostatic flying hovercraft 200 has upper surface 202, bottom surface 204, four duct openings 212 on bottom surface 204, and battery-powered ducted fan 214 mounted inboard from each duct opening 212. *Id.* at 9:36–50. “Each fan 214 is powered from an internal

¹ Although 35 U.S.C. § 311(c)(1) precludes some petitions from being filed within nine months of a patent being granted, “[s]ection 311(c) . . . shall not apply to a petition to institute an inter partes review of a patent that is not a patent described in section 3(n)(1) of the Leahy–Smith America Invents Act.” Pub. L. No. 112-274, 126 Stat. 2456, 2456 (2013); *see also* 37 C.F.R. § 42.102(a)(2). Here, given the effective filing date of the '292 patent, the record indicates that the '292 patent is not a patent described in § 3(n)(1) of Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011). Thus, § 311(c)(1) does not apply to this Petition.

pair of batteries 216.” *Id.* at 9:62–63; *see also id.* at 12:64–13:9, 13:21–42 (describing embodiment of Figs. 1–3).

Homeostatic control system 300 is “operably connected to the thrusters . . . in order to maintain a desired orientation” and includes “XYZ sensor arrangement 302 and associated control circuitry 304 that dynamically determines an inertial gravitational reference.” *Id.* at 11:21–29; *see also id.* at 10:54–61 (also describing a homeostatic control system and XYZ sensor arrangement). XYZ sensor arrangement 302 “comprises an X-axis sensor system, a Y-[axis] sensor system[,] and a Z-axis sensor system.” *Id.* at 11:39–41. “The X-axis sensor system is positioned in an X plane of the body and includes at least three first sensors that sense acceleration and gravity in the X plane and at least three second sensors that sense acceleration only in the X plane.” *Id.* at 11:41–45. The Y-axis and Z-axis sensor systems are similarly configured. *Id.* at 11:45–51. “Preferably, the X-axis sensor system comprises two sets of active accelerometers and two sets of passive accelerometers oriented in the X plane,” and the Y-axis sensor system similarly comprises active and passive accelerometers. *Id.* at 11:52–56. Each set of active accelerometers has a pair of active accelerometers “oriented at 90 degrees with respect to each other in the respective plane,” and each set of passive accelerometers has a pair of passive accelerometers also “oriented at 90 degrees with respect to each other in the respective plane.” *Id.* at 11:57–62. The pairs of active and passive accelerometers are “positioned at 45 degrees offset relative to a horizontal plane through a center of the body.” *Id.* at 11:62–65.

A hand-held bee controller 220 can be used to control remotely homeostatic flying hovercraft 200 or any radio-controlled (“RC”) aircraft. *Id.* at 10:33–35. A user selectively positioning an orientation of RC

controller 220 provides a “desired orientation.” *Id.* at 10:38–40. The homeostatic control system “includes an XYZ sensor arrangement and associated control circuitry” to sense the “desired orientation of the RC controller” and “dynamically determines an inertial gravitational reference for use in sensing the desired orientation.” *Id.* at 10:41–44. Controller 220 also includes a “bidirectional radio frequency (RF) transceiver providing two-way RF communications between the RC aircraft and the hand-held RC controller that communicates the desired orientation to the RC aircraft.” *Id.* at 10:45–49; *see also id.* at 13:38–42, 12:64–13:47 (describing embodiment of Figs. 1–3). The “preferred embodiment . . . incorporates state of the art radio frequency communications” such as a “900 MHz communication chip” that provides a communication link between controller 220 and saucer 200. *Id.* at 10:20–23.

E. Illustrative Claim

The '292 patent has 20 claims, of which Petitioner challenges claims 1–10 and 13–17. Of those, claims 1, 6, and 13 are independent. Claim 13 is reproduced below:

13. A method for configuring a hand-held controller to control a radio controlled (RC) drone remote from the hand-held controller, wherein the RC drone is a quadcopter multi-rotor flying craft having four electrically powered motors, each motor driving at least one blade configured to provide aerodynamic lift for the quadcopter multi-rotor flying craft, a battery system operably coupled to the motors, and a control system configured to automatically control a downwardly directed thrust produced by each motor and each motor's at least one blade in response to control commands communicated by radio communications, the method comprising:

providing software that is configured to be used by a battery-powered microprocessor system in the hand-held controller and is configured to control the RC drone by radio

communications that include control commands corresponding to a desired orientation of the RC drone based on a sensor system in the hand-held controller that is configured to sense a gravitational reference and a relative tilt of the hand-held controller with respect to the gravitational reference as a result of the user selectively orienting the hand-held controller,

wherein the RC drone is configured to be remotely controlled by radio communications with the hand-held controller so as to position the RC drone in the desired orientation based on the control system of the RC drone determining a gravitational reference for the RC drone and a sensed orientation of the RC drone and controlling a speed of each of the motors to position the RC drone in response to the control commands corresponding to the desired orientation.

Ex. 1001, 17:17–18:6.

F. Evidence

Petitioner identifies the following references as prior art in the asserted grounds of unpatentability:

(1) U.S. Patent Application Publication No. US 2002/0104921 A1, published August 8, 2002 (Ex. 1004, “Louvel”);

(2) Fixed and Flapping Wing Aerodynamics for Micro Air Vehicle Applications, 195 PROGRESS IN ASTRONAUTICS AND AERONAUTICS (2001) (Ex. 1006, “Kroo”);

(3) U.S. Patent No. 5,590,062, issued December 31, 1996 (Ex. 1010, “Nagamitsu”);

(4) U.S. Patent Application Publication No. US 2002/0193914 A1, published December 19, 2002 (Ex. 1007, “Talbert”);

(5) U.S. Patent Application Publication No. US 2001/0021669 A1, published September 13, 2001 (Ex. 1008, “Gabai”);

(6) U.S. Patent Application Publication No. US 2003/0040247 A1, published February 27, 2003 (Ex. 1009, “Rehkemper”); and

(7) U.S. Patent No. 5,703,623, issued December 30, 1997 (Ex. 1014, “Hall”).

Petitioner also provides declarations by Girish Chowdhary in support of the Petition (Ex. 1003), Petitioner’s Reply (Ex. 1021), and Petitioner’s Opposition to the Motion to Amend (Ex. 1022). Patent Owner relies on a declaration by John P. Condon (Ex. 2015). Deposition transcripts for Mr. Chowdhary (Exs. 2016, 2037) and Mr. Condon (Ex. 1020) were also filed.

G. Asserted Grounds

Petitioner asserts that claims 1–10 and 13–17 would have been unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 6	103 ²	Louvel, Kroo, Nagamitsu
2, 3, 7, 8	103	Louvel, Kroo, Nagamitsu, Talbert
4, 9	103	Louvel, Kroo, Nagamitsu, Gabai
5, 10	103	Louvel, Kroo, Nagamitsu, Rehkemper
13	103	Louvel, Kroo, Nagamitsu, Hall
15, 17	103	Louvel, Kroo, Nagamitsu, Hall, Talbert
14	103	Louvel, Kroo, Nagamitsu, Hall, Gabai
16	103	Louvel, Kroo, Nagamitsu, Hall, Rehkemper
13	103	Louvel, Kroo, Hall
15, 17	103	Louvel, Kroo, Hall, Talbert
14	103	Louvel, Kroo, Hall, Gabai

² The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284 (Sept. 16, 2011), took effect on March 16, 2013. Because the application from which the ’292 patent issued was filed before March 16, 2013, the effective date of the relevant amendment, the pre-AIA version of § 103 applies.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
16	103	Louvel, Kroo, Hall, Rehkemper

Pet. 8–9, 21–93.

II. ANALYSIS

A. Legal Standards

In an *inter partes* review, Petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail in its challenges, Petitioner must prove unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

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

B. Level of Ordinary Skill in the Art

Petitioner asserts that a person of ordinary skill in the art “would have at least a Bachelor of Science degree in Aerospace engineering, or a

comparable degree, in combination with at least two years of practical experience in the field.” Pet. 5 (citing Ex. 1003 ¶ 27).

Patent Owner generally agrees with Petitioner’s proposed level of ordinary skill and states that “a person of ordinary skill in this field of art at the time of the invention would possess a Bachelor of Science degree in Aerospace Engineering, or a comparable degree such as Electrical Engineering, with two to four years of practical experience in design and development in the field of remote-control aircraft.” PO Resp. 14 (citing Pet. 5; Ex. 1003 ¶ 27; Ex. 2015 ¶ 44).

We adopt the parties’ agreed-to level of ordinary skill and, based on the full record, find that one of ordinary skill in the art “would possess a Bachelor of Science degree in Aerospace Engineering, or a comparable degree such as Electrical Engineering, with two to four years of practical experience in design and development in the field of remote-control aircraft” (PO Resp. 14). To the extent there are any differences in the parties’ asserted levels of ordinary skill, those differences would not impact our analysis.

With its arguments regarding level of ordinary skill in the art, Patent Owner disputes characterizations in the Petition related to the field of endeavor and Petitioner’s declarant’s assumptions about the knowledge and motivation of an ordinarily skilled artisan. *See* PO Resp. 13–14. We address those arguments below in our analysis of Petitioner’s reason to combine the asserted references.

C. Claim Construction

Petitioner submits that no express interpretation of any claim term is necessary but “reserve[s] the right to respond to, and/or to offer alternative

constructions to any proposed claim constructions offered by Patent Owner.” Pet. 7–8.

Patent Owner proposes interpretations for “orientation,” “position,” “tilt,” and “sense a gravitational reference.” PO Resp. 15–17. Patent Owner proposes interpreting “orientation” to mean “angular displacement of a body coordinate frame relative to a reference coordinate frame, which for the ’292 patent is an inertial reference that uses gravity as a reference.” PO Resp. 16 (citing Ex. 2015 ¶ 82); *see also id.* at 15 (“[T]he reference coordinate frame for each of these terms must be interpreted under a broadest reasonable construction as an inertial reference that essentially provides an inert, non-moving reference coordinate frame that uses gravity as a reference.”) (citing Ex. 2015 ¶¶ 81, 99).

Patent Owner also proposes interpreting the noun “position” to mean “a set of values of an N-degree of freedom state vector describing both a location and an orientation of a body relative to the origin of a reference coordinate frame” and the verb “position” to mean “a translation of a body from one state to another state.” *Id.* at 16 (citing Ex. 2015 ¶¶ 88, 89); *see also id.* at 15 (“[T]he reference coordinate frame for each of these terms must be interpreted under a broadest reasonable construction as an inertial reference that essentially provides an inert, non-moving reference coordinate frame that uses gravity as a reference.”) (citing Ex. 2015 ¶¶ 81, 99). Patent Owner further describes what an “N-degree of freedom state vector” is. *Id.* at 16.

Patent Owner additionally proposes interpreting the noun “tilt” to mean “the set of angles of a body within a reference coordinate frame” and the verb “tilt” to mean “a rotation of a body from one set of angles to another set of angles with respect to a reference coordinate frame.” *Id.* at 16

(citing Ex. 2015 ¶¶ 90); *see also id.* at 15 (“[T]he reference coordinate frame for each of these terms must be interpreted under a broadest reasonable construction as an inertial reference that essentially provides an inert, non-moving reference coordinate frame that uses gravity as a reference.”) (citing Ex. 2015 ¶¶ 81, 99).

Patent Owner finally proposes interpreting “sense a gravitational reference” to mean “dynamically sense an inertial gravitational reference for use as an inertial reference that essentially provides an inert, non-moving reference coordinate frame that uses gravity as the reference.” *Id.* at 17; *see also id.* at 15 (“[T]he reference coordinate frame for each of these terms must be interpreted under a broadest reasonable construction as an inertial reference that essentially provides an inert, non-moving reference coordinate frame that uses gravity as a reference.”) (citing Ex. 2015 ¶¶ 81, 99).

Petitioner replies that “no construction is required.” Pet. Reply 7. Petitioner also argues that Patent Owner “provides almost half-page definitions for each of these easily understandable terms, tailored to fit its arguments, and professing that it is mandated by the ordinary meaning as informed by the [S]pecification” but “cites only its expert.” *Id.* Petitioner further argues that “a review of the [S]pecification plainly demonstrates that none of the terms were defined, either expressly or implicitly in any way.” *Id.* at 8. According to Petitioner, Patent Owner proposes “rewriting their claims to avoid an unpatentability ruling.” *Id.* (citing Ex. 2015 ¶¶ 99).

Patent Owner replies that Petitioner’s declarant “admits that there is nothing wrong with Patentee’s constructions” and agreed that the terms would be understood “with respect to a reference coordinate frame.” PO Sur-Reply 5 (citing Ex. 2037, 34), 6 (citing Ex. 2037, 23–24). Patent Owner also argues that Petitioner’s declarant “do[es] not properly account for how

the terms would be understood when read in light of the [S]pecification of the '292 patent" (*id.* at 5 (citing Ex. 2037, 28)), "ignored that the '292 patent teaches that the reference coordinate frame for each of these terms must be interpreted under a broadest reasonable construction as an inertial reference that essentially provides an inert, non-moving reference coordinate frame that uses gravity as a reference" (*id.* at 6 (citing Ex. 2015 ¶ 81)), and did not consider the '1550 and '1559 Final Decisions (*id.* at 7 (citing Ex. 2037, 7–8, 14–16)).

Patent Owner further argues that claim 13 should be interpreted to require an "orientation control scheme" and Petitioner does not respond to this argument, other than asserting collateral estoppel. *Id.* at 6–8 (citing PO Resp. 2, 16; Pet. Reply fn.7). According to Patent Owner, Petitioner focuses on whether claim 13 recites "mimic" and incorrectly argues that the Board has determined already that the prior art teaches an "orientation control scheme." *Id.* at 7–8 (citing Pet. Reply 8–9).

Based on the full record, we determine that express interpretation of any claim term is not necessary to resolve the parties' dispute. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (construing explicitly only those claim terms in controversy and only to the extent necessary to resolve the controversy); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of an *inter partes* review). In our analysis below, we address applying Patent Owner's proposed interpretations, and we determine that Petitioner would still show by a preponderance of the evidence that claims 13–17 are unpatentable, even if the claims were interpreted in the manner proposed by Patent Owner.

D. Grounds Asserted Against Claims 1–10

Petitioner challenges independent claims 1 and 6 as unpatentable over Louvel, Kroo, and Nagamitsu. Pet. 8, 21–52. Petitioner also challenges claims 2–5 and 7–10, which depend from claim 1 or 6, as unpatentable over Louvel, Kroo, Nagamitsu, and one of Talbert, Gabai, and Rehkemper. *Id.* at 8–9, 53–73.

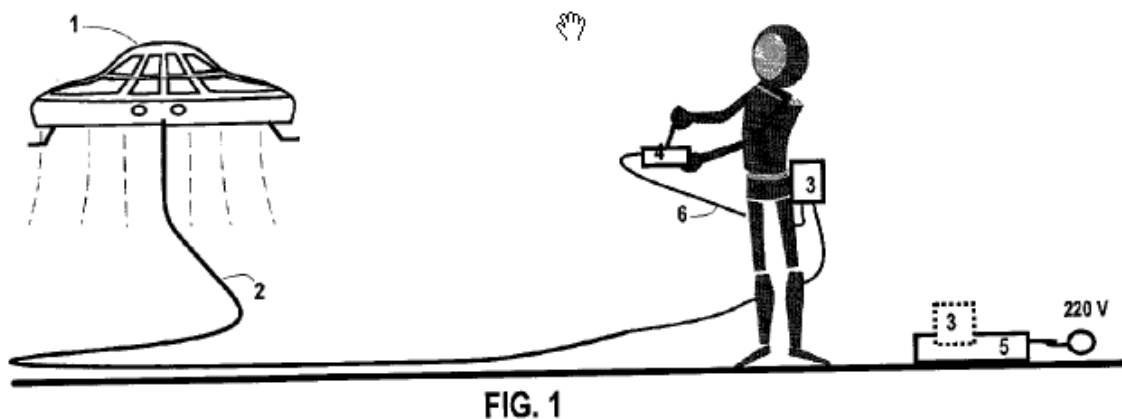
Patent Owner states that it “has elected in this proceeding to pursue a non-contingent cancellation of instituted claims 1–10 in view of the Motion to Amend.” PO Resp. 2. Because Patent Owner requests a non-contingent cancellation of claims 1–10, which we grant, we do not address Petitioner’s challenges to claims 1–10.

E. Ground Based on Louvel, Kroo, Nagamitsu, and Hall

1. Scope and Content of the Asserted Prior Art

a) Louvel (Ex. 1004)

Louvel “relates to a light aircraft, like a flying saucer, remotely controlled and remotely powered.” Ex. 1004 ¶ 1. Figures 1 and 2 of Louvel are reproduced below.



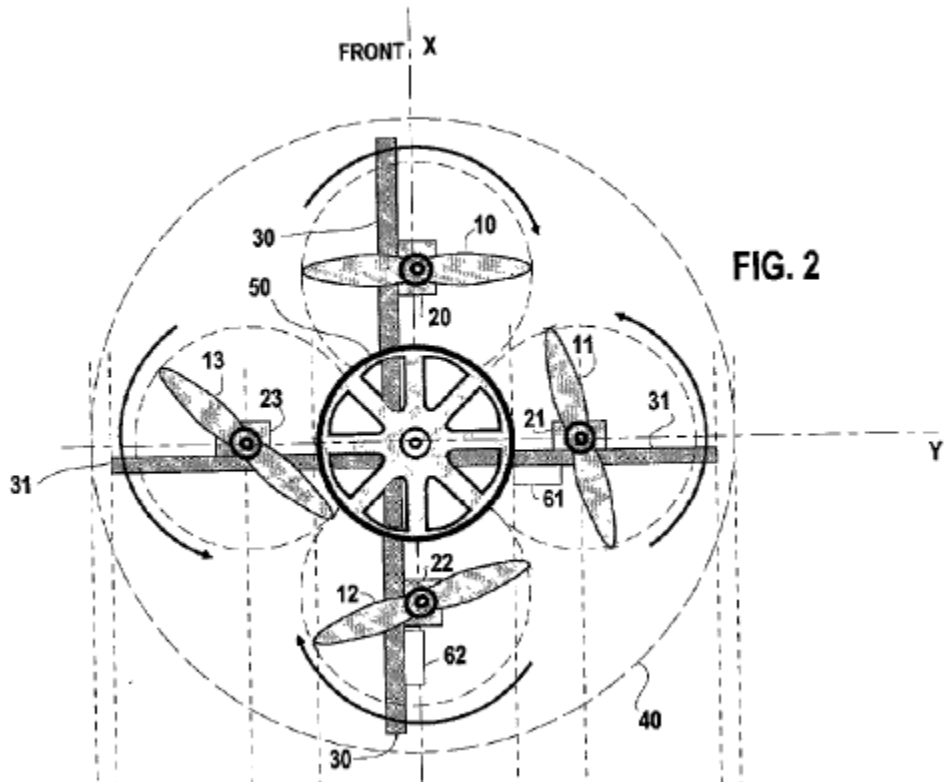


Figure 1 shows the invention of Louvel, including the exterior of aircraft 1; and Figure 2 shows a top view of an interior of aircraft 1. Ex. 1004 ¶¶ 12, 13. Aircraft 1 has four propellers 10, 11, 12, 13 with vertical axes to provide lift thrust, and each propeller 10–13 is driven independently by electric motor 20, 21, 22, 23, respectively. *Id.* ¶¶ 29, 30. Aircraft 1 is “fitted with three attitude sensors whose purpose is to provide information for the closed loop control,” and the sensors include roll tilt angle sensor 61, pitch tilt angle sensor 62, and yaw sensor 63. *Id.* ¶¶ 42–44, 46, Fig. 4.

Aircraft 1 is linked to control unit 3, which is also linked to handling unit 4. *Id.* ¶¶ 25, 26; *see also id.* ¶¶ 50–53, Fig. 5 (describing handling unit 4). When there is no action on handle 7, a closed control loop uses data from sensors 60–63 “to converge towards the horizontal normal attitude of the aircraft and to cancel the yaw movement.” *Id.* ¶ 91. When there is

action on handle 7, a “microcontroller corrects the present required values driven in each electric current to generate an imbalance in the direction required by the handle position,” and the imbalance is limited in order “to limit the displacement speed of the aircraft” and “to allow a quick stabilization as soon as the action on the handle stops.” *Id.* ¶ 93, Figs. 9, 10. For example, if sensor 62 indicates that aircraft 1 is tilting towards the rear, then the speed of propeller 12 is increased, the speed of propeller 10 is decreased, and the speeds of propellers 11, 13 are unchanged. *Id.* ¶ 98; *see also id.* ¶¶ 99–121 (describing roll control and yaw movement control). “The whole close loop calculus is performed at each moment in real time” and can be “performed in one step.” *Id.* ¶¶ 119, 120.

b) Kroo (Ex. 1006)

Kroo “focuses on mesoscale systems—devices larger than microscopic, yet significantly smaller than conventional air vehicles.” Ex. 1006, 15.³ Kroo also describes prototypes with motors driven by batteries. *Id.* at 18–20, 24–26, Figs. 2, 5. Kroo’s “initial devices consist of electrically driven rotors with energy stored in batteries.” *Id.* at 17. According to Kroo, “identifying very small batteries suitable for mesiopter . . . is not easy” (*id.* at 19), a “second prototype . . . can utilize existing batteries” (*id.* at 20), and a “more convenient approach involves the use of fewer cells . . . for the available motors” (*id.* at 25). Also, Kroo’s “rotorcraft flies using commercial lithium-ion batteries and is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter.” *Id.* at 26.

³ This decision refers to exhibit page numbers added by Petitioner. Petitioner also cites to those numbers in its arguments.

c) Nagamitsu (Ex. 1010)

Nagamitsu relates to a simulator. Ex. 1010, 1:8. Figure 4 of Nagamitsu is reproduced below.

FIG. 4

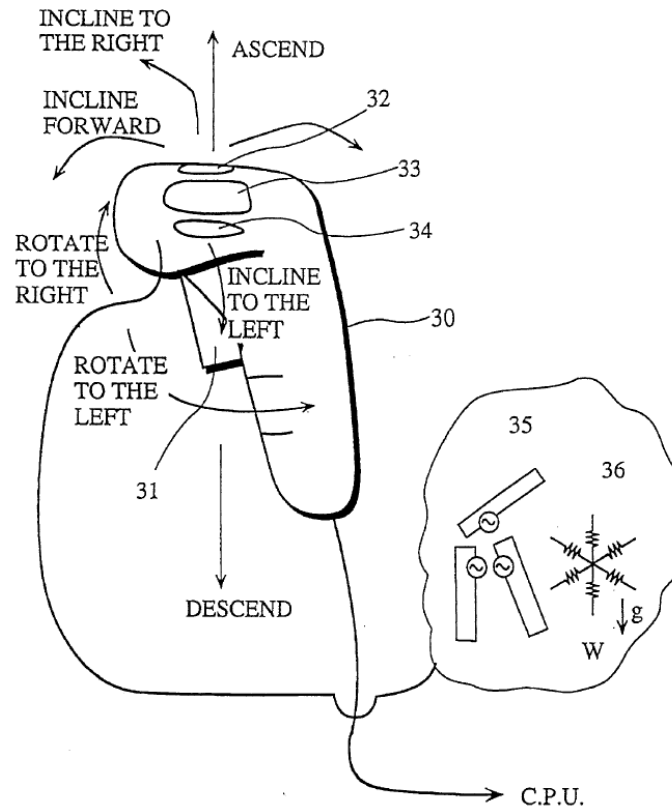


Figure 4 shows 3-D input unit 30. *Id.* at 10:41–43, 12:10–11. Input unit 30 “is of a configuration similar to a grip of a pistol” and “a magnetism detecting pointer 35 and an accelerometer 36 are installed therein for each direction in 3-D.” *Id.* at 12:12–13, 12:18–19. Nagamitsu explains:

By comparing the strengths of the three directions in the magnetic field detected by the magnetism detecting pointer 35 and detecting a[] direction of the gravity and acceleration by the accelerometer 36, the changes of rotational angles, movements, or acceleration of the 3-D input unit 30 with respect to the magnetic field indicated by arrows in FIG. 4 can be detected.

Id. at 12:20–26.

In a described example, a user can incline 3-D input unit 30 forward, to move forward in a simulator and can rotate 3-D input unit 30 to the right by twisting the wrist in that direction to view something to the right in a simulator. *See id.* at 15:25–32.

d) Hall (Ex. 1014)

Hall “relates to a smart device which senses changes to its own position and/or orientation, and transmits this information in a signal, which can be used to control . . . other features of an external device such as a[n] . . . electromechanical mechanism.” Ex. 1014 Abstract; *see also id.* at 1:6–11 (stating that Hall “relates to the field of position and orientation-sensing devices,” specifically, “a low cost, semiconductor, position and orientation-sensing circuit designed for communication of spatial coordinate data to other electronic devices for internal or external control of such devices”), 4:3–6 (stating that Hall “relates to a simplified version of an orientation and position smart sensor embedded into a handheld remote pointer or mouse adapted for use as a cursor or object control device”).

Hall’s device includes “intelligent interface software allowing for the use of a flexible, thinfilm, piezoelectric, pressure sensitive type button.” *Id.* at 4:15–17; *see also id.* at 4:39–44 (stating that “embedded intelligence melding herein conatates a fusion of semiconductor Hall-effect sensing and thinfilm piezoelectric effect technology to provide solutions to recognized problems occurring in the remote control of electronic devices”).

The preferred embodiment allows a user to point by hand movement to an icon on a video overlay to select an operation or function. *Id.* at 4:55–59; *see also id.* at 6:42–46 (stating that a “handheld, smart, remote-control, pointing and object orienting device 13 with six degrees of freedom in a Cartesian system” are primarily described).

Hall uses “semiconductor Hall-effect sensing and thinfilm piezoelectric effect technology” to determine multiple degrees of freedom within an orientation sensing remote control device, such as “yaw, pitch, and roll around the three axis.” *Id.* at 4:41–49, 5:1–3. According to Hall, the “fusion of semiconductor Hall-effect and thinfilm piezoelectric effect technology, allows for flexibility in the design of a more ergonomic, handheld device for any relevant remote sensing or control application.” *Id.* at 4:20–24. “Since the device uses the Earth’s magnetic field and gravity, orientation sensing is absolute.” *Id.* at 5:3–5. Figure 2 of Hall is reproduced below.

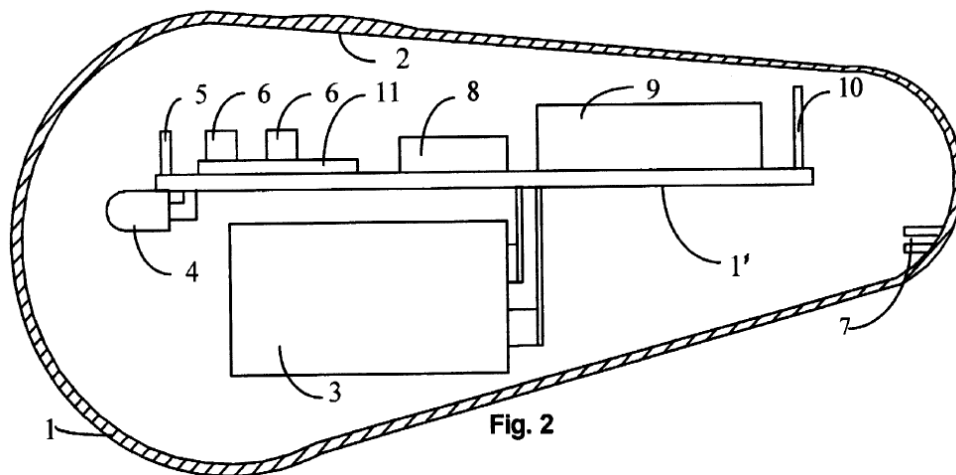


Figure 2 shows a cut-away view of Hall’s device. *Id.* at 5:62–63, 6:52–53. Within casing 1 are button 2, battery 3, and light emitting diode (“LED”) 4. *Id.* at 6:57–59. “It would be obvious to anyone skilled in the art that any wireless transmitter could be substituted for the LED” that “acts as the link between the device and a receiver mounted in the interactive control unit, TV, or computer.” *Id.* at 6:65–7:1.

Pairs of Hall-effect sensors 5, 6 are mounted 90° apart, and “[t]hese are the principle sensors providing the primary yaw, pitch and roll angular detection and bearing sensing capability of the device with some assistance

from the piezoelectric pairs 9, 10, and 11.” *Id.* at 7:3–10. Microprocessor 8 interprets signals from sensors 5, 6 and button 2 to relay control signals via LED 4. *Id.* at 7:10–12; *see also id.* at 7:55–60 (stating that “[s]ignals from the Hall-Effect 14 & piezoelectric 15 sensors . . . are transmitted to the onboard processor 17” and “resultant control signal 18 is then relayed via the infrared transmitter 19 to the remote receiver”), Fig. 7.

Piezoelectric pairs 9, 10, 11 “work together to form a three dimensional vector-point plot” and “provide some measure of orientation sensing whichever way the device is rotating.” *Id.* at 7:12–22. “The Hall-effect and piezoelectric sensors work in conjunction to provide sensing in all 6 degrees of freedom needed to position a cursor on a TV screen for selecting viewing options or for operating a control panel in a virtual reality environment.” *Id.* at 7:22–26. “Thinfilm, piezoelectric sensors, which have been constructed to work as accelerometers, are force sensing devices capable of determining minute changes in G-force making acceleration measurement possible.” *Id.* at 9:20–23.

Hall claims “a handheld, freespace, remote mouse” for “determining the device's own absolute orientation, thereby determining the orientation and direction of operatively associated physical objects.” *Id.* at 12:61–67.

2. *Analysis of Claim 13*

- a) *A method for configuring a hand-held controller to control a radio controlled (RC) drone remote from the hand-held controller*

Petitioner labels the preamble of claim 13 as “13[a]” (Pet. xii) and contends that Louvel teaches the preamble by referring to its arguments for recitations “1[a], [d]” of claim 1 (*id.* at 73 (citing Ex. 1003 ¶ 146)). *See also id.* at ix–x (assigning labels to the limitations of claim 1).

The label “1[a]” corresponds to a “method for operating a radio controlled (RC) flying hovercraft using an RC controller separate and remote from the RC flying hovercraft, the method comprising.” *Id.* at ix. For “1[a],” Petitioner relies on the Abstract and Figure 13 of Louvel and paragraphs 45–46 of its declarant testimony. *Id.* at 22–23.

For limitation 1[d] or “under control of a control system in the RC flying hovercraft that is responsive to radio frequency (RF) communications from the RC controller,” Petitioner relies on page 26 of Kroo and paragraphs 64–65 of its declarant testimony. *Id.* at 32–33.

Regardless of whether the preamble is limiting, Petitioner has shown that the recitation in the preamble is satisfied by the prior art. We find that the relied-upon portions of Louvel teach a “light aircraft, remotely supplied and remotely controlled, propelled by electrical motors” (Ex. 1004, Abstract) and an aircraft 1 shaped like a flying saucer linked to control unit 3 and handling unit 4 (*Id.* ¶¶ 25, 26, 124–127, Fig. 13); *see also id.* ¶ 9 (“The invention provides as well a method of controlling the flight of this device.”). We also find that the relied-upon portion of Kroo teaches that its “rotorcraft flies using commercial lithium-ion batteries and is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter.” Ex. 1006, 26. We further credit the testimony of Petitioner’s declarant regarding the preamble (Ex. 1003 ¶¶ 45–46 (limitation 1[a]), 64–65 (limitation 1[d]), 146 (applying the same testimony for claims 1 and 13)) because the record supports it. Ex. 1004, Abstract, Fig. 13.

Patent Owner does not present arguments specifically for a “method for configuring a hand-held controller to control a radio controlled (RC) drone remote from the hand-held controller.” *See generally* PO Resp.; PO Sur-Reply. Based on the full record before us, because Louvel teaches a

light aircraft remotely controlled and Kroo teaches a rotorcraft commanded from a radio-controlled transmitter, Petitioner persuades us that Louvel and Kroo teach a “method for configuring a hand-held controller to control a radio controlled (RC) drone remote from the hand-held controller.” *Cf.* ’1550 Final Dec. 18–20; ’1559 Final Dec. 19–20.

- b) wherein the RC drone is a quadcopter multi-rotor flying craft having four electrically powered motors, each motor driving at least one blade configured to provide aerodynamic lift for the quadcopter multi-rotor flying craft, a battery system operably coupled to the motors,*

Petitioner labels the above-quoted limitation of claim 13 as “13[b]” (Pet. xii) and contends that Louvel and Kroo teach the limitation by referring to its arguments for limitations “1[b]–[c]” of claim 1 (*id.* at 73 (citing Ex. 1003 ¶ 146)). *See also id.* at ix–x (assigning labels to the limitations of claim 1).

For limitation 1[b] or “providing an RC flying hovercraft having a set of generally downwardly directed thrusters,” Petitioner relies on Louvel’s Abstract; paragraphs 2–8, 29, 30, and 38; Figures 1, 3, and 13; and claim 9. *Id.* at 23–25. For limitation 1[c] or “each thruster including at least one blade driven by a battery powered motor to provide aerodynamic lift for the RC flying hovercraft,” Petitioner relies on Louvel’s Figures 1–3. *Id.* at 26, 31–32. Petitioner also relies on pages 17–20 and 24–26 and Figures 2 and 5 of Kroo for teaching batteries located in a hovercraft. *Id.* at 27–30, 32. Petitioner also points to paragraphs 50–63 of its declarant testimony. *Id.* at 26–27, 30–32.

We find that the relied-upon portions of Louvel teach that Louvel’s “system includes an aircraft, a control unit and a handling unit” (Ex. 1004 ¶ 8), the “aircraft has four propellers, each of them driven by an electric

motor” (*id.*), the “aircraft includes four propellers (10), (11), (12), (13) with vertical axis, that provides the lift thrust” (*id.* ¶ 29), “[e]ach propeller is driven independently by an electric motor” (*id.* ¶ 30), and “body (40) is a protection casing with grid-type areas that let the air flow go through the aircraft” (*id.* ¶ 38). Figures 1, 3, and 13 of Louvel show cable 2 linking aircraft 1 with control 3 and lines at the bottom of aircraft 1 indicating air being pushed downwardly.

We find that the relied-upon portions of Kroo teach that “initial devices consist of electrically driven rotors with energy stored in batteries” (Ex. 1006, 17), “identifying very small batteries suitable for mesiopter . . . is not easy” (*id.* at 19), a “second prototype . . . can utilize existing batteries” (*id.* at 20), and a “more convenient approach involves the use of fewer cells . . . for the available motors” (*id.* at 25). We further credit the testimony of Petitioner’s declarant regarding the above-quoted limitation (Ex. 1003 ¶¶ 47–49 (limitation 1[b]), 50–63 (limitation 1[c]), 146 (applying the same testimony for claims 1 and 13)) because the record supports it. Ex. 1004 Abstract, ¶¶ 29, 30, 38, Figs. 1–3, 13, claim 9; Ex. 1006, 17–20, 24–26, Figs. 2, 5; Ex. 1012, Fig. 50; Ex. 1013, Figs. 1–7; Ex. 1015.

Patent Owner does not present arguments specifically for this recitation of claim 13. *See generally* PO Resp. Based on the full record before us, because Louvel teaches an aircraft with four propellers driven by electric motors providing lift and because Kroo teaches electrically driven rotors using batteries, Petitioner persuades us that Louvel and Kroo teach “wherein the RC drone is a quadcopter multi-rotor flying craft having four electrically powered motors, each motor driving at least one blade configured to provide aerodynamic lift for the quadcopter multi-rotor flying

craft, a battery system operably coupled to the motors.” *Cf.* ’1550 Final Dec. 18–19; ’1559 Final Dec. 20–21.

- c) and a control system configured to automatically control a downwardly directed thrust produced by each motor and each motor’s at least one blade in response to control commands communicated by radio communications, the method comprising:*

Petitioner labels the above-quoted limitation as “13[c]” (Pet. xii) and argues that Louvel, Kroo, and Nagamitsu teach the limitation by referring to its arguments for limitations “1[b]–[i]” of claim 1 (*id.* at 73 (citing Ex. 1003 ¶ 146)). *See also id.* at ix–x (assigning labels to the limitations of claim 1). We summarize above Petitioner’s arguments for limitations “1[b],” “1[c],” and “1[d].” *See id.* at 23–32.

For limitation “1[e]” or “causing an RF receiver in the control system in the RC flying hovercraft to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft,” Petitioner relies again on page 26 of Kroo (Pet. 36) and descriptions related to Figure 4 of Nagamitsu (*id.* at 37–38 (citing Ex. 1010, 12:10–30, 15:25–46, Fig. 4)).

Limitation “1[f]” corresponds to

wherein the desired orientation communicated by the RC controller is determined based on a handheld structure housing a sensor system in the RC controller that senses a gravitational reference and at least a two dimensional, two-axis sensed orientation of the handheld structure with respect to said gravitational reference as a result of a user, remote from the RC flying hovercraft, selectively orienting the handheld structure.

Petitioner relies on Nagamitsu for teaching limitation “1[f].” Pet. 39–44 (citing Ex. 1010, 12:10–30, Fig. 4).

As discussed above, the relied-upon portion of Kroo teaches that its “rotorcraft . . . is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter.” Ex. 1006, 26.

We find that Figure 4 of Nagamitsu shows 3-D input unit 30. Ex. 1010, 12:10–11, Fig. 4. We also find that the relied-upon portions of Nagamitsu teach “magnetism detecting pointer 35 and an accelerometer 36 are installed therein for each direction in 3-D” (*id.* at 12:17–19) and that

[b]y comparing the strengths of the three directions in the magnetic field detected by the magnetism detecting pointer 35 and detecting a[] direction of the gravity and acceleration by the accelerometer 36, the changes of rotational angles, movements, or acceleration of the 3-D input unit 30 with respect to the magnetic field indicated by arrows in FIG. 4 can be detected (*id.* at 12:20–26). Nagamitsu further teaches that inclining and rotating 3-D input unit 30 causes a corresponding forward movement and rotation, respectively, in a simulator. *Id.* at 15:25–46.

For limitation “1[g]” or “causing a sensor system in the control system of the RC flying hovercraft to dynamically sense a gravitational reference for the RC flying hovercraft and determine an actual orientation of the RC flying hovercraft,” Petitioner relies on Louvel. Pet. 46–48 (citing Ex. 1004 ¶¶ 42–46, 75–78, 91, 94–95, 119–121, Fig. 4).

We find that the relied-upon portions of Louvel teach that Louvel’s “aircraft is fitted with three attitude sensors whose purpose is to provide information for the closed loop control” (Ex. 1004 ¶ 42) and has “two tilt sensors” (*id.* ¶ 43), “yaw movement sensor (63)” (*id.* ¶¶ 75, 78), “roll sensor (61)” (*id.* ¶ 76), and “pitch sensor (62)” (*id.* ¶ 77). Louvel also teaches that “[w]hen there is no action on the handle, the control loop uses the data coming from the various sensors (61), (62) and (63) to converge towards the

horizontal normal attitude of the aircraft and to cancel the yaw movement.”
Id. ¶ 91. Figure 4 of Louvel shows the arrangement of these sensors.

According to Louvel, “[w]hen there is an action on the handle (7), the microcontroller corrects the present required values driven in each electric current to generate an imbalance in the direction required by the handle position” and the “imbalance is limited by the microcontroller calculation in order to limit the displacement speed of the aircraft and also in order to allow a quick stabilization as soon as the action on the handle stops.” *Id.* ¶ 93. “The whole close loop calculus is performed at each moment in real time” and can be “performed in one step.” *Id.* ¶¶ 119, 120.

For limitation “1[h]” or “the sensor system including at least a three-dimensional, three-axis sensor,” Petitioner relies on Louvel. Pet. 48–49 (citing Ex. 1004 ¶¶ 42–46, 75–78, Fig. 4). As discussed above, we find that the relied-upon portions of Louvel teach three attitude sensors and two tilt sensors (Ex. 1004 ¶¶ 42–46) and roll sensor 61, pitch sensor 62, and yaw movement sensor 63 (*id.* ¶¶ 75–78), all of which are shown in Figure 4 of Louvel.

Limitation “1[i]” corresponds to

causing the control system in the RC flying hovercraft to automatically and dynamically control a thrust produced by each of said thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in response to the desired orientation communicated to the RC flying hovercraft by the RC controller and the actual orientation determined by the sensor system in the RC flying hovercraft without any additional communications being required for the user to control moment-to-moment balance and stabilization of the RC flying hovercraft.

Petitioner relies on Louvel for teaching limitation “1[i]”. Pet. 49–50 (citing Ex. 1004 ¶¶ 96–119).

We find that the relied-upon portions of Louvel teach how Louvel has pitch control (Ex. 1004 ¶¶ 96–98), roll control (*id.* ¶¶ 99–102), yaw control (*id.* ¶¶ 103–106), and attitude correction (*id.* ¶¶ 107–108) through changing the speed of propellers 10–13. We also find that the relied-upon portions of Louvel teach how moving the handle of a handling unit 7 affects the speed of the propellers 10–13 of Louvel’s aircraft. *Id.* ¶¶ 109–119.

We further credit the testimony of Petitioner’s declarant regarding how the asserted references teach the limitations (Ex. 1003 ¶¶ 47–49 (limitation 1[b]), 50–63 (limitation 1[c]), 64–65 (limitation 1[d]), 75–78 (limitation 1[e]), 82–86 (limitation 1[f]), 93–96 (limitation 1[g]), 97–98 (limitation 1[h]), 99–102 (limitation 1[i]), 146 (applying the same testimony for claims 1 and 13)) because the record supports it. Ex. 1004 Abstract, ¶¶ 29, 30, 38, 42–46, 75–78, 91, 96–121, Figs. 1–3, 13, claim 9; Ex. 1006, 17–20, 24–26, Figs. 2, 5; Ex. 1010, 12:10–30, 15:25–46, Fig. 4; Ex. 1012, Fig. 50; Ex. 1013, Figs. 1–7; Ex. 1015.

Patent Owner does not present arguments specifically for this recitation of claim 13. *See generally* PO Resp.; PO Sur-Reply. Based on the full record before us, because Louvel teaches how to control pitch, roll, yaw, and attitude by changing propeller speed and because Kroo teaches that a rotorcraft commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter, Petitioner persuades us that Louvel and Kroo teach “a control system configured to automatically control a downwardly directed thrust produced by each motor and each motor’s at least one blade in response to control commands communicated by radio communications.” *Cf.* ’1550 Final Dec. 30–31; ’1559 Final Dec. 21–22.

- d) providing software that is configured to be used by a battery-powered microprocessor system in the handheld controller*

Petitioner labels the above-quoted limitation as “13[d]” (Pet. xiii) and argues that Hall teaches this limitation of claim 13 (*id.* at 74–76 (citing Ex. 1003 ¶¶ 147–150; Ex. 1014, 4:3–24, 4:39–44, 4:51–58, 5:26–31, 6:58–61, 7:55–60, Figs. 2, 7)).

We find that the relied-upon portions of Hall teach an “intelligent interface software allowing for the use of a flexible, thinfilm, piezoelectric, pressure sensitive type button” (Ex. 1014, 4:15–17) and that “[s]ignals from the Hall-Effect 14 & piezoelectric 15 sensors or the pressure-sensitive button switch 16 are transmitted to the onboard processor 17” so that the “resultant control signal 18 is then relayed via the infrared transmitter 19 to the remote receiver” (*id.* at 7:55–60). We also find that Figure 2 of Hall shows that within Hall’s casing 1 are battery 3 and microprocessor 8 and Figure 7 of Hall shows processor 17.

We further credit the testimony of Petitioner’s declarant regarding “providing software that is configured to be used by a battery-powered microprocessor in the handheld controller” (Ex. 1003 ¶¶ 146 (applying the same testimony for claims 1 and 13), 147–150) because the record supports it. Ex. 1014, 4:3–24, 4:39–44, 4:51–58, 5:26–31, 6:58–61, 7:55–60, Figs. 2, 7.

Patent Owner does not present arguments specifically for this recitation of claim 13. *See generally* PO Resp.; PO Sur-Reply. Based on the full record before us, because Hall teaches that there is an intelligent interface software for a pressure sensitive button, a signal from such a button is transmitted to processor 17, and microprocessor 8 is housed with battery 3 in casing 1, Petitioner persuades us that Hall teaches “providing software

that is configured to be used by a battery-powered microprocessor system in the handheld controller.” Cf. ’1550 Final Dec. 18–20; ’1559 Final Dec.

- e) and is configured to control the RC drone by radio communications that include control commands corresponding to a desired orientation of the RC drone based on a sensor system in the hand-held controller that is configured to sense a gravitational reference and a relative tilt of the hand-held controller with respect to the gravitational reference as a result of the user selectively orienting the hand-held controller,*

Petitioner labels the above-quoted limitation as “13[e]” (Pet. xiii) and argues that Louvel, Kroo, and Nagamitsu teach the limitation by referring to its arguments for “1[b]–[i]” of claim 1 (*id.* at 73 (citing Ex. 1003 ¶ 146)). *See also id.* at ix–x (assigning labels to the limitations of claim 1). Petitioner additionally relies on further teachings of Nagamitsu. *Id.* at 77–81 (citing Ex. 1003 ¶¶ 154–157; Ex. 1010, 12:5–7, 12:30–13:9, 14:34–54, Figs. 3, 5, 7).

We summarize above Petitioner’s arguments for limitations “1[b]” through “1[i].” Pet. 23–33, 36–44, 46–50. We find that the relied-upon portions of Louvel teach how to control pitch, roll, yaw, and attitude by changing propeller speed (Ex. 1004 ¶¶ 96–119) and a relied-upon portion of Kroo teaches that a rotorcraft is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter (Ex. 1006, 26).

We also find that the relied-upon portions of Nagamitsu teach “magnetism detecting pointer 35 and an accelerometer 36 are installed therein for each direction in 3-D” (Ex. 1010, 12:17–19) and that “[b]y comparing the strengths of the three directions in the magnetic field detected by the magnetism detecting pointer 35 and detecting a[] direction of the gravity and acceleration by the accelerometer 36, the changes of rotational angles, movements, or acceleration of the 3-D input unit 30 with respect to

the magnetic field indicated by arrows in FIG. 4 can be detected.” *Id.* at 12:20–26. We additionally find that Nagamitsu teaches:

by inclining the 3-D beam unit 30 called the 3-D mouse in each direction as shown in FIG. 4, the rotation angle information is inputted into the 3-D space moving speed vector computation unit 133 via the input control unit 130 in the computation control unit 13, and a moving speed and a direction of the walk-through and hence the location of the eyes from the starting point are calculated depending on the degrees and direction of the rotation angle.

Id. at 14:46–54.

We further credit the testimony of Petitioner’s declarant regarding how the asserted references teach the limitations (Ex. 1003 ¶¶ 47–49 (limitation 1[b]), 50–63 (limitation 1[c]), 64–65 (limitation 1[d]), 75–78 (limitation 1[e]), 82–86 (limitation 1[f]), 93–96 (limitation 1[g]), 97–98 (limitation 1[h]), 99–102 (limitation 1[i]), 146 (applying the same testimony for claims 1 and 13)) because the record supports it. Ex. 1004 Abstract, ¶¶ 29, 30, 38, 42–46, 75–78, 91, 96–121, Figs. 1–3, 13, claim 9; Ex. 1006, 17–20, 24–26, Figs. 2, 5; Ex. 1010, 12:10–30, 15:25–46, Fig. 4; Ex. 1012, Fig. 50; Ex. 1013, Figs. 1–7; Ex. 1015.

Patent Owner does not present arguments specifically for this recitation of claim 13. *See generally* PO Resp.; PO Sur-Reply. Patent Owner, however, proposes interpretations for “orientation,” “sense a gravitational reference,” and “tilt,” all of which appear in this limitation. PO Resp. 16–17. Even under Patent Owner’s proposed interpretation of “orientation” to mean “angular displacement of a body coordinate frame relative to a reference coordinate frame, which for the ’292 patent is an inertial reference that uses gravity as a reference” (PO Resp. 16), we find that one of ordinary skill in the art would have understood that Nagamitsu

teaches such an orientation (Ex. 1010, 12:20–26). Under the proposed interpretation of “sense a gravitational reference” to mean “dynamically sense an inertial gravitational reference for use as an inertial reference that essentially provides an inert, non-moving reference coordinate frame that uses gravity as the reference” (PO Resp. 17), we find that one of ordinary skill in the art would have understood that Nagamitsu teaches sensing a gravitational reference (Ex. 1010, 12:20–26). Under the proposed interpretation of “tilt” to mean “the set of angles of a body within a reference coordinate frame” (PO Resp. 16), we find that one of ordinary skill in the art would have understood that Nagamitsu teaches tilt (Ex. 1010, 12:20–26).

Based on the full record before us, because Kroo teaches a radio-controlled transmitter commanding a rotorcraft and because Nagamitsu teaches a 3-D mouse that includes magnetism detecting pointer 35 and accelerometer 36 and that detects a direction of gravity to determine changes in angles, movements, and acceleration to change moving speed and direction, Petitioner persuades us that Kroo and Nagamitsu teach software

configured to control the RC drone by radio communications that include control commands corresponding to a desired orientation of the RC drone based on a sensor system in the hand-held controller that is configured to sense a gravitational reference and a relative tilt of the hand-held controller with respect to the gravitational reference as a result of the user selectively orienting the hand-held controller.

Cf. ’1550 Final Dec. 20–29; ’1559 Final Dec. 26–28.

- f) wherein the RC drone is configured to be remotely controlled by radio communications with the hand-held controller so as to position the RC drone in the desired orientation based on the control system of the RC drone determining a gravitational reference for the RC drone and a sensed orientation of the RC drone and controlling a speed of each of the motors to position the RC drone in response to the control commands corresponding to the desired orientation.*

Petitioner labels the above-quoted limitation as “13[f]” (Pet. xiii) and argues that Louvel, Kroo, and Nagamitsu teach the limitation by referring to its arguments for claim 1 (*id.* at 74 (asserting arguments for limitations “1[b]–[i]” against limitation “13[f]”) (citing Ex. 1003 ¶ 146)). *See also id.* at ix–x (assigning labels to the limitations of claim 1).

We summarize above Petitioner’s arguments for limitations “1[b]” through “1[i].” Pet. 23–33, 36–44, 46–50. We find that the relied-upon portions of Louvel teach controlling pitch, roll, yaw, and attitude by changing propeller speed (Ex. 1004 ¶¶ 96–119) and that “[w]hen there is no action on the handle, the control loop uses the data coming from the various sensors (61), (62) and (63) to converge towards the horizontal normal attitude of the aircraft and to cancel the yaw movement” (*id.* ¶ 91). We also find that a relied-upon portion of Kroo teaches that a rotorcraft is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter. Ex. 1006, 26.

We further credit the testimony of Petitioner’s declarant regarding how the asserted references teach the limitations (Ex. 1003 ¶¶ 47–49 (limitation 1[b]), 50–63 (limitation 1[c]), 64–65 (limitation 1[d]), 75–78 (limitation 1[e]), 82–86 (limitation 1[f]), 93–96 (limitation 1[g]), 97–98 (limitation 1[h]), 99–102 (limitation 1[i]), 146 (applying the same testimony for claims 1 and 13)) because the record supports it. Ex. 1004 Abstract,

¶¶ 29, 30, 38, 42–46, 75–78, 91, 96–121, Figs. 1–3, 13, claim 9; Ex. 1006, 17–20, 24–26, Figs. 2, 5; Ex. 1010, 12:10–30, 15:25–46, Fig. 4; Ex. 1012, Fig. 50; Ex. 1013, Figs. 1–7; Ex. 1015.

Patent Owner does not present arguments specifically for this recitation of claim 13. *See generally* PO Resp.; PO Sur-Reply. Patent Owner, however, proposes interpretations for “orientation” and “position.” PO Resp. 16. Under Patent Owner’s proposed interpretation of “orientation” to mean “angular displacement of a body coordinate frame relative to a reference coordinate frame, which for the ’292 patent is an inertial reference that uses gravity as a reference” (PO Resp. 16), we find that one of ordinary skill in the art would have understood that Louvel teaches such an orientation (Ex. 1004 ¶ 91). Under the proposed interpretation of the verb “position” to mean “a translation of a body from one state to another state” (PO Resp. 16), we find that one of ordinary skill in the art would have understood that Louvel teaches such positioning (Ex. 1004 ¶ 91).

Based on the full record before us, because Louvel teaches changing orientation by changing propeller speed and converging to a horizontal, normal attitude and because Kroo teaches a radio-controlled transmitter commanding a rotorcraft, Petitioner persuades us that Louvel teaches

RC drone is configured to be remotely controlled by radio communications with the hand-held controller so as to position the RC drone in the desired orientation based on the control system of the RC drone determining a gravitational reference for the RC drone and a sensed orientation of the RC drone and controlling a speed of each of the motors to position the RC drone in response to the control commands corresponding to the desired orientation.

Cf. ’1550 Final Dec. 29–31; ’1559 Final Dec. 22–26, 31–33.

g) Rationale

(1) Analogous Art

Petitioner states that the “art to which the ’292 patent is directed is the field of remote control aircraft.” Pet. 5 (citing Ex. 1003 ¶ 27). Petitioner also contends that Louvel, Kroo, and Nagamitsu are in the same field of endeavor. *Id.* at 44 (citing Ex. 1003 ¶ 88; Ex. 1014, 15:44–46, 16:24–25).

Patent Owner disputes “attempts in the Petition to characterize the field of endeavor as a more general field of ‘controlling remote objects’ or ‘control of a remote device.’” PO Resp. 13–14 (citing Pet. 44, 59, 69, 71). Patent Owner asserts that “the field of endeavor to which the ’292 patent pertains is the field of remote-control aircraft.” *Id.* at 14 (citing Ex. 2015 ¶¶ 41–43, 165; Ex. 2016, 2–6, 29).

To determine if a prior art reference is analogous, one must consider “(1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor’s endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.” *In re Clay*, 966 F.2d 656, 658 (Fed. Cir. 1992). “A reference is reasonably pertinent if, even though it may be in a different field from that of the inventor’s endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor’s attention in considering his problem.” *Id.* at 659.

The parties agree that the ’292 patent is in the field of remote controlled aircraft. Pet. 5; PO Resp. 14. Louvel states that it “relates to a light aircraft, like a flying saucer, remotely controlled and remotely powered, able to perform stationary flight and to move in the three directions.” Ex. 1004 ¶ 1. Based on the full record, Petitioner persuades us

that Louvel is analogous art because Louvel is in the parties' agreed to field of remote controlled aircraft.

Kroo "focuses on mesoscale systems—devices larger than microscopic, yet significantly smaller than conventional air vehicles." Ex. 1006, 15. Kroo also teaches that its "rotorcraft . . . is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter." *Id.* at 26. Based on the full record, Petitioner persuades us that Kroo is analogous art because Kroo is in the same field of remote controlled aircraft.

Nagamitsu "relates to a simulator" (Ex. 1010, 1:8), wherein inclining and rotating 3-D input unit 30 causes a corresponding forward movement and rotation, respectively, in a simulator (*id.* at 15:25–46), and Hall "relates to the field of position and orientation-sensing devices" (Ex. 1014, 1:6–7). Based on the full record, we determine that Nagamitsu and Hall are reasonably pertinent to the particular problem with which the inventors of the '292 patent are involved because these references logically would have commended themselves to the inventors' attention in considering a problem of the '292 patent, such as the need for "a heavier-than-air flying craft that has the ability to hover and to perform vertical air movements like a conventional model helicopter, yet is easier to operate" (Ex. 1001, 6:20–23). We also credit the testimony of Petitioner's declarant because the record supports it. Ex. 1003 ¶ 88 (citing Ex. 1010, 15:44–46, 16:24–25). Thus, based on the full record, Petitioner persuades us that one of ordinary skill in the art would have looked to Nagamitsu and Hall.

(2) Reason to Combine Louvel with Kroo

Petitioner argues that one of ordinary skill in the art "would have been motivated to combine the on-board battery system described in Kroo with

Louvel’s flying hovercraft” because the proposed combination “would enhance the user’s experience by eliminating the need for a user to carry around a separate battery pack.” Pet. 33 (citing Ex. 1003 ¶¶ 67–68); *see also id.* at 36 (citing Ex. 1003 ¶ 74). Petitioner also argues that one of ordinary skill in the art “would have been motivated to combine the RF technology disclosed in Kroo into the Louvel system to eliminate Louvel’s restrictive tether” and “[t]o further increase a user’s mobility.” *Id.* at 34 (citing Ex. 1003 ¶ 69). Petitioner cites Exhibits 1012, 1013, and 1015 to provide support for the assertion that one of ordinary skill in the art would have combined Kroo with the other asserted references. *Id.* at 30–31.

Petitioner further argues that one of ordinary skill in the art:

would have recognized that Kroo’s internal battery system was an improvement over the hip-carried battery pack of Louvel, and would have been motivated to adopt Kroo’s internal battery system to increase a user’s freedom of movement (eliminating the battery’s extra weight and the wiring between the battery, controller and/or aircraft that may get tangled) which would enhance the user’s experience

Id. at 34. Petitioner contends that, “[f]or the same reasons,” the ordinarily skilled artisan “would have been motivated to incorporate Kroo’s wireless, RF technology in Louvel’s hovercraft.” *Id.*

Patent Owner disputes the Petitioner’s declarant’s assumptions “as to what knowledge and motivations a person of ordinary skill would have possessed and the state of the art as of the time of invention in 2002-2003 with respect to the art of remote-control model aircraft and the field of endeavor of remote-control aircraft.” PO Resp. 14 (citing Ex. 2015 ¶¶ 45–49).

Based on the full record, Petitioner persuades us that one of ordinary skill in the art would have been motivated to include the on-board battery

system and RF technology of Kroo into Louvel because the combination “would enhance the user’s experience by eliminating the need for a user to carry around a separate battery pack,” “eliminate Louvel’s restrictive tether” and “further increase a user’s mobility.” Pet. 33–34 (citing Ex. 1003 ¶¶ 67–69). Petitioner also persuades us that one of ordinary skill in the art would have had a reasonable expectation of success in combining Louvel and Kroo. Ex. 1006, 26; *see also* Pet. 35 (discussing Ex. 1006, 26).

Regarding Patent Owner’s argument, Louvel and Kroo indicate what one of ordinary skill in the art would have known in the field of remote-controlled aircraft before 2002. Moreover, Patent Owner’s declarant, other than citing where Petitioner’s declarant provided testimony, does not indicate where in record support can be found for Patent Owner’s declarant testimony. *See* Ex. 2015 ¶¶ 45–49. Based on our findings, Petitioner shows that one of ordinary skill in the art would have had reasons to combine Louvel and Kroo. *See* Pet. 33–34.

(3) Reason to Combine Louvel as Modified by Kroo with Nagamitsu and Hall

Regarding Nagamitsu, Petitioner contends that one of ordinary skill in the art “would have been motivated to incorporate Nagamitsu’s orientation determination/control capabilities into the hovercraft of Louvel adapted to use the wireless transmission taught by Kroo.” Pet. 38 (citing Ex. 1003 ¶ 79). Petitioner also contends that implementing Nagamitsu’s sensor scheme into the proposed combination of Louvel and Kroo would have been a simple, predictable substitution. *Id.* at 44–45 (citing Ex. 1003 ¶ 88). In particular, according to Petitioner, “[g]iven the advantages of Nagamitsu’s controller, namely, enhanced control of the aircraft based on the fine movements of the user, it would have been a simple modification . . . to

include the sensor scheme and associated circuitry disclosed by Nagamitsu's controller" in the proposed combination of Louvel, which teaches "a remote control for sending multi-dimensional orientation information to the flying structure," and Kroo, which teaches "transmitting control data from the controller to the controlled device," "to achieve a predictable result." *Id.* (referring to arguments at Pet. 32–33 for limitations "1[d]") (citing Ex. 1003 ¶ 88; Ex. 1004 ¶¶ 50–53, Fig. 5). Petitioner contends that the addition of Nagamitsu's sensor scheme and microprocessor "would have enhanced the ability of the Louvel/Kroo combination to remotely control an aircraft with the more natural control and freedom of movement offered by Nagamitsu's tilt-operated remote controller." *Id.* at 45 (citing Ex. 1003 ¶¶ 89–90).

Petitioner also argues that "[t]here are a finite number of ways to remotely control an object," the asserted references "disclose similar remote controls," and "given the advantages of Nagamitsu's handling mechanism, *e.g.*, improved accuracy and more natural control, it would have been obvious to improve upon the controllers of Louvel and Kroo by incorporating Nagamitsu's sensor scheme into the proposed combination." *Id.* (citing Ex. 1003 ¶ 91). Petitioner further argues that Nagamitsu teaches a "hand-held remote control 'may depend on *only* the gravity'" and, thus, a "magnetic sensor is optional, not required." *Id.* at 46 (citing Ex. 1003 ¶ 92; Ex. 1010, 27:53–56; '1550 Final Dec. 56; '1559 Final Dec. 66–67).

Petitioner persuades us that one of ordinary skill in the art would have been motivated to combine Louvel as modified by Kroo "to include the sensor scheme and associated circuitry disclosed by Nagamitsu's controller" to "enhance[] the ability of the Louvel/Kroo combination to remotely control an aircraft with the more natural control and freedom of movement offered by Nagamitsu's tilt-operated remote controller." *See* Pet. 38, 44–45.

Petitioner also persuades us that including Nagamitsu's sensor scheme and associated circuitry in Louvel as modified by Kroo represents a simple substitution. *See* Pet. 44–45. We further credit Petitioner's declarant testimony regarding the reason to combine because the record supports it. Ex. 1003 ¶¶ 79, 88–90 (citing Ex. 1004 ¶¶ 50–53, Fig. 5).

Regarding Hall, Petitioner contends that one of ordinary skill in the art would have further modified the combination of Louvel, Kroo, and Nagamitsu with the teachings of Hall “to employ [] Hall's battery-powered microprocessor in the handheld remote.” Pet. 76. According to Petitioner, Hall's controller is compatible with Louvel's controller as modified by Nagamitsu because both are battery-powered, are handheld, use a microprocessor, and “determine[] ‘position and orientation’ by using a ‘circuit designed for communication of spatial coordinate data to other electronic devices for internal or external control of such device.’” *Id.* (quoting Ex. 1014, 1:5–11) (citing Ex. 1003 ¶¶ 151–152; Ex. 1010, 12:4–9, 12:30–37; Ex. 1014, 6:57–61, 7:55–60).

Petitioner also argues that Hall improves the modified Louvel controller by “plac[ing] Louvel's batteries and Nagamitsu's microprocessor system *in* the handheld controller” and the further modification “would have increased the usability of the controller by decreasing the number of required wires, decreased its complexity, and further afford the user greater freedom of movement.” *Id.* at 77 (citing Ex. 1003 ¶ 153). Petitioner contends that one of ordinary skill in the art “would have had to exercise no more than ordinary skill to further modify Louvel's controller according to the teachings of Hall.” *Id.* at 76.

Petitioner persuades us that one of ordinary skill in the art would have been motivated to combine Louvel as modified by Kroo and Nagamitsu “to

employ [] Hall’s battery-powered microprocessor in the handheld remote” (Pet. 76) and “would have increased the usability of the controller by decreasing the number of required wires, decreased its complexity, and further afford the user greater freedom of movement” (*id.* at 77). We credit Petitioner’s declarant testimony regarding the reason to combine and that the combination is within ordinary skill because it is consistent with the record. Ex. 1003 ¶¶ 152, 153 (citing Ex. 1010, 12:4–9, 12:30–37; Ex. 1014, 6:57–61, 7:55–60).

Patent Owner responds that Petitioner insufficiently shows that one of ordinary skill in the art would have used the air-mouse controller of Nagamitsu or Hall instead of the joystick of Louvel. PO Resp. 31, 32–39. Patent Owner argues that one of ordinary skill in the art would not have been motivated to look to air-mouse controllers or use such controllers in Louvel because, at the time of the invention, dual joystick RC controllers were the conventional, preferred, and primary way to control RC model aircraft. *Id.* at 32–33 (citing Pet. 45; Ex. 1003 ¶¶ 88–91; Ex. 2015 ¶¶ 172, 176).

As discussed above for analogous art, Petitioner persuades us that one of ordinary skill in the art would have looked to Nagamitsu and Hall because these references are reasonably pertinent to a problem that the inventors of the ’292 patent faced and logically would have commended themselves to the inventors’ attention in considering the problem. Louvel also indicates that a joystick like Louvel’s, not a dual joystick RC controller, was a way to control RC model aircraft. *See* Ex. 1004, Fig. 5. Moreover, Patent Owner’s declarant testimony does not point us to any evidence that supports that dual joystick RC controllers “dominated the RC model aircraft market at the time” or were “commonly used.” Ex. 2015 ¶¶ 172, 176.

Patent Owner also contends that “controlling a quadrotor aircraft in three dimensions was understood to be a complex problem” because of complex accelerometer technology, difficulties in implementing control schemes, and the challenge of sensing gravity. PO Resp. 33–34 (citing Ex. 2015 ¶¶ 26–27, 171). Patent Owner further contends that, at the relevant time period, the focus was on “getting the craft to be stable enough to be flown by a pilot-in-the-loop control scheme” so there would have been no motivation to introduce additionally a “different kind of RC controller for flying what is an inherently unstable aircraft.” *Id.* at 35 (citing Ex. 2015 ¶¶ 165, 172). Patent Owner also replies that Petitioner’s declarant could not identify any other prior art that used a mono-joystick controller like Louvel and admitted Hall does not control a remote device. PO Sur-Reply 9 (citing Pet. Reply 14; Ex. 2037, 55–57, 135), 11–12 (citing Ex. 2037, 28–30, 56–57).

We agree with Petitioner that “Louvel’s closed loop control system itself is already designed to handle any ‘complex’ physics and stabilizes the aircraft.” Pet. Reply 13 (citing Pet. 11–12, 47–48); *see also* Ex. 1004 ¶ 7 (“The invention is an aircraft, remotely controlled . . . whose characteristics enable this device to perform stationary flight and to perform controlled displacements in any of the three directions of space.”). We also agree with Petitioner that the “proposed combination does not modify Louvel’s hovercraft’s stabilization control—which would account for instability caused by the ‘real world’—the combination merely incorporates Nagamitsu’s sensor scheme into the Louvel-Kroo controller such that the orientation data sent to Louvel’s hovercraft is based on gravity.” Pet. Reply 13 (citing Pet. 44–46). Furthermore, Patent Owner’s declarant testimony

does not indicate where supporting evidence can be found. *See* Ex. 2015 ¶¶ 165, 171, 172.

Patent Owner also points to the “lack of widespread market adoption of air mouse controllers for computers and gaming . . . due to technical challenges” and the questionable advantage of substituting a more expensive air-mouse controller for the conventional controller for computer and gaming applications. PO Resp. 35 (citing Ex. 2019 ¶ 6; Ex. 2024 ¶ 10). Petitioner, however, proposes combining the sensor scheme and associated circuitry of Nagamitsu with Louvel as modified by Kroo, not replacing a game controller with an air mouse controller. The record also does not indicate that concerns with using an air-mouse controller in computer and gaming applications would have been understood by one of ordinary skill in the art to apply to Petitioner’s proposed combination.

According to Patent Owner, air mouse controllers were designed for computers and gaming and would need to be redesigned to incorporate 900MHz radio technology used in dual joystick RC controllers for RC model aircraft. PO Resp. 35–36 (citing Ex. 2015 ¶ 176). Louvel, however, does not have a dual joystick RC controller. Ex. 1004, Fig. 5. Petitioner also does not propose combining Louvel and Kroo so that it incorporates 900MHz radio technology. *See* Pet. 33–34; Pet. Reply 15. Even if it could be said that the proposed combination requires 900MHz radio technology, such a modification appears to be within the parties’ agreed-to level of ordinary skill in the art. *See* PO Resp. 14 (asserted level of ordinary skill).

Patent Owner disputes the Petitioner’s declarant’s assumptions “as to what knowledge and motivations a person of ordinary skill would have possessed and the state of the art as of the time of invention in 2002-2003 with respect to the art of remote-control model aircraft and the field of

endeavor of remote-control aircraft.” PO Resp. 14 (citing Ex. 2015 ¶¶ 45–49). Patent Owner argues that Petitioner’s declarant relied on what would have purportedly been known to one of ordinary skill in the art, acknowledged that using a horizontal reference is not a simple substitution for a gravitational reference, “admitted that there were significant differences between real-world physics and simulations,” and based his opinion on what could have been done, not what would have been done. *Id.* at 36–37 (citing Ex. 2015 ¶¶ 167, 168; Ex. 2016, 84:4–12, 101:10–19, 124:4–17, 131:3–9, 135:6–14).

Patent Owner also argues that Petitioner’s declarant uses hindsight in “presuming that the technical problem to be solved is how to create a tilt-to-fly RC controller for an RC control scheme for a quadrotor craft,” but “there was no awareness of this desire, nor any reason to focus on substituting a new kind of RC controller for the conventional dual joystick RC controllers that dominated the RC model aircraft market at the time” and the challenge at the time was “to stabilize the RC quadrotor craft sufficiently enough to allow skilled pilots to fly such a craft with pilot-in-the-loop controls.” *Id.* at 38 (citing Ex. 2015 ¶¶ 165, 172).

Patent Owner further argues that the “impermissible use of an obvious to try everything approach” prompts Petitioner’s declarant “to even consider the proposed combination.” *Id.* at 38. According to Patent Owner, Petitioner’s declarant “has provided no evidence that the prior art was pointing to directions that would likely be successful in term[s] of substituting other kinds of controllers for the convention[al] and well-accepted joystick controller for controlling RC model aircraft” and “fails to offer any evidence that a person skilled in the art of RC model aircraft would

even find general guidance about how to use a non-joystick controller for control of an RC quadrotor hovercraft as of 2002–2003.” *Id.* at 39.

Petitioner replies that Patent Owner mischaracterizes the deposition testimony of Petitioner’s declarant. Pet. Reply 16 (citing PO Resp. 36–39; Ex. 1003 ¶¶ 60, 68, 77–79, 87, 106, 114, 121, 129, 135, 145, 160; Ex. 1021 ¶¶ 60–65; Ex. 2016, 103:6–104:6, 131:3–9). Patent Owner replies that Petitioner only points to testimony of Petitioner’s declarant and no other evidence. PO Sur-Reply 10–11 (citing Ex. 2015 ¶¶ 27–40; Ex. 2017; Ex. 2021; Ex. 2022; Ex. 2023; Ex. 2031; Ex. 2032; Ex. 2033; Ex. 2037, 45, 56, 59–60, 102, 134, 138). Patent Owner also argues that Petitioner has the burden. *Id.* at 13.

As summarized above, Petitioner provides a motivation and reason for one of ordinary skill in the art to combine Louvel as modified by Kroo with Nagamitsu so that the sensor scheme and associated circuitry of Nagamitsu is included—to “enhance[] the ability of the Louvel/Kroo combination to remotely control an aircraft with the more natural control and freedom of movement offered by Nagamitsu’s tilt-operated remote controller.” *See* Pet. 38, 44–45. Regarding hindsight, Petitioner’s proposed combination does not modify any dual joystick RC controller, and even if Patent Owner’s argument were applied to Louvel as modified by Kroo, Petitioner provides a reason for modifying the Louvel-Kroo joystick further in view of Nagamitsu. *See id.* Petitioner’s reason is sufficient and does not require further direction or guidance from prior art to make the proposed combination, which the record indicates was within the level of ordinary skill in the art. Ex. 1004; Ex. 1010; Ex. 1014.

Patent Owner also responds that the Examiner of a related patent, U.S. Patent No. 9,645,580 (“the ’580 patent”), considered the Decisions to

Institute in IPR2016-01550 and IPR2016-01559. PO Resp. 41. Patent Owner argues that the Examiner's reasons for allowance of that related patent shows that Petitioner's proposed combination can only be the result of impermissible use of hindsight. *Id.* at 31, 39–42 (citing Ex. 2034, 5); PO Sur-Reply 21 (citing Ex. 2034, 5). Petitioner replies that the Examiner's reasons for allowance are irrelevant. Pet. Reply 18–19 (citing PO Resp. 41; Ex. 1016, 49; Ex. 1017, 53–54; Ex. 1018).

The record does not indicate that the Examiner of the '580 patent considered the evidence and arguments of this proceeding. The record also does not indicate that the scope of the claims of the challenged claims and the claims of the '580 patent are such that the reasons for allowance for the '580 patent can be applied to the challenged patents. *See also* '1550 Final Dec. 39–40 (reaching a similar determination).

Patent Owner further responds that the prior art taught away from Petitioner's proposed combination. PO Resp. 31–32, 42–43. According to Patent Owner, U.S. Patent No. 5,453,758 to Sato, issued September 26, 1995 (Ex. 2020, "Sato") teaches that "air-mouse controllers are more difficult to operate and, as a result, teaches away from using gravity as a reference." *Id.* at 42 (quoting Ex. 2020, 2:4–14). In particular, Patent Owner argues that Sato uses floating sensors that hold Sato's motion sensors still with respect to gravity and thus, do not sense relative tilt of Sato's controller, do not sense gravity to establish a gravitational reference, and avoids experiencing gravity. *Id.* at 42–43. Patent Owner, thus, contends that Sato criticizes, discredits, and discourages the claimed invention, and even if Sato expresses a general preference, Sato is relevant to determining if one of ordinary skill in the art would have been motivated to combine the asserted references. *Id.* at 43. Patent Owner additionally responds that there are no reasons for using

an air-mouse controller because an air-mouse controller does not have a “zero input,” such as Sato’s floating detection means. *Id.* at 44 (citing Ex. 2015 ¶¶ 173, 174). Petitioner replies that it does not rely on Sato and that Sato does not teach away from the proposed combination. Pet. Reply 19–20 (citing PO Resp. 42, 44; Ex. 1021 ¶¶ 66–67). Patent Owner replies that Sato indicates there was a problem with air-mouse controllers. PO Sur-Reply 12 (citing Pet. Reply 19).

We agree that Petitioner does not rely on Sato in its proposed combination. *See* Pet. 21–52, 73–81; Pet. Reply 19. We also do not understand Petitioner to be relying on Louvel, Kroo, Nagamitsu, and Hall for teaching anything similar to the “floating detection means” of Sato. *See* Pet. 21–52, 73–81. Even assuming Sato can be said to teach away in the manner Patent Owner asserts, Sato would allegedly teach away from using a “floating detection means,” which is not part of Petitioner’s proposed combination. *See* Pet. Reply 19.

We also agree with Petitioner that one of ordinary skill in the art would have been able to combine the references based on “zero input” and that “Louvel does not teach a ‘zero output,’ but instead describes providing a voltage level of ‘half of Vreg’ in neutral.” *See* Pet. Reply 20 (citing Ex. 1004 ¶ 83); Ex. 1004 ¶ 83 (“When there is no effort on the handle, the voltage supplied is half of Vreg.”).

Patent Owner additionally responds that “air-mouse controller patents such as *Nagamitsu* and *Hall* were cited numerous times within the field of computer control and video gaming systems,” but there are no such citations in the field of remote-control model aircraft or remote-control aircraft before 2002. PO Resp. 44 (citing Ex. 2015 ¶ 175). As discussed above, we determine that one of ordinary skill in the art would have looked to the

teachings of Nagamitsu and Hall. We also agree with Petitioner that a “discussion of forward citations is not a requirement in an obviousness analysis and is wholly irrelevant in this case.” Pet. Reply 21.

Patent Owner additionally responds that Petitioner insufficiently shows that one of ordinary skill in the art by substituting a different controller would or could change Louvel to an orientation control scheme. PO Resp. 32, 46–52. Patent Owner argues that Petitioner “fails to prove that by substituting a different RC controller a person skilled in the art would/could change the closed loop feedback for the pilot-in-the-loop type of control of the RC aircraft in *Louvel*” and a “control scheme where a user directly imparts an imbalance on the craft is not equivalent to a control scheme where a craft can achieve and selectively maintain the actual orientation of the craft in response to the desired orientation communicated by an RC controller.” *Id.* at 46 (citing Ex. 2015 ¶ 128); *see also* PO Sur-Reply 21–22 (presenting similar arguments). Patent Owner contends that Louvel teaches a closed control loop. PO Resp. 46–47 (citing Dec. to Inst. 18; Ex. 2015 ¶ 120; Ex. 2016, 135–150).

Petitioner replies that Patent Owner “mischaracterizes the proposed combination” and “Louvel’s control loop need not be changed in the proposed combination” because the “combination merely uses the sensor output of Nagamitsu to off-balance the aircraft in such a way as to mimic the controller’s orientation.” Pet. Reply 23. Petitioner argues that “Louvel already accepts sensor output based on the orientation of its controller handle with respect to its base.” *Id.*

Patent Owner replies that (i) Petitioner has the burden, (ii) the parties’ declarants “disagree on how the control loop of *Louvel* would behave in operation,” and (iii) Louvel’s craft would continue to rotate due to

imbalance signals because Louvel is a rate control system. PO Sur-Reply 13–14 (citing Pet. Reply 23; Ex. 1004 ¶¶ 93; Ex. 1021 ¶ 15; Ex. 2015 ¶¶ 71, 72, 120, 125, 128; Ex. 2016, 149:22–24; Ex. 2037, 84:12–13), 18. Patent Owner also argues Petitioner’s declarant gave inconsistent testimony and was confused as to how the proposed combination works. *Id.* at 15–16 (citing Ex. 1004 ¶¶ 20, 110–115, Fig. 9; Ex. 2015 ¶ 66; Ex. 2037, 118:24–119:1, 172:9–17, 179:24–180:23). Patent Owner further argues that Petitioner’s testimony is suspect. *Id.* at 16–17 (citing Ex. 2015 ¶¶ 165, 172; Ex. 2016, 124:4–17; Ex. 2037, 137).

As described above, Petitioner proposes further modifying the Louvel and Kroo combination “to include the sensor scheme and associated circuitry disclosed by Nagamitsu’s controller” to “enhance[] the ability of the Louvel/Kroo combination to remotely control an aircraft with the more natural control and freedom of movement offered by Nagamitsu’s tilt-operated remote controller.” *See* Pet. 38, 44–45. We do not understand Petitioner to be changing the control loop of Louvel in the proposed combination.

Patent Owner also asserts Petitioner’s declarant admitted that Louvel’s reference to accelerometers is not accurate and Louvel teaches using a horizontal reference, not sensing a gravitational reference. PO Resp. 47 (citing Ex. 1003 ¶¶ 31–32; Ex. 2016, 129:12–25, 130:19–23). Petitioner replies that Patent Owner mischaracterizes the testimony of Petitioner’s declarant. Pet. Reply 23–24 (citing PO Resp. 47; Ex. 1021 ¶¶ 47, 74–75; Ex. 2016, 129:4–131:9, 136:13–137:3). Based on our review, the testimony of Petitioner’s declarant regarding Louvel’s tilt sensors being accelerometers and gravitational reference finds support in the record. Ex. 1004 ¶¶ 42–45, 91, Figs. 6, 9; Ex. 2016, 129:4–131:9, 136:13–137:3.

Patent Owner argues that Louvel's remote control does not send multi-dimensional orientation information or a desired orientation and instead sends an imbalance to accelerate away from a preset ideal attitude. PO Resp. 47–48 (citing Pet. 45; Ex. 1003 ¶¶ 50–53, 93, 100, 112, 122, 123, Fig. 5). According to Patent Owner with support from Patent Owner's declarant testimony, Louvel's controller action and control scheme are similar to that described in Exhibit 2022, which describes a rolling motion by changing rotor power to preserve overall thrust, and Louvel describes a craft that is not stable when there is action on the handle of Louvel's controller. *Id.* at 48–52 (citing Ex. 1004 ¶¶ 76–77, 93, 120, Figs. 9, 10; Ex. 2015 ¶¶ 131–133, 135; Ex. 2016, 112:7–16).

Patent Owner lastly responds that the proposed combination of Louvel with Nagamitsu or Hall would not result in an orientation control scheme. PO Resp. 32, 52–57. In particular, Patent Owner argues that Petitioner's proposed combination “would not yield a solution in which the RC controller and the RC hovercraft implement an orientation control scheme.” *Id.* at 52. Louvel, according to Patent Owner, “automatically returns to a horizontal flat attitude” when there is no action on Louvel's joystick, and “if the entire controller is tilted sideways, nothing happens to the position of the craft because the position of the joystick relative to its base does not change.” *Id.* at 53. Patent Owner also argues that Nagamitsu and Hall “do not change the ideal attitude that is preset into the control circuitry (Fig. 9) or software (Fig. 10) of Louvel” because, when an air-mouse controller stops moving, no control signals are sent and Louvel's craft would go to its preset horizontal flat attitude. *Id.* at 53–54; *see also* PO Sur-Reply 22–23 (presenting similar arguments). Patent Owner further contrasts the control system of Louvel with the control system of the '292 patent to explain that

Louvel's craft assumes a horizontal position when its controller is angled and the '292 patent's craft maintains an orientation mimicking the controller. PO Resp. 54–57 (providing modified Figs. 1, 5 from Louvel and Fig. 2 from the '292 patent) (citing Ex. 2015 ¶¶ 106, 107).

Petitioner replies that Patent Owner “admits that when Louvel's handle is in neutral, the craft remains in neutral;” “admits that when Louvel's handle is moved, the aircraft's orientation changes to match the orientation of the handle;” “defines ‘position’ to include ‘orientation;’” and thus, “confirms that desired orientation information (*i.e.*, the orientation of the handle with respect to its base[]) is transmitted to the hovercraft.” Pet. Reply 24–25 (citing PO Resp. 16, 47–51; Ex. 1021 ¶¶ 76–78).

We agree with Petitioner that including Nagamitsu's sensor scheme and associated circuitry into Louvel as modified by Kroo would result in a change in the aircraft's orientation when the controller is moved. Patent Owner's arguments focus on when there is no action on the handle, but they do not address Petitioner's argument that moving the handle results in an orientation control scheme. *See* Pet. Reply 8–9 (arguing that claim 13 has “no requirement that the drone ‘continuously mimic’ the orientation of the remote control”).

Thus, based on the full record before us, Petitioner persuades us that one of ordinary skill in the art would have had a reason to combine Louvel as modified by Kroo with the teachings of Nagamitsu and Hall. Pet. 44–45, 76–77. Because Nagamitsu teaches a remote control with sensor and associated circuitry and Hall teaches a remote control with a microprocessor and software, Petitioner also persuades us that one of ordinary skill in the art would have had a reasonable expectation of success. Pet. 76.

F. Ground Based on Louvel, Kroo, Nagamitsu, Hall, and Gabai

1. Scope and Content of the Asserted Prior Art

Louvel, Kroo, Nagamitsu, and Hall are discussed above.

a) Gabai (Ex. 1008)

Gabai relates to “toys used in conjunction with a computer system.”

Ex. 1008 ¶ 1. Figure 56 of Gabai is reproduced below.

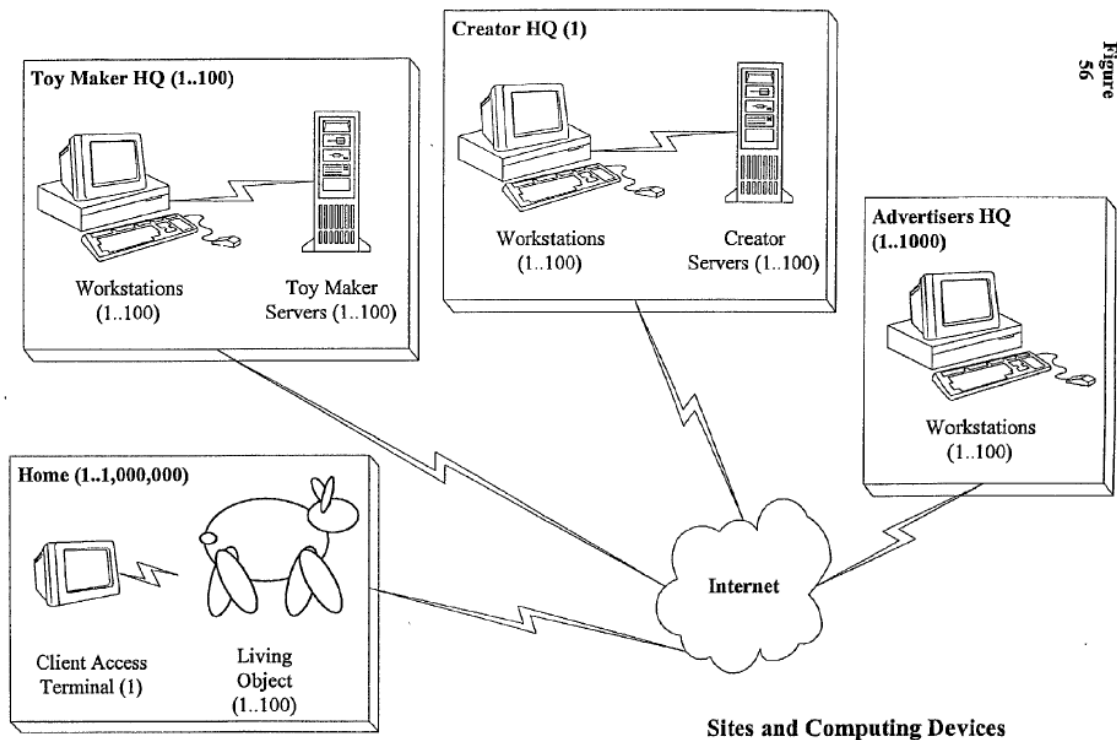


Figure 56 shows a Living Object Internet Service System (“LOIS”).

Id. ¶ 108. The computer system can transmit wireless signals that are received by toys to carry out an action. *Id.* ¶¶ 14–16, 116–120. Updates can be sent to the toys. *Id.* ¶¶ 59–60. Gabai states that “Software Updates . . . are the latest version of [Living Object Internet Service System] client software” that are “pushed and installed automatically.” *Id.* ¶ 692; *see also id.* ¶¶ 613–673 (describing the Living Object Internet Service System).

2. *Analysis of Claim 14*

Claim 14 depends directly from claim 13 and recites “wherein the RC drone is configured to be controlled by software executing in the RC drone, the method further comprising configuring the software used by the battery-powered microprocessor system in the hand-held controller to receive software updates from an Internet connection.” Ex. 1001, 18:7–12. For the reasons discussed above, Petitioner persuades us that Louvel, Kroo, Nagamitsu, and Hall teach the limitations of claim 13.

Petitioner contends that “Louvel discloses that its RC drone employs a control system that uses software loaded onto a microprocessor to control the RC drone,” “Hall discloses a battery-powered microprocessor system in a hand-held controller utilizing software,” and “Gabai discloses software updates from an internet connection.” Pet. 83–84 (referencing arguments for limitations “1[g]” and “13[d]” and arguments for a challenge based on Louvel, Kroo, Nagamitsu, and Gabai at Pet. 63–70) (citing Ex. 1003 ¶¶ 164–166; Ex. 1004 ¶¶ 119–121); *see also id.* at 63–66 (citing Ex. 1003 ¶¶ 122–128; Ex. 1004 ¶ 121; Ex. 1008 ¶¶ 15–16, 59–60, 116–120, 613–673, 691–692, 727, Figs. 1A, 41, 44, 56).

For claim 14, we find that the relied-upon portions of Louvel teach a closed-loop calculus (Ex. 1004 ¶¶ 119–121), the relied-upon portions of Hall teach a battery-power microprocessor and software (Ex. 1014, 4:15–17, 7:55–60, Fig. 2), and the relied-upon portions of Gabai teach software updates through the Internet (Ex. 1008 ¶¶ 15–16, 59–60, 116–120, 613–673, 691–692, 727, Figs. 1A, 41, 44, 56). We also credit Petitioner’s declarant testimony because it is consistent with the record. Ex. 1003 ¶¶ 122–128, 164–166. Patent Owner does not provide arguments specifically for claim 14. *See generally* PO Resp.; PO Sur-Reply.

Based on the full record and our findings summarized above, Petitioner persuades us that Louvel, Hall, and Gabai teach “wherein the RC drone is configured to be controlled by software executing in the RC drone, the method further comprising configuring the software used by the battery-powered microprocessor system in the hand-held controller to receive software updates from an Internet connection.”

a) Reason to Combine with Gabai

Petitioner also contends that one of ordinary skill in the art would have been motivated to incorporate Gabai into the proposed combination of Louvel, Kroo, Nagamitsu, and Hall because “it would have been a natural fit to configure Hall’s microprocessor in the proposed combination to receive Gabai’s software updates, since Gabai’s remote controller, a PC, is configured to receive software updates and push them to the toy.” Pet. 84 (referencing arguments for claim 13 and arguments at Pet. 63–70) (citing Ex. 1003 ¶¶ 167, 168). In its challenge based on Louvel, Kroo, Nagamitsu, and Gabai, Petitioner argues that (1) the references are in the same field of endeavor and address the same problem and (2) adding Gabai’s software updates would have been a simple substitution of one known element for another with predictable results, would have constituted the use of known techniques to improve a similar device in the same way, and would have been obvious to try. *Id.* at 66–69 (citing Ex. 1003 ¶¶ 129–134; Ex. 1008, Abstract, ¶¶ 121, 122, 606). Petitioner also argues that one of ordinary skill in the art would have had a reasonable expectation of success in incorporating the teachings of Gabai into the proposed combination. *Id.* at 69–70 (citing Ex. 1003 ¶ 135). Patent Owner does not provide arguments specifically for claim 14. *See generally* PO Resp.; PO Sur-Reply.

For the reasons discussed above, Petitioner persuades us that one of ordinary skill in the art would have had a reason to combine Louvel, Kroo, Nagamitsu, and Hall for claim 13. Based on the full record, Petitioner also persuades us that one of ordinary skill in the art would have had a reason to combine Gabai with the proposed combination of Louvel, Kroo, Nagamitsu, and Hall with a reasonable expectation of success. Pet. 66–70, 84.

G. Ground Based on Louvel, Kroo, Nagamitsu, Hall, and Talbert

1. Scope and Content of the Asserted Prior Art

Louvel, Kroo, Nagamitsu, and Hall are discussed above.

a) Talbert (Ex. 1007)

Talbert relates to a “televised remote-control aircraft.” Ex. 1007 ¶ 2.

Figure 9 of Talbert is reproduced below.

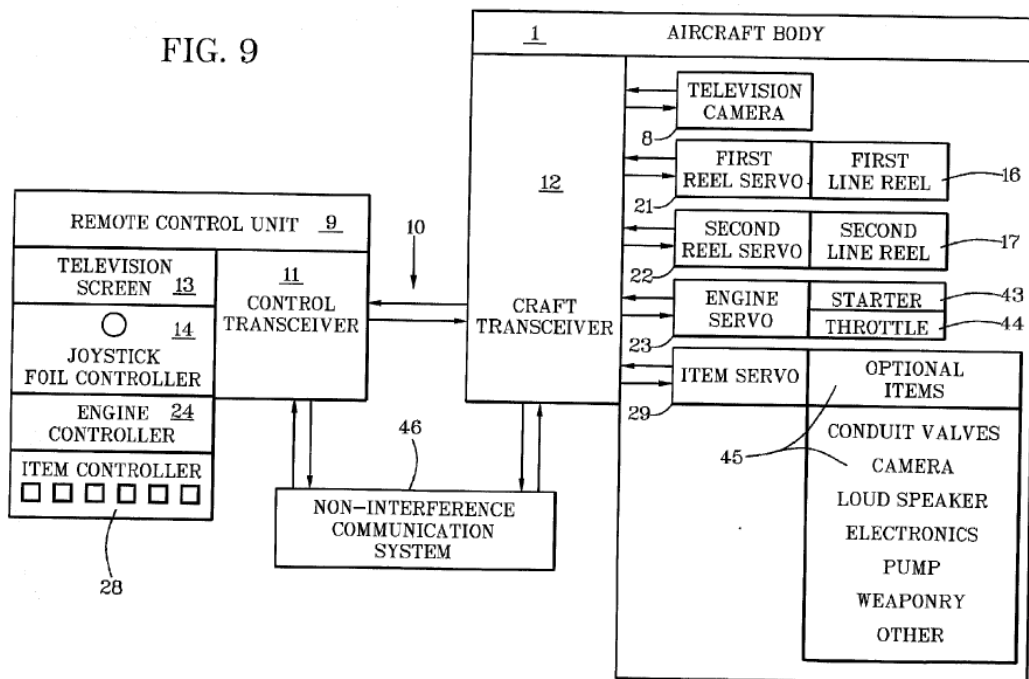


Figure 9 is a diagram of a remote-controlled aircraft having communication between a remote-control unit and an aircraft body. *Id.* ¶ 29. “A control unit 9 is provided for remote control of the parafoil aircraft” and “[t]here is control communication 10 intermediate a control transceiver 11

on the control unit 9 and a craft transceiver 12 on the aircraft body 1.” *Id.* ¶ 35.

Television camera 8 is on aircraft body 1. *Id.* ¶ 34. “There is television communication intermediate the television camera 8 and a television screen 13 which can be a picture-in-picture screen proximate the control unit 9.” *Id.* ¶ 35. “The television camera 8 sends live video vision from the aircraft body 1 to the television screen 13 proximate the remote-control unit 9.” *Id.* ¶ 46.

2. Analysis of Claim 15

Claim 15 depends directly from claim 13 and recites “further comprising configuring the software used by the battery-powered microprocessor system in the hand-held controller to receive video images from the RC drone.” Ex. 1001, 18:13–16. For the reasons discussed above, Petitioner persuades us that Louvel, Kroo, Nagamitsu, and Hall teach the limitations of claim 13.

Petitioner argues that Hall teaches the recited software and battery-powered microprocessor for the reasons asserted for limitation “13[d].” Pet. 81. Petitioner relies on Talbert for teaching two-way communications that include video streaming. *Id.* at 81 (citing Ex. 1007 ¶¶ 35, 46).

For claim 15, we find that the relied-upon portions of Talbert teach that there is “television screen 13 which can be a picture-in-picture screen proximate the control unit 9” and “television camera 8 sends live video vision from the aircraft body 1 to the television screen 13 proximate the remote-control unit 9.” Ex. 1007 ¶¶ 35, 46. Patent Owner does not provide arguments specifically for claim 15. *See generally* PO Resp.; PO Sur-Reply.

Based on the full record, because Talbert teaches sending live video from camera 8 of aircraft body 1 to remote-control unit 9, Petitioner

persuades us that Talbert teaches “further comprising configuring the software used by the battery-powered microprocessor system in the hand-held controller to receive video images from the RC drone.”

3. Analysis of Claim 17

Claim 17 depends directly from claim 13 and recites “further comprising configuring the software used by the battery-powered microprocessor system in the hand-held controller to perform two-way communications between the hand-held controller and the RC drone, wherein the two-way communications include data transmissions besides the control commands.” Ex. 1001, 18:20–25. For the reasons discussed above, Petitioner persuades us that Louvel, Kroo, Nagamitsu, and Hall teach the limitations of claim 13.

Petitioner argues that Hall teaches the recited software and battery-powered microprocessor, relies on Talbert for teaching two-way communications that include control commands, and contends “[i]t would have been a trivial design choice to configure the software running on Hall’s microprocessor to perform the two-way communications of Talbert.” Pet. 82 (referencing arguments made for claim 15) (citing Ex. 1003 ¶¶ 161–162).

For claim 17, as discussed above for claim 15, we find that the relied-upon portions of Talbert teach that there is “television screen 13 which can be a picture-in-picture screen proximate the control unit 9” and “television camera 8 sends live video vision from the aircraft body 1 to the television screen 13 proximate the remote-control unit 9.” *Id.* ¶¶ 35, 46. We also find that Figure 9 of Talbert shows television camera 8 on aircraft body 1 communicating with craft transceiver 12 that is also communicating with control transceiver 11 of remote control unit 9. Patent Owner does not

provide arguments specifically for claim 17. *See generally* PO Resp.; PO Sur-Reply.

Based on the full record, because Talbert teaches sending live video from camera 8 of aircraft body 1 to remote-control unit 9, Petitioner persuades us that Talbert teaches “further comprising configuring the software used by the battery-powered microprocessor system in the hand-held controller to perform two-way communications between the hand-held controller and the RC drone, wherein the two-way communications include data transmissions besides the control commands.”

4. Reason to Combine with Talbert

Petitioner argues that one of ordinary skill in the art would have recognized the advantage of incorporating Talbert’s video capability into Louvel as modified by Hall. Pet. 81–82 (citing Ex. 1003 ¶¶ 158–159). Petitioner also argues that one of ordinary skill in the art would have been motivated to make the modification with a reasonable expectation of success. *Id.* at 82 (citing Ex. 1003 ¶ 160; Ex. 1014, 6:42–45, Fig. 1). Patent Owner does not provide arguments for Petitioner’s asserted reason to combine Louvel as modified by Kroo, Nagamitsu, and Hall with the further teachings of Talbert. *See generally* PO Resp.; PO Sur-Reply.

As discussed above for claim 13, Petitioner persuades us that one of ordinary skill in the art would have had a reason to combine Louvel, Kroo, Nagamitsu, and Hall with a reasonable expectation of success for claim 13. Based on the full record, Petitioner also persuades that one of ordinary skill in the art would have further modified the combination of Louvel, Kroo, Nagamitsu, and Hall with the teachings of Talbert with a reasonable expectation of success.

H. Ground Based on Louvel, Kroo, Nagamitsu, Hall, and Rehkemper

1. Scope and Content of the Asserted Prior Art

Louvel, Kroo, Nagamitsu, and Hall are discussed above.

a) Rehkemper (Ex. 1009)

Rehkemper relates to “toy airplanes having microprocessors for assisting flight.” Ex. 1009 ¶ 2. The toy airplane assembly of Rehkemper includes a plane having a radio receiver that receives signals from a hand-held remote control radio transmitter. *Id.* Abstract. The toy assembly also includes a microprocessor and batteries in the plane’s fuselage. *Id.* Rehkemper also describes that “microprocessor 71 may be programmed to have an ‘out of range’ feature, i.e., if a command is not received by the plane for a predetermined amount of time from the radio transmitter 51, the microprocessor causes the plane to enter the landing mode.” *Id.* ¶ 33.

2. Analysis of Claim 16

Claim 16 depends directly from claim 13 and recites “further comprising configuring the software to utilize the control commands to keep the RC drone within 500 feet of the hand-held controller.” Ex. 1001, 18:17–19. For the reasons discussed above, Petitioner persuades us that Louvel, Kroo, Nagamitsu, and Hall teach the limitations of claim 13.

For claim 16, Petitioner argues that Rehkemper teaches a microprocessor programmed with software for an “out of range” feature. *Id.* at 85 (citing Ex. 1003 ¶¶ 169–170; Ex. 1009 ¶ 33). We find that the relied-upon portion of Rehkemper teaches that “microprocessor 71 may be programmed to have an ‘out of range’ feature, i.e., if a command is not received by the plane for a predetermined amount of time from the radio transmitter 51, the microprocessor causes the plane to enter the landing mode.” Ex. 1009 ¶ 33. We also credit the testimony of Petitioner’s

declarant regarding claim 16 because the record supports that testimony. Ex. 1003 ¶ 170 (referring also to *id.* ¶¶ 136–145). We agree with Petitioner’s declarant that one of ordinary skill in the art “would have understood that any reasonable predetermined distance could be programmed into the Rehkemper plane’s microprocessor—including the claimed 500ft.” *Id.* ¶ 138. Patent Owner does not provide arguments addressing whether the asserted references fail to teach or suggest the limitations of claim 16. *See generally* PO Resp.; PO Sur-Reply.

Based on the full record, because Rehkemper teaches a microprocessor programmed to cause a toy plane to enter landing mode after a predetermined time without receiving a command and because one of ordinary skill in the art would have understood a predetermined distance could be programmed into the microprocessor, Petitioner persuades us that Rehkemper teaches “further comprising configuring the software to utilize the control commands to keep the RC drone within 500 feet of the hand-held controller.”

a) Reason to Combine with Rehkemper

Petitioner also argues the one of ordinary skill in the art would have been motivated to include Rehkemper’s software in the proposed combination of Louvel, Kroo, Nagamitsu, and Hall because “Hall’s microprocessor is already configured to control the movement of the remote object – an aircraft in the proposed combination,” adding Rehkemper’s software “would have been a trivial configuration,” and the addition would “enhance the user’s control of the aircraft.” Pet. 85–86 (citing Ex. 1003 ¶¶ 171, 172). Patent Owner does not provide arguments addressing whether one of ordinary skill in the art would have combined the asserted references

to arrive at the subject matter of claim 16. *See generally* PO Resp.; PO Sur-Reply.

For the reasons discussed above, Petitioner persuades us that one of ordinary skill in the art would have had a reason to combine Louvel, Kroo, Nagamitsu, and Hall for claim 13. Based on the full record, Petitioner also persuades us that one of ordinary skill in the art would have had a reason to combine Rehkemper with the proposed combination of Louvel, Kroo, Nagamitsu, and Hall with a reasonable expectation of success.

I. Objective Indicia of Nonobviousness

Patent Owner asserts alleged objective evidence of non-obviousness. PO Resp. 39–42. The proffered objective evidence of non-obviousness are the Examiner’s reasons for allowance of the ’580 patent, arguments that Sato “teaches away from using gravity as a reference,” and arguments that there are no reasons for using an air-mouse controller to support substitution or design choice. PO Resp. 42–46; PO Sur-Reply 20–21. Because these arguments are more related to Petitioner’s asserted reason for combining the references, we address these arguments above in our analysis of claim 13.

We, therefore, determine that there are no objective evidence of non-obviousness in the record.

J. Weighing the Graham Factors

“Once all relevant facts are found, the ultimate legal determination [of obviousness] involves weighing of the fact findings to conclude whether the claimed combination would have been obvious to an ordinary artisan.”

Arctic Cat Inc. v. Bombardier Recreational Prods. Inc., 876 F.3d 1350, 1361 (Fed. Cir. 2017) (quoting *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1068–69 (Fed. Cir. 2012)).

Above, based on full record before us, we provide our factual findings

regarding (1) the level of ordinary skill in the art, (2) the scope and content of the prior art, (3) any differences between the claimed subject matter and the prior art, and (4) objective evidence of nonobviousness.

In particular, we find that (1) the parties' agreed to level of ordinary skill in the art is consistent with the prior art of record, (2) Louvel, Kroo, Nagamitsu, Hall, Gabai, Talbert, and Rehkemper teach all the limitations of claims 13–17, (3) one of ordinary skill in the art would have had a reason to modify Louvel with the teachings of at least one of Kroo, Nagamitsu, Hall, Gabai, Talbert, and Rehkemper with a reasonable expectation of success, and (4) there is no objective evidence of nonobviousness in the record.

Weighing these underlying factual determinations, a preponderance of the evidence persuades us that claim 13 of the '292 patent is unpatentable over Louvel, Kroo, Nagamitsu, and Hall; claim 14 is unpatentable over Louvel, Kroo, Nagamitsu, Hall, and Gabai; claims 15 and 17 are unpatentable over Louvel, Kroo, Nagamitsu, Hall, and Talbert; and claim 16 is unpatentable over Louvel, Kroo, Nagamitsu, Hall, and Rehkemper.

K. Other Arguments

1. Grounds Based on Louvel, Kroo, and Hall

Petitioner argues that (1) claim 13 is unpatentable over Louvel, Kroo, and Hall; (2) claim 14 is unpatentable over Louvel, Kroo, Hall, and Gabai; (3) claims 15 and 17 are unpatentable over Louvel, Kroo, Hall, and Talbert; and (4) claim 16 is unpatentable over Louvel, Kroo, Hall, and Rehkemper. Pet. 86–93.

Because we determine above that these same claims are unpatentable based on Louvel, Kroo, Nagamitsu, and Hall or these same references further combined with one of Gabai, Talbert, and Rehkemper, we do not need to reach Petitioner's additional grounds that do not rely on Nagamitsu.

2. 35 U.S.C. § 315(a)(1)

Patent Owner argues that Petitioner lacks standing under 35 U.S.C. § 315(a)(1), that Petitioner has the burden to establish that it has standing, and that Patent Owner “expressly reserves the right to appeal the standing issue.” PO Resp. 1, 12–13 (citing Pet. 1, 94; Dec. to Inst. 10; Paper 20, 2). Petitioner replies that it has filed a civil action challenging the validity of a related patent, not the ’292 patent. Pet. Reply 2 (citing PO Resp. 12–13; Ex. 1019).

Under 35 U.S.C. § 315(a)(1), “[a]n inter partes review may not be instituted if, before the date on which the petition for such a review is filed, the petitioner or real party in interest filed a civil action challenging the validity of a claim of the patent.” Based on the record, we agree with Petitioner that it has not filed a civil action challenging the validity of the ’292 patent. Patent Owner does not identify any civil action where Petitioner (or a real party in interest) challenged the validity of the ’292 patent before filing the instant Petition. Paper 4, 4–6. Patent Owner also does not persuade us or identify any authority to read § 315(a)(1) as preventing review if Petitioner challenged the validity of a claim of a *related* patent and not the ’292 patent itself.

We, thus, determine that the express terms of § 315(a)(1), as applied to the facts of this proceeding, are contrary to Patent Owner’s position and would not prevent review of the ’292 patent.

3. *Collateral Estoppel*

Petitioner argues that Patent Owner is collaterally estopped because previous proceedings addressed the same issues of claim construction and unpatentability, those issues were essential to final judgement, and previous

determinations are conclusive in this proceeding. Pet. Reply 1–6. Patent Owner provides a reply. PO Sur-Reply 2–4.

We agree that the claims at issue here contain some identical language, but the record does not provide sufficient argument that we should consider the claims at issue here to be the same as the claims that were at issue in IPR2016-01550 and IPR2016-01559. We are, thus, not persuaded that collateral estoppel bars Patent Owner in this proceeding. Nonetheless, for the reasons discussed above, Petitioner carries its burden of showing that claims 13–17 are unpatentable.

4. Patent Owner’s Declarant Testimony

Petitioner also argues that Patent Owner’s declarant, John P. Condon, “is a co-founder of QFO, is its chief technical officer, and admitted to having a direct, financial stake in the outcome.” Pet. Reply 6 (citing Ex. 1020, 48:19–51:3, 54:16–19; Ex. 2015 ¶¶ 5–6). Petitioner thus argues that Patent Owner’s declarant is biased and his testimony should be given little weight. *Id.* Patent Owner replies that Petitioner does not challenge its declarant’s technical qualifications, Petitioner does not point to any instances of where bias has tainted testimony, and record evidence supports Patent Owner’s declarant testimony. PO Sur-Reply 4.

After considering the parties’ arguments and evidence, we agree with Petitioner that Patent Owner’s declarant, Mr. Condon, is an interested witness because of his position and financial stake. Ex. 1020, 48:19–51:3, 54:16–19; Ex. 2015 ¶¶ 5–6. In evaluating his testimony, we consider his status as an interested witness in determining the probative weight of his testimony. For example, when objective record evidence does not sufficiently corroborate Mr. Condon’s testimony, we attribute little or no weight to his testimony, but when objective record evidence sufficiently

corroborates Mr. Condon's testimony, we consider it in our analysis. Therefore, we consider Mr. Condon's interest when evaluating his testimony.

III. MOTION TO AMEND

In its Motion to Amend, Patent Owner states that it "cancels instituted claims 1-10 on a non-contingent basis in favor of substitute claims 21 and 22, and submits substitute claim[] [23] to amend instituted claim 13 on a contingent basis depending upon the outcome of this proceeding." Mot. 1.

As requested by Patent Owner, we cancel claims 1–10 in favor of proposed substitute claims 21 and 22, which we analyze below. For the reasons stated above, Petitioner persuades us by a preponderance of the evidence that claim 13 is unpatentable, and thus, we also analyze below Patent Owner's proposed substitute claim 23.

A. Proposed Substitute Claims 21–23

Proposed substitute claim 21 recites, with underlining indicating language added to original claim 1 and brackets indicating language deleted:

Proposed Substitute Claim 21. A method for operating a radio controlled (RC) flying hovercraft using an RC controller separate and remote from the RC flying hovercraft, the method comprising:

providing an RC flying hovercraft having a set of generally downwardly directed thrusters, each thruster including at least one blade driven by a battery powered motor to provide aerodynamic lift for the RC flying hovercraft under control of a control system in the RC flying hovercraft that is responsive to radio frequency (RF) communications from the RC controller;

causing an RF receiver in the control system in the RC flying hovercraft to receive communications from the RC controller, the communications including a desired orientation of

the RC flying hovercraft, wherein the desired orientation communicated by the RC controller is determined based on a handheld structure housing a sensor system in the RC controller that dynamically senses a gravitational reference as an inertial reference for the RC controller and at least a two dimensional, two-axis sensed orientation of the handheld structure with respect to said gravitational reference as a result of a user, remote from the RC flying hovercraft, selectively holding [[orienting]] the handheld structure in a position that is tilted relative to the gravitational reference;

causing a sensor system in the control system of the RC flying hovercraft to dynamically sense a gravitational reference as an inertial reference for the RC flying hovercraft and determine an actual orientation of the RC flying hovercraft, the sensor system including at least a three-dimensional, three-axis sensor; and

causing the control system in the RC flying hovercraft to automatically and dynamically control a thrust produced by each of said thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in a position that mimics the position of the handheld structure in response to the desired orientation communicated to the RC flying hovercraft by the RC controller and the actual orientation determined by the sensor system in the RC flying hovercraft without any additional communications being required for the user to control moment-to-moment balance and stabilization of the RC flying hovercraft, such that the control system in the RC flying hovercraft and the RC controller implement an orientation control scheme.

Mot. 27–28.

Proposed substitute claim 22 provides similar changes to original independent claim 6. Specifically, proposed substitute claim 22 recites, *inter alia*:

using a sensor system in the hand-held controller to dynamically sense a gravitational reference as an inertial reference for the handheld controller and a relative tilt of the hand-held controller with respect to the gravitational reference in response to a user

selectively holding [[orienting]] the hand-held controller in a position that is tilted relative to the gravitational reference; . . .

using the control circuitry and the sensor system in the RC drone to dynamically sense a gravitational reference as an inertial reference for the RC drone

and automatically and dynamically control a downwardly directed thrust produced by each motor and each motor's at least one blade to achieve and maintain the actual orientation of the RC drone in a position that mimics the position of the hand-held controller in response to the desired orientation communicated in the control commands from the hand-held controller, such that the RC drone and the hand-held controller implement an orientation control scheme in which the actual orientation of the RC drone is controlled to achieve and then maintain an attitude of the RC drone so as to mimic the position of the hand-held controller when the hand-held controller is held by the user in the position that is tilted relative to the gravitational reference.

Mot. 28–29.

Patent Owner proposes substitute claim 23 for claim 13 if claim 13 is found unpatentable. Mot. 1, 2. Patent Owner states that proposed substitute claim 23 expressly requires an “orientation control scheme.” *Id.* at 2.

Proposed substitute claim 23 recites the same limitations as claim 13 but adds:

such that the control system of the RC drone and the software in the hand-held controller implement an orientation control scheme in which an actual orientation of the RC drone is controlled to achieve and then maintain an attitude of the RC drone so as to mimic the position of the hand-held controller when the hand-held controller is held by the user in the position that is tilted relative to the gravitational reference.

Mot. 29–30.

B. Requirements Under 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121

We first determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. *See Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 and IPR2018-01130, Paper 14 (PTAB Feb. 25, 2019) (precedential) (“*Lectrosonics*”).

1. Reasonable Number of Substitute Claims

A motion to amend may, “[f]or each challenged claim, propose a reasonable number of substitute claims.” 35 U.S.C. § 316(d)(1)(B) (2012). “The presumption is that only one substitute claim would be needed to replace each challenged claim, and it may be rebutted by a demonstration of need.” 37 C.F.R. § 42.121(a)(3) (2018).

Patent Owner argues that it proposes only one substitute claim for each challenged independent claim, and thus, its motion presents a reasonable number of substitute claims. Mot. 2–3. Petitioner does not provide an argument that an unreasonable number of substitute claims have been presented. *See generally* Opp.; Pet. Sur-Reply; *see also* PO Reply 1 (“The only requirement for the substitute claims opposed by Petitioners is that the substitute claims respond to a ground of unpatentability.”).

We determine that Patent Owner presents a reasonable number of substitute claims under 35 U.S.C. § 316(d)(1)(B) and 37 C.F.R. § 42.121(a)(3).

2. Responds to a Ground of Unpatentability

“A motion to amend may be denied where . . . [t]he amendment does not respond to a ground of unpatentability involved in the trial.” 37 C.F.R. § 42.121(a)(2)(i). Patent Owner contends that the proposed substitute claims expressly require an “orientation control scheme.” Mot. 3. Patent Owner

asserts the proposed amendments respond to the references applied in this proceeding and claims that expressly recite “orientation control scheme” were not analyzed in prior proceedings. *Id.* Patent Owner explains why it believes the proposed substitute claims are patentable over the grounds instituted for claim 13. *Id.* at 12–25.

Petitioner argues that Patent Owner “repeats the same arguments it made in prior IPR proceedings . . . regarding materially identical limitations and indeed, arguments identical to those raised in its Response.” Opp. 4 (citing Ex. 1022 ¶ 32). Petitioner points to arguments regarding “orientation control scheme,” which, according to Petitioner, the Board has already determined to be unpatentable. *Id.* at 4–5 (citing PO Resp. 3, 10; ’1550 Final Dec. 54–56).

Patent Owner replies that the proposed amendments respond to the grounds of unpatentability and that Petitioner has the burden to show unpatentability of the proposed substitute claims. PO Reply 1–2. Petitioner does not provide a reply. *See generally* Pet. Sur-Reply.

Patent Owner has presented proposed substitute claims that it believes are patentable, which requires analysis based on the record of this proceeding. Petitioner’s arguments indicate that, because the proposed added limitations were presented and determined to be unpatentable in a previous proceeding, the proposed added limitations fail to show patentability and, thus, fail to respond to the asserted grounds of unpatentability in this proceeding. Even if we were to agree with Petitioner, Petitioner’s argument that the proposed substitute claims are not responsive to a ground of unpatentability would involve some analysis of their patentability based on the present record. Moreover, Petitioner does not present a persuasive reason why we should determine patentability of

proposed amendments as part of our inquiry into whether the amendments are responsive to a ground of unpatentability.

For the reasons above, we determine that the amended language in the proposed substitute claims is responsive to a ground of unpatentability in this trial under 37 C.F.R. § 42.121(a)(2)(i).

3. Does Not Enlarge the Scope of the Claims

A motion to amend “may not enlarge the scope of the claims of the patent.” 35 U.S.C. § 316(d)(3); *see* 37 C.F.R. § 42.121(a)(2)(ii). Patent Owner contends that the proposed substitute claims each retain all the limitations of one of claims 1, 6, and 13 with no claim language deleted. Mot. 3. According to Patent Owner, the “only claim language added to the existing claim limitations are clarifying limitations that narrow the claim scope under a broadest reasonable construction.” *Id.*; *see also id.* at 4–5 (comparing certain limitations of claims 1 and 6 and proposed substitute claims 21 and 22). Patent Owner states that “[n]ew claim limitations in the form of ‘such that’ clauses are added to expressly clarify that these claims require an ‘orientation control scheme.’” *Id.* at 4.

Petitioner does not address specifically the scope of the proposed substitute claims. *See generally* Opp.; Pet. Sur-Reply; *see also* PO Reply 1 (“The only requirement for the substitute claims opposed by Petitioners is that the substitute claims respond to a ground of unpatentability.”).

Based on our review of the proposed amendments, because the proposed amendments are narrowing (*see* Mot. 26–30), we determine that the amended language does not enlarge the scope of the original challenged claims under 37 C.F.R. § 42.121(a)(2)(ii).

4. *Does Not Introduce New Matter*

A motion to amend “may not . . . introduce new matter.” 35 U.S.C. § 316(d)(3); 37 C.F.R. § 42.121(a)(2)(ii). Patent Owner contends that the “amendments are supported by the original disclosure and do not introduce new matter.” Mot. 5. Patent Owner identifies support in a table with citations to the originally filed disclosure (Appl. No. 14/791,253 (Ex. 1002, 314–355, 363–388)) and a national stage entry application for which benefit of the filing date is sought (PCT Appl. No. PCT/US03/27415 (Ex. 2014)). *Id.* at 6–8. Petitioner does not provide an argument that the amendments introduce new matter. *See generally* Opp.; Pet. Sur-Reply; *see also* PO Reply 1 (“The only requirement for the substitute claims opposed by Petitioners is that the substitute claims respond to a ground of unpatentability.”).

Based on the cited portions of the originally filed disclosure and the national stage entry application, we find that there is sufficient written description support for “dynamically senses a gravitational reference as an inertial reference for the RC controller,” as recited by proposed substitute claim 21, and “dynamically sense a gravitation reference as an inertial reference for the hand-held controller,” as recited by proposed substitute claim 22. *See, e.g.*, Ex. 1002, 378:19–22 (“The homeostatic control system includes an XYZ sensor arrangement and associated control circuitry as previously described that dynamically determines an inertial gravitational reference for use in sensing the desired orientation.”); Ex. 2014, 14:11–13 (“The homeostatic control system includes an XYZ sensor arrangement and associated control circuitry as previously described that dynamically determines an inertial gravitational reference for use in sensing the desired orientation.”).

We also find that there is sufficient written description support for “selectively holding the handheld structure in a position that is tilted relative to the gravitational reference,” as recited by proposed substitute claim 21, and “holding the hand-held controller in a position that is tilted relative to the gravitational reference,” as recited by proposed substitute claim 22. *See, e.g.*, Ex. 1002, 384:7–8 (“As shown in Fig. 7, the XY axis tilt switch stabilizer 52 is a fluid suspended tilt switch mechanism.”); Ex. 2014, 19:18–19 (“As shown in Fig. 7, the XY axis tilt switch stabilizer 52 is a fluid suspended tilt switch mechanism.”).

We additionally find sufficient written description support for “sense a gravitational reference as an inertial reference for the RC flying hovercraft,” as recited by proposed substitute claim 21, and “sense a gravitational reference as an inertial reference for the RC drone,” as recited by proposed substitute claim 22. *See, e.g.*, Ex. 1002, 372:26–29 (“The hover control system uses an XYZ sensor arrangement and associated control circuitry that dynamically determines an inertial gravitational reference for use in automatically and continuously determine the speed needed for each fan in order to keep the craft at a desired orientation.”); Ex. 2014, 9:8–11 (“The hover control system uses an XYZ sensor arrangement and associated control circuitry that dynamically determines an inertial gravitational reference for use in automatically and continuously determine the speed needed for each fan in order to keep the craft at a desired orientation.”).

We further find sufficient written description support for “a position that mimics the position of the handheld structure,” as recited by proposed substitute claim 21, and “a position that mimics the position of the hand-held controller,” as recited by proposed substitute claim 22. *See, e.g.*, Ex. 1002, 373:16–18 (“The unique and intuitive one-handed bee controller also

includes an XY sensor arrangement and associated control circuitry that allows the craft to mimic the positions of the controller in terms of yaw, pitch, roll and lateral flight maneuvers.”); Ex. 2014, 9:27–29 (“The unique and intuitive one-handed bee controller also includes an XY sensor arrangement and associated control circuitry that allows the craft to mimic the positions of the controller in terms of yaw, pitch, roll and lateral flight maneuvers.”).

For the “such that” clauses at the ends of proposed substitute claims 21–23, we find sufficient written support. *See, e.g.*, Ex. 1002, 372:3–10 (“In one embodiment, the flying hovercraft is a flying saucer shaped over-powered skirtless hovercraft capable of up/down, lateral and yaw, pitch and roll flight maneuvers by mimicking the position of the craft to the position of the remote controller.”); Ex. 2014, 8:13–20 (“In one embodiment, the flying hovercraft is a flying saucer shaped over-powered skirtless hovercraft capable of up/down, lateral and yaw, pitch and roll flight maneuvers by mimicking the position of the craft to the position of the remote controller.”).

For the reasons above, we determine that the motion to amend does not introduce new matter under 35 U.S.C. § 316(d)(3) and 37 C.F.R. § 42.121(a)(2)(ii).

C. Level of Ordinary Skill

Patent Owner’s arguments regarding the level of ordinary skill in the Motion to Amend are substantially identical to its level of ordinary skill arguments in its Patent Owner Response. *Compare* Mot. 9–10, with PO Resp. 13–14. Petitioner does not provide a response. *See generally* Opp.; Pet. Sur-Reply.

As discussed above, we adopt the parties’ agreed-to level of ordinary skill and, based on the full record, find that one of ordinary skill in the art “would possess a Bachelor of Science degree in Aerospace Engineering, or a comparable degree such as Electrical Engineering, with two to four years of practical experience in design and development in the field of remote-control aircraft” (PO Resp. 14; Mot. 9–10; *see also* Pet. 5 (providing generally the same level of ordinary skill)). To the extent there are any differences in the parties’ asserted level of ordinary skill, those differences would not impact our analysis.

D. Claim Construction

Patent Owner states that the “terms *orientation*, *position*, and *tilt* and the phrase *sense a gravitational reference* have the same meanings as set forth in the Patent Owner Response” and “use a reference frame that must be interpreted as an inertial reference that essentially provides an inert, non-moving reference coordinate frame that uses gravity as a reference.” Mot. 10–11 (citing Ex. 2015 ¶ 81). Patent Owner also proposes interpretations for “holding the [handheld structure/hand-held controller] in a position that is tilted relative to the gravitational reference,” “a position that mimics the position of the [handheld structure/hand-held controller],” and “an orientation control scheme.” *Id.* at 11–12 (citing Ex. 2015 ¶¶ 183–185).

Petitioner argues that Patent Owner’s proposed interpretations are improper, Patent Owner “cites only its expert,” and “a review of the specification plainly demonstrates that none of the terms were defined, either expressly or implicitly in any way.” Opp. 11–12.

For the terms “orientation,” “position,” “tilt,” and “sense a gravitational reference,” we again determine that express interpretation of

these claim terms is not necessary to resolve the parties' dispute. *Vivid Techs.*, 200 F.3d at 803.

For “holding the [handheld structure/hand-held controller] in a position that is tilted relative to the gravitational reference,” “a position that mimics the position of the [handheld structure/hand-held controller],” and “an orientation control scheme,” Patent Owner proposes interpretations that include “a state vector representing the position of the RC controller” and “state vector representing the position of the RC craft.” *See* Mot. 11–12. The express language of proposed substitute claims 21–23 do not recite such state vectors, and thus, cannot support Patent Owner's proposed interpretations.

Turning to the Specification, the term “orientation control scheme” is not used. The Specification also does not describe state vectors representing the positions of an RC controller and RC craft. Turning to extrinsic evidence, Patent Owner's declarant testimony does not provide an analysis of the claims, Specification, or prosecution history of the '292 patent that would indicate how one of ordinary skill in the art would understand the terms, for which an interpretation has been proposed. Ex. 2015 ¶¶ 81, 183–185.

For the reasons above, we determine that Patent Owner's proposed interpretations are not the broadest reasonable interpretation in view of the Specification of the '292 patent because the Specification does not use these terms or describe state vectors. For our analysis, we apply the plain and ordinary meaning.

E. Patentability of Proposed Substitute Claims 21–23

Patent Owner “does not bear the burden of persuasion to demonstrate the patentability of [the proposed] substitute claims.” *Lectrosonics*,

IPR2018-01129, Paper 15 at 4 (citing *Bosch Auto. Servs. Sols., LLC v. Iancu*, 878 F.3d 1027 (Fed. Cir. 2017); *Aqua Prods., Inc. v. Matal*, 82 F.3d 1290 (Fed. Cir. 2017)). “Rather, as a result of the current state of the law and [Office] rules and guidance, the burden of persuasion ordinarily will lie with the petitioner to show that any proposed substitute claims are unpatentable by a preponderance of the evidence.” *Id.*

Because Petitioner argues that the proposed added limitations fail to show patentability and, thus, fail to respond to the asserted grounds of unpatentability in this proceeding (Opp. 4–5), we understand Petitioner to be arguing that proposed substitute claims 21 and 22 are unpatentable over Louvel, Kroo, and Nagamitsu, the ground asserted against claims 1 and 6, and that proposed substitute claim 23 is unpatentable over Louvel, Kroo, Nagamitsu, and Hall, the ground asserted against claim 13. *See* Opp. 5–10, 12–25; *see also* Mot. 12 (“Although it is Petitioners’ burden to establish the unpatentability of substitute claims 21–23, these claims are patentable over the grounds instituted for original claim 13.”).

1. Analysis of Proposed Substitute Claim 21

As discussed above for claim 13, Petitioner refers to its arguments for claim 1, for which Patent Owner proposes substitute claim 21. *See* Pet. 73–74. Our analysis of claim 13 includes a summary of Petitioner’s arguments for claim 1 and our findings based upon the portions of Louvel, Kroo, and Nagamitsu that Petitioner relies. We apply those same arguments and findings below in our analysis of substitute claim 21.

- a) A method for operating a radio controlled (RC) flying hovercraft using an RC controller separate and remote from the RC flying hovercraft, the method comprising:*

Petitioner relies on the Abstract and Figure 13 of Louvel for teaching the preamble of claim 1. Pet. 22–23. Patent Owner does not present arguments specifically for the identical preamble recited by proposed substitute claim 21. *See generally* Mot.; PO Reply.

Regardless of whether the preamble is limiting, Petitioner has shown that the recitation in the preamble is satisfied by the prior art. Based on the full record before us, because Louvel teaches a light aircraft remotely controlled (Ex. 1004 Abstract, ¶¶ 25, 26, 124–127, Fig. 13), Petitioner persuades us that Louvel teaches a “method for operating a radio controlled (RC) flying hovercraft using an RC controller separate and remote from the RC flying hovercraft.”

- b) providing an RC flying hovercraft having a set of generally downwardly directed thrusters,*

Petitioner relies on Louvel’s Abstract; paragraphs 2–8, 29, 30, and 38; Figures 1, 3, and 13; and claim 9 for this limitation of claim 1. Pet. 23–25. Patent Owner does not present arguments specifically for the identical limitation recited by proposed substitute claim 21. *See generally* Mot.; PO Reply.

Based on the full record before us, because Louvel teaches an aircraft with four propellers driven by electric motors providing lift (Ex. 1004 ¶¶ 8, 29, 30, 38), Petitioner persuades us that Louvel teaches “providing an RC flying hovercraft having a set of generally downwardly directed thrusters.”

- c) each thruster including at least one blade driven by a battery powered motor to provide aerodynamic lift for the RC flying hovercraft*

Petitioner relies on Louvel's Figures 1–3 for this limitation of claim 1. Pet. 26, 31–32. Patent Owner does not present arguments specifically for the identical limitation recited by proposed substitute claim 21. *See generally* Mot.; PO Reply.

Based on the full record before us, because Figures 1–3 of Louvel show an aircraft with four propellers driven by electric motors providing lift (*see* Ex. 1004 ¶¶ 8, 29, 30, 38), Petitioner persuades us that Louvel teaches “each thruster including at least one blade driven by a battery powered motor to provide aerodynamic lift for the RC flying hovercraft.”

- d) under control of a control system in the RC flying hovercraft that is responsive to radio frequency (RF) communications from the RC controller;*

Petitioner relies on page 26 of Kroo for teaching this limitation of claim 1. Pet. 32–33. Patent Owner does not present arguments specifically for the identical limitation recited by proposed substitute claim 21. *See generally* Mot.; PO Reply.

Based on the full record, because Kroo teaches that its “rotorcraft flies using commercial lithium-ion batteries and is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter” (Ex. 1006, 26), Petitioner persuades us that Kroo teaches “under control of a control system in the RC flying hovercraft that is responsive to radio frequency (RF) communications from the RC controller.”

- e) *causing an RF receiver in the control system in the RC flying hovercraft to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft,*

Petitioner relies on page 26 of Kroo (Pet. 36) and descriptions related to Figure 4 of Nagamitsu (*id.* at 37–38 (citing Ex. 1010, 12:10–30, 15:25–46, Fig. 4)) for the original limitation recited by claim 1. Patent Owner does not present arguments specifically for the identical limitation of proposed substitute claim 21. *See generally* Mot.; PO Reply.

Based on the full record before us, because Kroo teaches that a rotorcraft is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter, Petitioner persuades us that Kroo teaches “causing an RF receiver in the control system in the RC flying hovercraft to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft.”

- f) *wherein the desired orientation communicated by the RC controller is determined based on a handheld structure housing a sensor system in the RC controller that dynamically senses a gravitational reference as an inertial reference for the RC controller and at least a two dimensional, two-axis sensed orientation of the handheld structure with respect to said gravitational reference as a result of a user, remote from the RC flying hovercraft, selectively holding [[orienting]] the handheld structure in a position that is tilted relative to the gravitational reference;*

Petitioner relies on Nagamitsu for teaching the original limitation recited by claim 1. Pet. 39–44 (citing Ex. 1010, 12:10–30, Fig. 4). For the added “dynamically,” Petitioner argues that “Nagamitsu teaches that its handheld input unit 30 includes accelerometer 36 in each of its 3-D directions and accelerometer 36 detects the direction of gravity and

acceleration so that it can detect, at least, changes in acceleration of input unit 30.” Opp. 6 (citing Pet. 41–42; Ex. 1010, 12:10–30, Fig. 4; Ex. 1022 ¶¶ 33–35). For “inertial reference,” Petitioner contends that Patent Owner “describes an ‘inertial reference’ as a fixed reference” and that “[s]ince the reference at issue is gravity, which is fixed by nature, this additional language does not change the scope of the ‘gravitational reference’ of the original claims.” Opp. 6 (citing PO Resp. 15; Ex. 1022 ¶ 36; Ex. 2015 ¶ 81).

Patent Owner replies for both “dynamically” sensed and “inertial reference” that Louvel does not teach expressly gravity and “the frame of reference of *Louvel*’s craft is not a dynamically sensed gravitational reference.” PO Reply 4 (citing Opp. 5–7; Ex. 2016, 131:3–9; Ex. 2037, 105, 112). Patent Owner contends “it is an imputed gravitational reference that is not used by *Louvel* as an inertial reference.” *Id.* at 4–5.

Petitioner replies that “[s]ince the reference at issue is gravity, which is fixed by nature, this additional language does not change the scope of the ‘gravitational reference’ of the original claims, and this analysis does not change from the controller to the aircraft.” Pet. Sur-Reply 6 (citing PO Reply 4–5; PO Resp. 23; Ex. 1022 ¶ 36; Ex. 2015 ¶ 81).

As for “holding,” Petitioner argues that Patent Owner “gives no special meaning to this term, using its ordinary meaning in its explanation of how this limitation should be read.” Opp. 6 (citing PO Resp. 54; Mot. 11). Petitioner also argues that Louvel’s and Nagamitsu’s controllers are handheld. *Id.* at 6–7 (citing Pet. 18, 22; Ex. 1004, Abstract, Fig. 1; Ex. 1010, 15:25–46). Regarding “tilted relative to the gravitational reference,” Petitioner contends that “Nagamitsu teaches a handheld controller tilted relative to a gravitational reference, *i.e.*, held in a position

not parallel to the gravitational reference.” Opp. 7 (citing Ex. 1022 ¶¶ 39–40).

Patent Owner replies for both “holding” and “tilted relative to the gravitational reference” that Nagamitsu cannot teach these limitations because Louvel’s control scheme is admittedly not changed. PO Reply 5 (citing Opp. 6–7, 22). Patent Owner contends that “the amended claim limitations require an orientation control scheme that operates to cause the RC craft to implement tilt-to-fly control even when the user is holding the RC controller still in a position that is tilted relative to the gravitational reference.” *Id.*

Because the limitation recites “desired orientation communicated by the RC controller,” Petitioner replies that Patent Owner’s argument makes no sense because it would “require[] a user to hold the (flying) aircraft in a specific position to control it.” Pet. Sur-Reply 7 (citing PO Reply 5).

We find that the relied-upon portions of Nagamitsu teach “magnetism detecting pointer 35 and an accelerometer 36 are installed therein for each direction in 3-D” (Ex. 1010, 12:17–19) and that “[b]y comparing the strengths of the three directions in the magnetic field detected by the magnetism detecting pointer 35 and detecting a[] direction of the gravity and acceleration by the accelerometer 36, the changes of rotational angles, movements, or acceleration of the 3-D input unit 30 with respect to the magnetic field indicated by arrows in FIG. 4 can be detected.” *Id.* at 12:20–26. We also find that Nagamitsu teaches:

In other words, by inclining the 3-D beam unit 30 called the 3-D mouse in each direction as shown in FIG. 4, the rotation angle information is inputted into the 3-D space moving speed vector computation unit 133 via the input control unit 130 in the computation control unit 13, and a moving speed and a direction

of the walk-through and hence the location of the eyes from the starting point are calculated depending on the degrees and direction of the rotation angle.

Id. at 14:46–54. We also agree with Petitioner that Louvel’s controller is handheld. Opp. 6–7; Ex. 1004, Abstract, Fig. 1.

Because Louvel teaches a handheld controller and Nagamitsu teaches a 3-D mouse that detects a direction of gravity to determine changes in angles, movements, and acceleration to change moving speed and direction, Petitioner persuades us that Louvel and Nagamitsu teach:

wherein the desired orientation communicated by the RC controller is determined based on a handheld structure housing a sensor system in the RC controller that dynamically senses a gravitational reference as an inertial reference for the RC controller and at least a two dimensional, two-axis sensed orientation of the handheld structure with respect to said gravitational reference as a result of a user, remote from the RC flying hovercraft, selectively holding [[orienting]] the handheld structure in a position that is tilted relative to the gravitational reference.

g) causing a sensor system in the control system of the RC flying hovercraft to dynamically sense a gravitational reference as an inertial reference for the RC flying hovercraft and determine an actual orientation of the RC flying hovercraft,

Petitioner relies on Louvel for teaching the original limitation recited by claim 1. Pet. 46–48 (citing Ex. 1004 ¶¶ 42–46, 75–78, 91, 94–95, 119–121, Fig. 4). Petitioner additionally argues that “inertial reference” has the same scope as gravitational reference recited by the original claims. Opp. 7 (citing Ex. 1022 ¶ 41). Above we summarize the parties’ position regarding “inertial reference.”

We find that the relied-upon portions of Louvel teach that Louvel’s “aircraft is fitted with three attitude sensors whose purpose is to provide

information for the closed loop control” (Ex. 1004 ¶ 42) and has “two tilt sensors” (*id.* ¶ 43), “yaw movement sensor (63)” (*id.* ¶¶ 75, 78), “roll sensor (61)” (*id.* ¶ 76), and “pitch sensor (62)” (*id.* ¶ 77). Louvel also teaches that “[w]hen there is no action on the handle, the control loop uses the data coming from the various sensors (61), (62) and (63) to converge towards the horizontal normal attitude of the aircraft and to cancel the yaw movement.” *Id.* ¶ 91. Figure 4 of Louvel shows the arrangement of these sensors.

Based on the full record, because Louvel teaches tilt, yaw, and roll sensors in an aircraft that are used to converge to a horizontal normal attitude, Petitioner persuades us that Louvel teaches “causing a sensor system in the control system of the RC flying hovercraft to dynamically sense a gravitational reference as an inertial reference for the RC flying hovercraft and determine an actual orientation of the RC flying hovercraft.”

h) the sensor system including at least a three-dimensional, three-axis sensor; and

Petitioner relies on Louvel for teaching the original limitation found in claim 1. Pet. 48–49 (citing Ex. 1004 ¶¶ 42–46, 75–78, Fig. 4). Patent Owner does not present arguments specifically for the identical limitation recited by proposed substitute claim 21. *See generally* Mot.; PO Reply.

Because Louvel teaches that Louvel’s “aircraft is fitted with three attitude sensors whose purpose is to provide information for the closed loop control” (Ex. 1004 ¶ 42) and has “two tilt sensors” (*id.* ¶ 43), “yaw movement sensor (63)” (*id.* ¶¶ 75, 78), “roll sensor (61)” (*id.* ¶ 76), and “pitch sensor (62)” (*id.* ¶ 77), Petitioner persuades us that Louvel teaches “a sensor system in the control system of the RC flying . . . the sensor system including at least a three-dimensional, three-axis sensor.”

- i) *causing the control system in the RC flying hovercraft to automatically and dynamically control a thrust produced by each of said thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in a position that mimics the position of the handheld structure in response to the desired orientation communicated to the RC flying hovercraft by the RC controller and the actual orientation determined by the sensor system in the RC flying hovercraft without any additional communications being required for the user to control moment-to-moment balance and stabilization of the RC flying hovercraft.*

Petitioner relies on Louvel for teaching the original limitation recited by claim 1. Pet. 49–50 (citing Ex. 1004 ¶¶ 96–119). Petitioner additionally argues that Louvel and Nagamitsu teach an aircraft orientation that corresponds to its controller on a moment-to-moment basis. Opp. 8 (citing Ex. 1003 ¶ 99; Ex. 1004 ¶¶ 96–119; Ex. 1010, 12:10–30, 15:43–46).

We find that the relied-upon portions of Louvel teach how Louvel has pitch control (Ex. 1004 ¶¶ 96–98), roll control (*id.* ¶¶ 99–102), yaw control (*id.* ¶¶ 103–106), and attitude correction (*id.* ¶¶ 107–108) through changing the speed of propellers 10–13. We also find that the relied-upon portions of Louvel teach how moving the handle of a handling unit 7 affects the speed of the propellers 10–13 of Louvel’s aircraft. *Id.* ¶¶ 109–119. Louvel also teaches that the “whole close loop calculus is performed at each moment in real time” and can be “performed in one step.” *Id.* ¶¶ 119, 120.

We further find that the relied-upon portions of Nagamitsu teach a 3-D mouse that includes magnetism detecting pointer 35 and accelerometer 36 and that detects a direction of gravity to determine changes in angles, movements, and acceleration to change moving speed and direction. Ex. 1010, 12:10–30, 15:43–46.

Based on the full record and our findings from Louvel and Nagamitsu, Petitioner persuades us that Louvel and Nagamitsu teach:

causing the control system in the RC flying hovercraft to automatically and dynamically control a thrust produced by each of said thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in a position that mimics the position of the handheld structure in response to the desired orientation communicated to the RC flying hovercraft by the RC controller and the actual orientation determined by the sensor system in the RC flying hovercraft without any additional communications being required for the user to control moment-to-moment balance and stabilization of the RC flying hovercraft.

j) such that the control system in the RC flying hovercraft and the RC controller implement an orientation control scheme.

Petitioner argues that “Nagamitsu and Louvel both teach that the orientation of the drone is controlled on a moment-to-moment basis so as to mimic the position of the handheld controller when the controller is tilted relative to a gravitational reference.” Opp. 9. Petitioner also argues Louvel teaches the recited “orientation control scheme” under Patent Owner’s proposed interpretation for that term. *Id.* at 9–10 (citing Pet. 49–50; Ex. 1004 ¶¶ 96–119; Mot. 11). Petitioner, therefore, contends that the asserted prior art teaches all the limitations of proposed substitute claim 23. *Id.* at 10.

Patent Owner replies that the limitation cannot be met by “a temporary correspondence between a tilting of the RC controller and the attitude of the RC craft.” PO Reply 5. Patent Owner also argues that “*Louvel’s* control scheme only teaches stabilizing the craft at a horizontal orientation” and “the proposed combination . . . makes no changes to the control loop in the craft of *Louvel*” so that “the position of the RC controller will not match the position of the RC craft because the positions will be

based on different inertial references.” *Id.* at 6. Patent Owner further argues, *inter alia*, that Petitioner’s declarant could not identify prior art using a mono-joystick controller or solving tilt-to-fly problem, Petitioner provides unsupported rebuttal testimony, Sato teaches away from the proposed combination, Petitioner improperly shifts the burden to Patent Owner, Louvel teaches an angular-rate control scheme, Louvel does not clearly describe the control system, Petitioner’s declarant impermissibly uses hindsight, and Louvel only stabilizes at the ideal horizontal attitude. *Id.* at 6–12.

Petitioner replies that Patent Owner’s proposed interpretation does not differentiate the claim from the asserted references. Pet. Sur-Reply 4–5. Petitioner also replies that Patent Owner “repeats the same arguments previously raised.” *Id.* at 7 (citing PO Resp. 52–58; Mot. 24–25). Petitioner thus refers to arguments it made earlier. *Id.* (citing Pet. 36–44, 46–50; Pet. Reply 8–10; Opp. 4–10); *see also id.* at 7–12 (responding to Patent Owner’s arguments).

Based on the full record, because Louvel teaches changing orientation by changing propeller speed and converging to a horizontal, normal attitude and because Nagamitsu teaches a 3-D mouse that detects a direction of gravity to determine changes in angles, movements, and acceleration to change moving speed and direction, Petitioner persuades us that Louvel and Nagamitsu teach the recitation “such that the control system in the RC flying hovercraft and the RC controller implement an orientation control scheme.”

Even under Patent Owner’s proposed interpretation of “orientation control scheme” (Mot. 11–12), Petitioner persuades us that Louvel and Nagamitsu teach the final recitation of proposed substitute claim 21. Petitioner’s proposed combination of Louvel and Nagamitsu so “to include

the sensor scheme and associated circuitry disclosed by Nagamitsu's controller" in the controller of Louvel would control the actual orientation of an RC hovercraft relative to a gravitational reference determined and used by the RC hovercraft to achieve and maintain a position that can be represented by a vector and that mimics the position of the RC controller that is tilted relative to a gravitational reference sensed by the RC controller and that can be represented by another vector. *See* Mot. 11–12.

2. Analysis of Proposed Substitute Claim 22

Petitioner refers to its arguments for claim 1 to argue that claim 6 is unpatentable. *See* Pet. 51 (“The limitations of claim 6 are disclosed in the prior art for the same reasons discussed above in connection with claim 1.”). Patent Owner proposes substitute claim 22 for claim 6. *See* Mot. 3 (“As shown in the appendix, proposed substitute independent claims 21-23 retain all claim limitations of the corresponding original independent claims 1, 6 and 13 with no claim language deleted.”). Our analysis of claim 13 above includes a summary of Petitioner's arguments for claim 1 and our findings based upon the portions of Louvel, Kroo, and Nagamitsu that Petitioner relies. We apply those same arguments and findings below in our analysis of substitute claim 22.

a) A method for operating a radio controlled (RC) drone that is remote from a hand-held controller,

Petitioner relies on the Abstract and Figure 13 of Louvel and on page 26 of Kroo for teaching the preamble of claim 1. Pet. 22–23, 32–33, 51. Patent Owner does not present arguments specifically for the identical preamble recited by proposed substitute claim 22. *See generally* Mot.; PO Reply.

Regardless of whether the preamble is limiting, Petitioner has shown that the recitation in the preamble is satisfied by the prior art. Based on the full record before us, because Louvel teaches a light aircraft remotely controlled and Kroo teaches a rotorcraft commanded from a radio-controlled transmitter, Petitioner persuades us that Louvel and Kroo teach a “method for operating a radio controlled (RC) drone that is remote from a hand-held controller.”

- b) wherein the RC drone is a quadcopter multi-rotor flying craft having four electrically powered motors, each motor driving at least one blade configured to provide aerodynamic lift for the quad-copter multi-rotor flying craft, a battery system operably coupled to the motors,*

Petitioner relies on Louvel’s Abstract; paragraphs 2–8, 29, 30, and 38; Figures 1, 3, and 13; and claim 9 and on pages 17–20 and 24–26 and Figures 2 and 5 of Kroo. Pet. 23–25, 27–30, 32, 51. Patent Owner does not present arguments specifically for the identical limitation recited by proposed substitute claim 22. *See generally* Mot.; PO Reply.

Based on the full record before us, because Louvel teaches an aircraft with four propellers driven by electric motors providing lift (Ex. 1004 ¶¶ 8, 29, 30, 38) and because Kroo teaches electrically driven rotors using batteries (Ex. 1006, 17, 19, 20), Petitioner persuades us that Louvel and Kroo teach “wherein the RC drone is a quadcopter multi-rotor flying craft having four electrically powered motors, each motor driving at least one blade configured to provide aerodynamic lift for the quad-copter multi-rotor flying craft, a battery system operably coupled to the motors.”

- c) and a control system that includes control circuitry and a sensor system, the method comprising*

Petitioner contends that Louvel teaches the original limitation of claim 6. Pet. 52 (citing Ex. 1003 ¶ 104; Ex. 1004 ¶¶ 20–21, 59–61, Fig. 9). We find that Figure 9 of Louvel shows a diagram of a closed loop control circuit. *See also* Ex. 1004 ¶¶ 20, 59–61 (describing Fig. 9).

Patent Owner does not present arguments specifically for the identical limitation recited by proposed substitute claim 22. *See generally* Mot.; PO Reply. Based on the full record before us and our findings from Louvel, Petitioner persuades us that Louvel teaches “a control system that includes control circuitry and a sensor system.”

- d) using a sensor system in the hand-held controller to dynamically sense a gravitational reference as an inertial reference for the handheld controller and a relative tilt of the hand-held controller with respect to the gravitational reference in response to a user selectively holding ~~orienting~~ the hand-held controller in a position that is tilted relative to the gravitational reference;*

Petitioner relies on page 26 of Kroo (Pet. 36) and descriptions related to Figure 4 of Nagamitsu (Pet. 37–38 (citing Ex. 1010, 12:10–30, 15:25–46, Fig. 4)). Petitioner also relies on Nagamitsu. *Id.* at 39–44 (citing Ex. 1010, 12:10–30, Fig. 4); *see also id.* at 51 (matching arguments for limitations of claim 6 to arguments made for limitations of claim 1).

In our analysis above of a similar limitation in proposed substitute claim 21, we summarize the parties’ position and our findings from Nagamitsu. Because Nagamitsu teaches a 3-D mouse that includes accelerometer 36 and that detects a direction of gravity to determine changes in angles, movements, and acceleration to change moving speed and

direction, Petitioner persuades us that Nagamitsu teaches the above-quoted limitation.

- e) *communicating control commands corresponding to a desired orientation of the RC drone based on the relative tilt of the handheld controller by radio communications between the hand-held controller and the RC drone;*

Petitioner relies on Kroo and Nagamitsu for teaching this original limitation of claim 6. Pet. 32–33, 36–44, 51 (Ex. 1003 ¶¶ 64–65; Ex. 1006, 26; Ex. 1010, 12:10–30, 15:25–46, Fig. 4). Patent Owner does not present arguments specifically for the identical limitation recited by proposed substitute claim 22. *See generally* Mot.; PO Reply.

Based on the full record before us, because Kroo teaches that a rotorcraft is commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter and because Nagamitsu teaches a 3-D mouse that includes accelerometer 36 and that detects a direction of gravity to determine changes in angles, movements, and acceleration to change moving speed and direction, Petitioner persuades us that Kroo and Nagamitsu teach “communicating control commands corresponding to a desired orientation of the RC drone based on the relative tilt of the handheld controller by radio communications between the hand-held controller and the RC drone.”

- f) *using the control circuitry and the sensor system in the RC drone to dynamically sense a gravitational reference as an inertial reference for the RC drone and determine an actual orientation of the RC drone*

Petitioner relies on Louvel and Kroo for teaching this original limitation of claim 6. Pet. 32–33 (citing Ex. 1003 ¶¶ 64–65; Ex. 1006, 26), 46–48 (citing Ex. 1004 ¶¶ 42–46, 75–78, 91, 94–95, 119–121, Fig. 4), 51. Patent Owner does not present arguments specifically for the identical

limitation recited by proposed substitute claim 22. *See generally* Mot.; PO Reply.

Based on the full record before us, because Louvel teaches how to control pitch, roll, yaw, and attitude by changing propeller speed and because Kroo teaches a rotorcraft commanded using a conventional pulse-width modulated signal from a radio-controlled transmitter, Petitioner persuades us that Louvel and Kroo teach “using the control circuitry and the sensor system in the RC drone to dynamically sense a gravitational reference as an inertial reference for the RC drone and determine an actual orientation of the RC drone.”

g) and automatically and dynamically control a downwardly directed thrust produced by each motor and each motor's at least one blade to achieve and maintain the actual orientation of the RC drone in a position that mimics the position of the hand-held controller in response to the desired orientation communicated in the control commands from the hand-held controller.

Petitioner relies on Louvel for teaching the original limitation recited by claim 6. Pet. 23–26 (citing Ex. 1004 Abstract, ¶¶ 2–8, 29, 30, 38, Figs. 1, 3, 13, claim 9), 31–32 (citing Ex. 1004, Figs. 1–3), 49–50 (citing Ex. 1004 ¶¶ 96–119). In our analysis above of a similar limitation in proposed substitute claim 21, we summarize the parties' position regarding “mimic.”

Based on the full record, because Louvel teaches how to control pitch, roll, yaw, and attitude by changing propeller speed, Petitioner persuades us that Louvel teaches the above-quoted limitation of proposed substitute claim 22.

- h) such that the RC drone and the hand-held controller implement an orientation control scheme in which the actual orientation of the RC drone is controlled to achieve and then maintain an attitude of the RC drone so as to mimic the position of the hand-held controller when the hand-held controller is held by the user in the position that is tilted relative to the gravitational reference.

In our analysis above of a similar limitation in proposed substitute claim 21, we summarize the parties' position regarding "orientation control scheme." Based on the full record, because Louvel teaches changing orientation by changing propeller speed and converging to a horizontal, normal attitude and because Nagamitsu teaches a 3-D mouse that detects a direction of gravity to determine changes in angles, movements, and acceleration to change moving speed and direction, Petitioner persuades us that Louvel and Nagamitsu teach the above-quoted recitation.

3. *Analysis of Proposed Substitute Claim 23*

"If the Board finds instituted claim 13 unpatentable," Patent Owner "submits contingent substitute claim 23 to expressly require that this claim requires an 'orientation control scheme.'" Mot. 2. For the reasons discussed above in Section II, Petitioner persuades us by a preponderance of the evidence that claim 13 is unpatentable over Louvel, Kroo, Nagamitsu, and Hall.

Proposed substitute claim 23 includes all the limitations of claim 13. *Compare* Mot. 29–30 *with* Ex. 1001, 17:17–18:6. For the limitations recited by proposed substitute claim 23 that are found identically in claim 13, Petitioner persuades us that Louvel, Kroo, Nagamitsu, and Hall teach those limitations for the reasons stated in Section II.E.2.

Proposed substitute claim 23 additionally recites:

such that the control system of the RC drone and the software in the hand-held controller implement an orientation control scheme in which an actual orientation of the RC drone is controlled to achieve and then maintain an attitude of the RC drone so as to mimic the position of the hand-held controller when the hand-held controller is held by the user in the position that is tilted relative to the gravitational reference.

Mot. 30 (labeled as “23[g]”).

In our analysis above of a similar limitation in proposed substitute claim 21, we summarize the parties’ position regarding “orientation control scheme.” Based on the full record, because Louvel teaches changing orientation by changing propeller speed and converging to a horizontal, normal attitude and because Nagamitsu teaches a 3-D mouse that detects a direction of gravity to determine changes in angles, movements, and acceleration to change moving speed and direction, Petitioner persuades us that Louvel and Nagamitsu teach the above-quoted recitation.

4. Rationale

Above in Section II.E.2.g, we determine that Petitioner shows that one of ordinary skill in the art would have had reasons to combine Louvel and Kroo. *See* Pet. 33–34. Patent Owner does not provide arguments that dispute Petitioner’s asserted reasons for combining Louvel and Kroo based on the amendments shown in proposed substitute claims 21–23.

Also, above in Section II.E.2.g, we determine that Petitioner shows that one of ordinary skill in the art would have combined Louvel as modified by Kroo with the teachings of Nagamitsu. In the same section, we also determine that Petitioner shows that one of ordinary skill in the art would have combined Louvel as modified by Kroo with the teachings of Hall.

Patent Owner presents arguments that are substantively similar to the ones discussed above for claim 13. *Compare* Mot. 12–25, *with* PO Resp.

30–57; *see also* Pet. Sur-Reply 4 (contending that “PO’s Reply recites truncated versions of its assertions in its Motion to Amend and Patent Owner’s Response”). Petitioner provides arguments similar to ones summarized above for claim 13. *Compare* Opp. 12–25, *with* Pet. Reply 12–25.

For the reasons stated above in Section II.E.2.g., Petitioner persuades us that one of ordinary skill in the art would have combined Louvel as modified by Kroo with the teachings of Nagamitsu alone or with the teachings of Nagamitsu and Hall.

5. *Objective Indicia of Nonobviousness*

Patent Owner asserts alleged objective evidence of non-obviousness. PO Sur-Reply 20–21. The proffered objective evidence of non-obviousness include the Examiner’s reasons for allowance of the ’580 patent. *See id.* Because these arguments are more related to Petitioner’s asserted reason for combining the references, we determine that there are no objective evidence of non-obviousness in the record.

For same the reasons discussed above for a similar argument regarding the ’580 patent for claim 13, we determine Petitioner provides sufficient reason for why one of ordinary skill in the art would have combined the asserted references at arrive at proposed substitute claims 21–23.

6. *Weighing the Graham Factors*

Above, based on full record before us, we provide our factual findings regarding (1) the level of ordinary skill in the art, (2) the scope and content

of the prior art, (3) any differences between the claimed subject matter and the prior art, and (4) objective evidence of nonobviousness.

In particular, we find that (1) the parties agreed to level of ordinary skill in the art is consistent with the prior art of record, (2) Louvel, Kroo, Nagamitsu, and Hall teach all the limitations of proposed substitute claims 21–23, (3) one of ordinary skill in the art would have had a reason to modify Louvel with the teachings of at least one of Kroo, Nagamitsu, and Hall with a reasonable expectation of success, and (4) there is no objective evidence of nonobviousness in the record.

Weighing these underlying factual determinations, a preponderance of the evidence persuades us that proposed substitute claims 21 and 22 are unpatentable over Louvel, Kroo, and Nagamitsu and that proposed substitute claim 23 is unpatentable over Louvel, Kroo, Nagamitsu, and Hall.

7. Other Arguments

The parties also dispute the issue of collateral estoppel and the alleged bias of Patent Owner’s declarant. Opp. 1–4, 10–11; PO Reply 2, 3; Pet. Sur-Reply 1–4. We address both of those disputes above in Section II.K.

IV. CONCLUSION⁴

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1, 6	103	Louvel, Kroo, Nagamitsu ⁵		
2, 3, 7, 8	103	Louvel, Kroo, Nagamitsu, Talbert		
4, 9	103	Louvel, Kroo, Nagamitsu, Gabai		
5, 10	103	Louvel, Kroo, Nagamitsu, Rehkemper		
13	103	Louvel, Kroo, Nagamitsu, Hall	13	
15, 17	103	Louvel, Kroo, Nagamitsu, Hall, Talbert	15, 17	
14	103	Louvel, Kroo, Nagamitsu, Hall, Gabai	14	

⁴ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

⁵ As explained above in Section II.D., we do not address the challenges to claims 1–10 based on Louvel, Kroo, and Nagamitsu or the same references further combined with Talbert, Gabai, or Rehkemper because Patent Owner “has elected in this proceeding to pursue a non-contingent cancellation of instituted claims 1–10 in view of the Motion to Amend.” PO Resp. 2.

16	103	Louvel, Kroo, Nagamitsu, Hall, Rehkemper	16	
13	103	Louvel, Kroo, Hall ⁶		
15, 17	103	Louvel, Kroo, Hall, Talbert		
14	103	Louvel, Kroo, Hall, Gabai		
16	103	Louvel, Kroo, Hall, Rehkemper		
Overall Outcome			13–17	

Motion to Amend Outcome	Claim(s)
Original Claims Cancelled by Amendment	1–10
Substitute Claims Proposed in the Amendment	21–23
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	21–23
Substitute Claims: Not Reached	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that that claims 13–17 of U.S. Patent No. 9,904,292 B2 have been shown, by a preponderance of the evidence, to be unpatentable;

⁶ As explained above in Section II.K., we do not reach the challenges to claims 13–16 based on Louvel, Kroo, and Hall or the same references further combined with Talbert, Gabai, or Rehkemper because the same claims are determined unpatentable based on Louvel, Kroo, Nagamitsu, and Hall or these same references further combined with one of Gabai, Talbert, and Rehkemper.

FURTHER ORDERED that Patent Owner's request in its Motion to Amend to cancel claims 1–10 non-contingently is granted;

FURTHER ORDERED that Patent Owner's request in its Motion to Amend to substitute proposed claims 21–23 is denied; and

FURTHER ORDERED that, because this is a Final Written Decision, the 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.

IPR2018-01690
Patent 9,904,292 B2

FOR PETITIONER:

James M. Glass
Matthew A. Traupman
Sean T. Gloth
QUINN EMANUEL URQUHART & SULLIVAN LLP
jimglass@quinnemanuel.com
matthewtraupman@quinnemanuel.com
seangloth@quinnemanuel.com

FOR PATENT OWNER:

Brad D. Pedersen
QFO LABS, INC.
bpedersen@qfolabs.com

Charles A. Lemaire
Jonathan M. Rixen
LEMAIRE PATENT LAW FIRM
clemaire@lemairepatent.com
jrixen@lemairepatent.com