

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

QFO LABS, INC.,
Patent Owner.

Case IPR2016-01559
Patent 9,073,532 B2

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

JUNG, *Administrative Patent Judge*.

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

I. INTRODUCTION

Parrot S.A., Parrot Drones S.A.S., and Parrot Inc. (“Petitioners”) filed a Petition (Paper 2, “Pet.”), requesting institution of an *inter partes* review of claims 1–24 of U.S. Patent No. 9,073,532 B2 (Ex. 1001, “the ’532 patent”). QFO Labs, Inc. (“Patent Owner”) timely filed a Preliminary Response (Paper 6). Upon considering the Petition and the Preliminary Response, we instituted *inter partes* review of claims 8–14 of the ’532 patent. Paper 15 (“Dec. on Inst.”).

After institution, Patent Owner filed a Response (Paper 25, “PO Resp.”)¹ and a Contingent Motion to Amend (Paper 26, “Mot.”). Petitioners filed a Reply (Paper 37, “Pet. Reply”) and an Opposition to Patent Owner’s Contingent Motion to Amend (Paper 38), to which Patent Owner filed a Reply to Petitioner Opposition to Contingent Motion to Amend (Paper 39). Because of then-recently issued *en banc* decision in *Aqua Products, Inc. v. Matal*, 872 F.3d 1290 (Fed. Cir. 2017) (“*Aqua Products*”), the parties requested, and we authorized, additional briefing regarding Patent Owner’s Contingent Motion to Amend. Paper 43. Petitioners thereafter filed a Brief in Opposition to Patent Owner’s Contingent Motion to Amend (Paper 47), and Patent Owner filed a Reply to Petitioner Opposition to Contingent Motion to Amend (Paper 48), to which Petitioners filed a Sur-Reply Brief in Opposition to Patent Owner’s Contingent Motion to Amend (Paper 51).

Petitioners proffered a Declaration of Prof. Girish Chowdhary, Ph.D. in Support of Petition (Ex. 1003, “First Chowdhary Declaration” or “1st Chowdhary Decl.”), a Declaration of Prof. Girish Chowdhary, Ph.D. in

¹¹ See also Paper 27 (correcting certain citations from Ex. 1006 to Ex. 1005 or from Ex. 1007 to Ex. 1006).

Support of Petitioners' Opposition to Patent Owner's Contingent Motion to Amend and Its Reply to Patent Owner's Response (Ex. 1030, "Second Chowdhary Declaration"), and a Declaration of Prof. Girish Chowdhary, Ph.D. in Support of Petitioners' Brief in Opposition to Patent Owner's Contingent Motion to Amend (Ex. 1035, "Third Chowdhary Declaration" or "3d Chowdhary Decl."). Patent Owner proffered a Declaration of John P. Condon (Ex. 2005, "1st Condon Decl.") with its Preliminary Response and a Second Declaration of John P. Condon (Ex. 2013, "Second Condon Declaration" or "2d Condon Decl.") with its Response. A deposition transcript for Mr. Condon (Ex. 1034) was filed, but no deposition transcript was filed for Prof. Chowdhary.

A joint oral hearing in this proceeding and Case IPR2016-01550 was held on November 15, 2017; a transcript of the hearing is included in the record (Paper 54, "Tr.").

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 Petitioners have shown by a preponderance of the evidence that 8–14 of the '532 patent are unpatentable. Also based on the entirety of the record, we *deny* Patent Owner's Contingent Motion to Amend.

A. Grounds of Unpatentability at Issue

We instituted *inter partes* review on the grounds that, under 35 U.S.C. § 103(a):

- (1) claims 8–12 and 14 are unpatentable over Louvel², Thomas³, and Jimenez⁴;
- (2) claims 10 and 11 are unpatentable over Louvel, Thomas, Jimenez, and Yavnai⁵; and
- (3) claim 13 is unpatentable over Louvel, Thomas, Jimenez, and Gabai⁶. Dec. on Inst. 36.

B. Related Proceedings

Patent Owner indicates that the '532 patent, U.S. Patent No. 7,931,239 B2 (“the '239 patent”) (Ex. 2002), and U.S. Patent No. 9,645,580 B2 (“the '580 patent”) (Ex. 2012) are involved in case 1:16-cv-00682-GM in the U.S. District Court for the District of Delaware. Paper 4, 2; Paper 14, 3; PO Resp. 11; Paper 44, 3; Paper 52, 3; *see also* Pet. 76 (indicating intent to file an action in the District of Delaware). The parties indicate that the '532 patent issued from a continuation application of the '239 patent, and the '580 patent issued from a continuation application of the '532 patent. Pet. 76; Paper 14, 1–2; Paper 14, 1–2; Mot. 4–5; PO Resp. 9; Paper 44, 2; Paper 52, 2.

Patent Owner also indicates that the '239 patent, the '532 patent, and the '580 patent were asserted against Petitioners in case 0:16-cv-03443-JRT-

² US 2002/0104921 A1, published Aug. 8, 2002 (Ex. 1004).

³ US 5,128,671, issued July 7, 1992 (Ex. 1005).

⁴ US 2002/0106966 A1, published Aug. 8, 2002 (Ex. 1006).

⁵ US 6,588,701 B2, issued July 8, 2003 (Ex. 1007).

⁶ US 2001/0021669 A1, published Sept. 13, 2001 (Ex. 1008).

HB (D. Minn.) and in *QFO Labs, Inc. v. Brookstone Stores, Inc.*, case 0:17-cv-01100-JNE-SR (D. Minn.), both of which were dismissed. Paper 14, 3–4; PO Resp. 11; Paper 44, 3–4; Paper 52, 3–4; Ex. 1027. Patent Owner further indicates that the '239, '532, and '580 patents have been asserted in *QFO Labs, Inc. v. Amazon.com, Inc.*, case 0:17-cv-05014-DWF-HB (D. Minn.); *QFO Labs, Inc. v. Best Buy Co., Inc.*, case 0:17-cv-5011-JNE-TNL (D. Minn.); and *QFO Labs, Inc. v. Target Corp.*, case 0:17-cv-05012-JRT-DTS (D. Minn.). Paper 52, 4–5.

The '532 patent is also the subject of Case IPR2017-01090; the '239 patent is the subject of Cases IPR2016-01550 and IPR2017-01089; and the '580 patent is the subject of Case IPR2017-01400. Paper 4, 1–2; Paper 14, 1–2; PO Resp. 11; Paper 44, 2–3; Paper 52, 2; Ex. 1026; Ex. 2014. We denied institution in IPR2017-01089, IPR2017-01090, and IPR2017-01400.

C. The '532 Patent (Ex. 1001)

The '532 patent relates to a “homeostatic flying hovercraft and to a radio controlled flying saucer toy employing the [principles] of a homeostatic flying hovercraft.” Ex. 1001, 1:19–25. Figure 21 of the '532 patent is reproduced below:

Fig.21

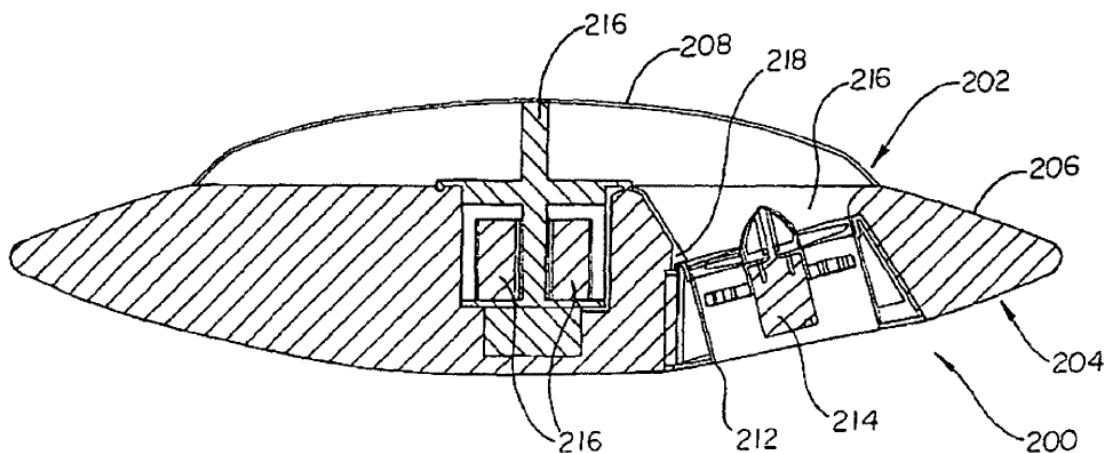


Figure 21 illustrates a “side cutaway view” of a “preferred embodiment of a homeostatic flying hovercraft.” *Id.* at 8:48–50, 58–59, 9:18–20. Homeostatic flying craft 200 has upper surface 202, bottom surface 204, four duct openings 212 on bottom surface 204, and battery-powered ducted fan 214 mounted inboard from each duct opening 212. *Id.* at 9:20–33. Each fan 214 is powered from an internal pair of batteries 216. *Id.* at 9:45–46; *see also id.* at 12:35–13:7 (describing embodiment of Figs. 1–3).

Homeostatic control system 300 is “operably connected to 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 11:1–10; *see also id.* at 10:35–45 (also describing a homeostatic control system and XYZ sensor arrangement before stating “[f]inally, the RC aircraft has . . .”). XYZ sensor arrangement 302 “comprises an X-axis sensor system, a Y-[axis] sensor system[,] and a Z-axis sensor system.” *Id.* at 11:20–23. “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.” Ex. 1001, 11:23–26. The Y-axis and Z-axis sensor systems are similarly configured. *Id.* at 11:26–32. “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 11:33–37. 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 11:38–43. 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 11:44–47.

Figure 22a of the '532 patent is reproduced below:

Fig.22a

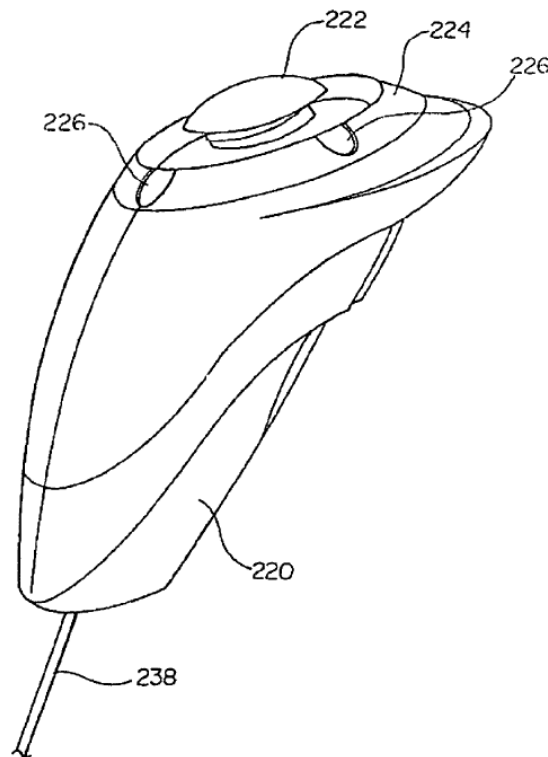


Figure 22a is an isometric view of a hand-held “bee controller.” Ex. 1001, 8:60–61, 9:53–54. A radio-controlled (“RC”) controller 220 “includes a body adapted to be held in one hand” and a “homeostatic control system IS positioned within the body.” *Id.* at 10:18–22. A user selectively positioning an orientation of RC controller 220 provides a “desired orientation.” *Id.* 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 10:22–26. RC 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 10:26–30; *see also id.* at 13:17–29 (describing embodiment of Figs. 1–3).

D. Illustrative Claim

The ’532 patent has 24 claims, of which claims 8–14 are at issue. Of those, claim 8, reproduced below, is the only independent claim.

8. A system that includes a radio controlled (RC) flying hovercraft controlled by a handheld RC controller separate and remote from the RC flying hovercraft, the system comprising:

an RC flying hovercraft that includes a set of generally downwardly directed thrusters, each thruster including at least one blade driven by an electrically powered motor to provide aerodynamic lift for the RC flying hovercraft;

an electrical-power system attached to the flying hovercraft and electrically coupled to the set of thrusters;

a control system that is attached to the RC flying hovercraft and operably connected to the thrusters and that automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the RC flying hovercraft, the control system including at least a three dimensional, three-axis sensor system and associated control circuitry that dynamically determines a gravitational reference other than by dead reckoning alone for use by the control system in automatic control of said thrusters to maintain stabilization of the RC flying hovercraft in the desired orientation that is responsive to radio frequency (RF) communications from the RC controller;

a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation received from the RC controller is based on at least a

two dimensional, two-axis sensed orientation of the RC controller itself;

a sensor system in the control system of the RC flying hovercraft configured to dynamically determine an actual orientation of the RC flying hovercraft, the sensor system including at least a three-dimensional, three-axis sensor; and

wherein the control system in the RC flying hovercraft automatically and dynamically controls a thrust produced by each of the thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in response to the desired orientation received from 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 control of moment-to-moment balance and stabilization of the RC flying hovercraft.

Ex. 1001, 16:19–64.

II. CLAIM CONSTRUCTION

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard).

In the Decision on Institution, we determined that express interpretation of any term, including “homeostatic” and “orientation” for which Patent Owner proposed interpretations, was not necessary. Dec. on Inst. 8. *See also* Pet. 14 (stating that “for purposes of this IPR, no construction of any claim term is needed”).

Patent Owner quotes from the Decision on Institution “[f]or purposes of this Decision, we determine that express interpretations of these terms or any other terms are not necessary” and states that “[f]or purposes of [Patent

Owner's] Response, Patentee accepts this BRI construction.” PO Resp. 16 (quoting Dec. on Inst. 8). Patent Owner also maintains that the “proper construction under the *Markman* standard [(*Markman v. Westview Instruments*, 116. S. Ct. 1384, (1996))] of the term ‘orientation’ as used in the ’532 patent does not encompass either ‘position’ control or ‘motion’ control” and “expressly reserves the right to argue for such a claim construction under the *Markman* standard in any litigation proceedings.” *Id.* n.5.

We understand Patent Owner to be agreeing that, if interpretation of claims terms was required, those terms should be interpreted according to their broadest reasonable construction in light of the specification of the ’532 patent. See Tr. 29:9–31:17, 32:14–25. We also understand Patent Owner to be accepting that express interpretations of “homeostatic” and “orientation” are not necessary for this proceeding.

After reviewing the complete record, we agree with the parties that express interpretation of any claim term is not necessary for determining whether Petitioners have carried their burden of proving claims 8–14 unpatentable by a preponderance of the evidence. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (construing only those terms in controversy and only to the extent necessary to resolve the controversy); see Pet. 14; PO Resp. 16; Tr. 29:9–31:17, 32:14–25.

III. CHALLENGES TO CLAIMS 8–14

Petitioners contend that (1) claims 8–12 and 14 are obvious in view of Louvel, Thomas, and Jimenez; (2) claims 10 and 11 are obvious in view of Louvel, Thomas, Jimenez, and Yavnai; and (3) claim 13 is obvious in view

of Louvel, Thomas, Jimenez, and Gabai. Pet. 40–42 (also referring to the same arguments made against claim 1 for the unpatentability of claim 8), 44–59; *see also id.* at 30–39 (arguing claim 1 is unpatentable over Louvel, Thomas, and Jimenez). In support of these contentions, Petitioners cite to Louvel, Thomas, Jimenez, Yavnai, Gabai, and the First and Second Chowdhary Declarations (Exs. 1003, 1030). *See* Pet. 30–59; Pet. Reply 3–25. Patent Owner disputes the alleged unpatentability of independent claim 8 supported by citations to the asserted references and the Second Condon Declaration (Ex. 2013). *See* PO Resp. 12 (stating that the “grounds instituted by the Decision all hinge upon whether independent system claim 8 is unpatentable), 15–52, 53 (concluding that the “Petition has failed to show by a preponderance of the evidence that independent system claim 8 is unpatentable”).

To prevail in their challenges, under 35 U.S.C. § 103, of (1) claims 8–12 and 14 as obvious in view of Louvel, Thomas, and Jimenez; (2) claims 10 and 11 as obvious in view of Louvel, Thomas, Jimenez, and Yavnai; and (3) claim 13 as obvious in view of Louvel, Thomas, Jimenez, and Gabai, Petitioners 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 (1996).

As discussed below, the parties’ disputes are related to the scope and content of the prior art, differences between claim 8 and the prior art, and Petitioners’ rationales for combining the asserted references. The parties do not dispute the level of ordinary skill in the art, and the parties have not directed us to any objective evidence of nonobviousness.

After reviewing the complete record, we conclude that Petitioners have shown by a preponderance of the evidence that Louvel, Thomas, and Jimenez with or without at least one of Yavnai and Gabai teach or suggest each limitation of claims 8–14, that a person of ordinary skill in the art would have had a reason to combine the teachings of the asserted references, and that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of the asserted references.

A. Level of Ordinary Skill

Petitioners contend that one of ordinary skill in the art “would have a Bachelor of Science in Aerospace engineering, or a comparable degree, in combination with at least two years of practical experience in the field.” Pet. 13–14 (citing Ex. 1003 ¶ 46). Patent Owner states that it “generally agrees with Petitioners that a person of ordinary skill . . . would possess a Bachelor’s of Science degree in aeronautical or electrical engineering with at least two years of practical experience in the design and development of remote control aircraft.” PO Resp. 15 (citing Pet. 13; Ex. 2013 ¶ 13).

We adopt the parties’ agreed to level of ordinary skill and find that one 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. 13–14). We note that any differences in the parties’ asserted level of ordinary skill would not impact our analysis.

B. 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.

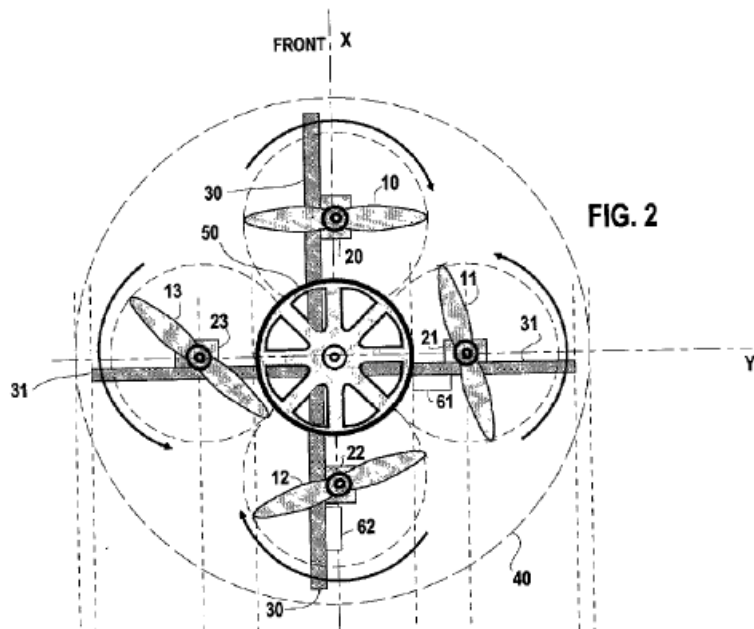
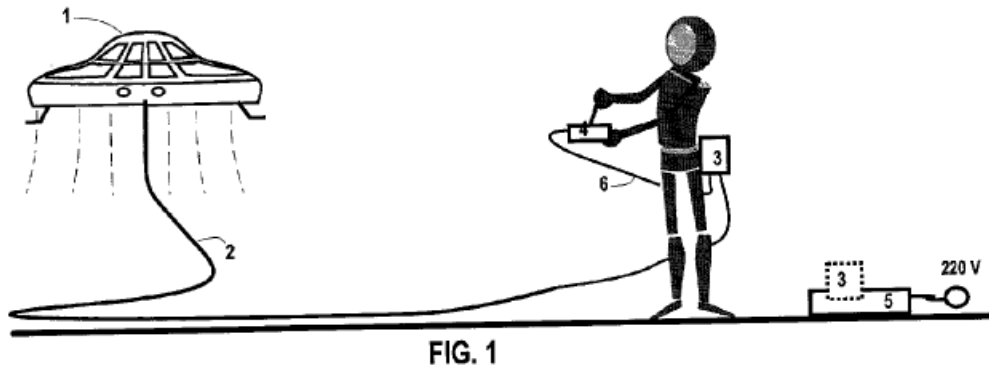


Figure 1 shows the invention of Louvel, including the exterior of aircraft 1; and Figure 2 shows a top view of an interior of aircraft 1. Ex. 1004 ¶¶ 12, 13. Aircraft 1 “has a general shape looking like a flying saucer.” *Id.* ¶ 25. Aircraft 1 has four propellers 10, 11, 12, 13 with vertical axis to provide lift thrust, and each propeller 10–13 is driven independently by electric motor 20, 21, 22, 23. *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 62, and yaw sensor 63. *Id.* ¶¶ 42–44, 46.

Aircraft 1 is linked to control unit 3, which is also linked to handling unit 4. *Id.* ¶¶ 25, 26. Control unit 3 includes rechargeable battery 80 that supplies enough current to the electric motors of aircraft 1 for several minutes. Ex. 1004 ¶ 60.

Figure 5 of Louvel is reproduced below.

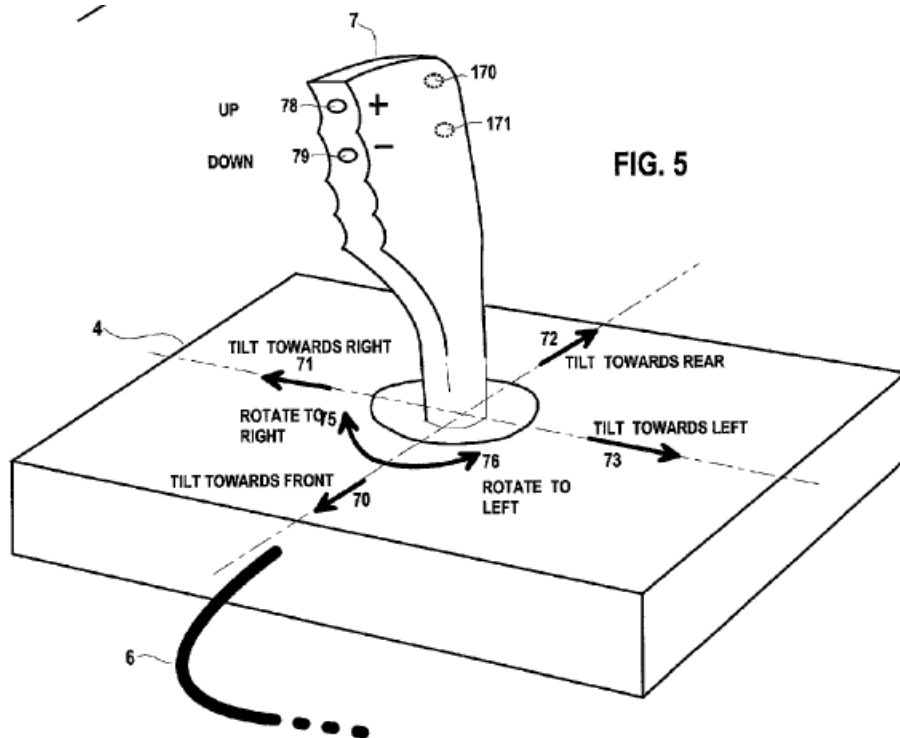


Figure 5 shows handling unit 4. *Id.* ¶¶ 16, 50. Handling unit 4 includes handle 7 and is linked to the control unit. *Id.* ¶ 49. Pushing handle 7 towards direction 70, 72, 71, or 73 causes aircraft 1 to tilt towards the front side, the rear side, the right side, or the left side, respectively, and turning handle 7 in direction 75 or 76 causes aircraft 1 to rotate towards the right or left. *Id.* ¶¶ 51–53.

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. For example, if sensor 62 indicates that aircraft 1 is tilting towards the rear, then speed of propeller 12 is increased, speed of propeller 10 is decreased, and speeds of propellers 11, 13 are unchanged. *Id.* ¶ 98.

C. Thomas (Ex. 1005)

Thomas relates to a “hand-held control device detecting multiple degrees of freedom of movement.” Ex. 1005, 1:7–9. According to Thomas, “[i]n the past joysticks of various kinds have been used” that “comprise a lever with a handle at one” and the “other end of the lever is attached to . . . potentiometers” so that “[m]ovement of the handle . . . generates electrical signals which stimulate an electrical object.” *Id.* at 1:11–17. Thomas utilizes “accelerometers of various kinds in small packages some of which incorporate electronic signal processing” in a “hand-held joystick able to

detect at least six degrees of freedom of movement.” *Id.* at 1:26–31. Figure 1 of Thomas is reproduced below.

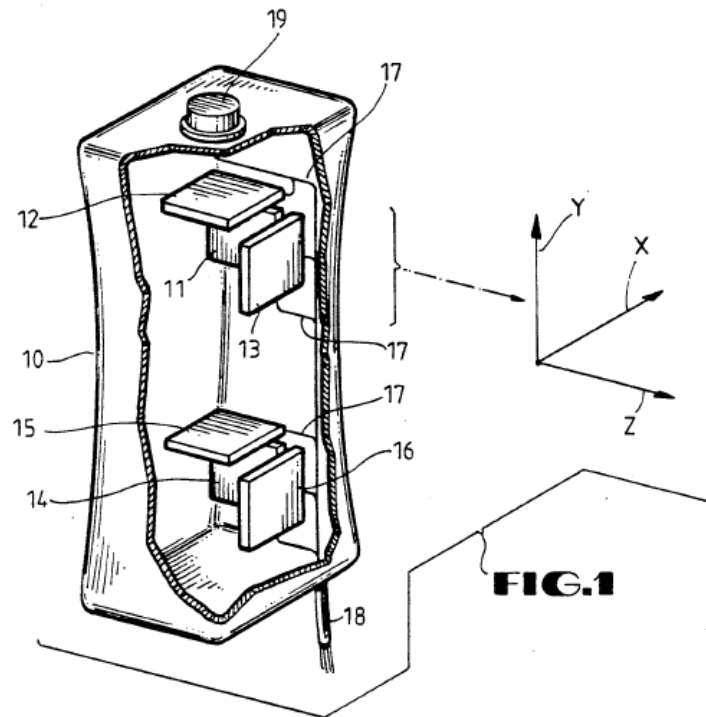


Figure 1 illustrates a “partly broken away” view of a “hand-held joystick using six accelerometers.” Ex. 1005 at 1:59–61. Hand-held enclosure 10 is “not mounted to swivel about some fixed anchor point” and “is held by the user as a pistol-grip type of hand-held device, free from any mechanical connection to a supporting structure.” *Id.* at 2:15–19. It supports two sets of three mutually-perpendicular accelerometers 11, 12, 13, 14, 15, 16. *Id.* at 2:12–14. The geometric configuration of the accelerometers uniquely identifies any combination of translations or linear motions along X, Y, and Z axes and rotations about X, Y, and Z axes. *Id.* at 2:60–3:3.

For example, if housing 10 is moved linearly along the X axis, accelerometers 11, 14 “produce equal signals of the same sign, and all the other accelerometers produce no signal.” *Id.* at 3:3–6. Linear motion along

the Y axis causes accelerometers 12, 15 to generate signals, and linear motion along the Z axis causes accelerometers 13, 16 to generate signals. *Id.* at 3:6–10. The signals from accelerometers 11–16 are sent to conditioning circuitry 26 via cable 18. *Id.* at 2:24–29, 3:43–50.

“Alternatively, the cable 18 may be omitted altogether and a wireless RF transmitter may be employed, transmitting the signals generated by the accelerometers 11–16 to a receiver in the computer 28.” *Id.* at 3:62–65. The hand-held joystick can replace “the joystick, pedals, throttle assembly, trim controls and other input devices on an aircraft such as a helicopter” or “may be used to control robots.” *Id.* at 4:9–13, 26–27.

D. Jimenez (Ex. 1006)

Jimenez relates to a “radio controlled toy blimp.” Ex. 1006 ¶ 2. “The blimp includes conventional radio frequency remote control means known to the art for controlling vertical and horizontal flight patterns.” *Id.* ¶ 14. Figure 3 of Jimenez is reproduced below.

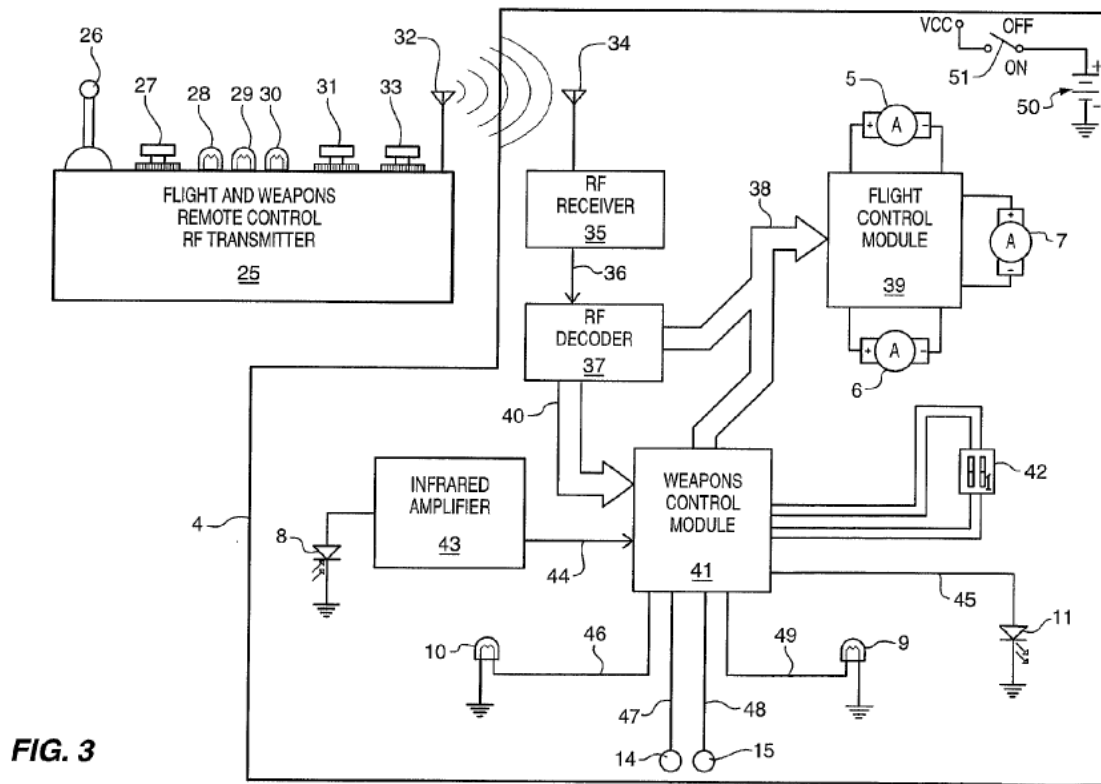


Figure 3 is an electrical block diagram of printed circuit board 4. *Id.* ¶ 25. A gondola is attached to an underside of the blimp, and the gondola includes printed wired circuit board 4. *Id.* ¶¶ 14, 23, 24, 31. It shows “remote control RF transmitter 25 which the pilot employs to transmit flight . . . commands to blimp 1.” *Id.* “The pilot uses joy stick 26 to change the direction and/or elevation of the blimp 1” and “remote control RF transmitter 25 . . . is used . . . to transmit flight . . . commands to the blimp 1.” *Id.* ¶ 35. “The flight . . . commands are transmitted from antenna 32 to antenna 34” and “transformed into a series of binary ones and zeros by RF Receiver 35 and supplied via wire 36 to RF decoder 37 where they are assembled into distinctive binary codes representing flight . . . commands.” *Id.*

E. Independent Claim 8

Petitioners contend that the limitations of independent claim 8 are disclosed by Louvel, Thomas, and Jimenez. Pet. 40–42; *see also id.* at 8–10 (assigning labels to limitations of claims 1 and 8).

1. “A system that includes a radio controlled (RC) flying hovercraft controlled by a handheld RC controller separate and remote from the RC flying hovercraft”

Petitioners persuade us that Louvel teaches a “system that includes a radio controlled (RC) flying hovercraft controlled by a handheld RC controller separate and remote from the RC flying hovercraft” (Ex. 1001, 16:19–21). Pet. 9 (labeling this portion of claim 8 as “8a”), 30–32 (citing Ex. 1004 Abstract, ¶¶ 1, 24–26, 29, 30, 38, 49, 51–53, Figs. 1, 2, 5 for “[l]imitations 1a and 1b”), 40 (correlating arguments for “1a” with “8a”).

In particular, we find that that Louvel teaches a “light aircraft, . . . remotely controlled” (Ex. 1004 Abstract), “a light aircraft, like a flying saucer, remotely controlled” (*id.* ¶ 1), “handling unit (4) . . . handled by the user and [] linked to the control unit (3)” (*id.* ¶ 26, Figs. 1, 5), “handling unit include[ing] a handle” (*id.* ¶ 49), “tilting of the aircraft towards the [front, rear, right, or left sides that] is achieved by pushing [or pulling] the handle towards [that] direction” (*id.* ¶¶ 51, 52, Fig. 5), and rotation of the aircraft that is achieved by turning the handle in the desired direction (*id.* ¶¶ 52, 53, Fig. 5). *See also* Ex. 1034, 28:24–25 (Patent Owner’s declarant stating “a hovercraft . . . generates lift using thrusters, downward-facing thrusters”), 151: 20–23 (Patent Owner’s declarant agreeing that “remote controlled hovercraft were known way before ’239 and ’532 patents”), 153:8–22 (stating “[Louvel] generally describes a . . . type of hovercraft). Thus, we determine that Louvel teaches a system that includes a flying hovercraft

controlled by a handheld controller separate and remote from the flying hovercraft, as required by claim 8. Ex. 1001, 16:19–21.

The “radio controlled” and “RC controller” recitations are addressed below. *See also* Pet. 32 (stating “a radio controller is expressly disclosed by Jimenez, as described in connection with limitation 1e”).

2. *“an RC flying hovercraft that includes a set of generally downwardly directed thrusters, each thruster including at least one blade driven by an electrically powered motor to provide aerodynamic lift for the RC flying hovercraft”*

Petitioners persuade us that Louvel teaches “an RC flying hovercraft that includes a set of generally downwardly directed thrusters, each thruster including at least one blade driven by an electrically powered motor to provide aerodynamic lift for the RC flying hovercraft” (Ex. 1001, 16:23–27). Pet. 9 (labeling this portion of claim 8 as “8b”), 30–32 (citing Ex. 1004 Abstract, ¶¶ 1, 24–26, 29, 30, 38, 49, 51–53, Figs. 1, 2, 5 for “[l]imitations 1a and 1b”), 41 (referring to the “same reasons discussed in connection with limitation 1b” and citing Ex. 1004 ¶ 29).

Specifically, we find that Louvel teaches an “aircraft include[ing] four propellers” (Ex. 1004 ¶ 29, Figs. 2, 3), “each propeller [] driven independently by an electric motor” (*id.* ¶ 30), and “air flow go[ing] through the aircraft” (*id.* ¶ 38, Figs. 1 (showing air flowing downwardly from aircraft 1), 11, 12). *See also* Ex. 1034, 28:24–25 (Patent Owner’s declarant stating “a hovercraft . . . generates lift using thrusters, downward-facing thrusters”). Thus, we determine that Louvel teaches a flying hovercraft that includes a set of generally downwardly directed thrusters, each thruster including at least one blade driven by an electrically powered motor to provide

aerodynamic lift for the flying hovercraft, as required by claim 8. Ex. 1001, 16:23–27.

3. *“an electrical-power system attached to the flying hovercraft and electrically coupled to the set of thrusters”*

Petitioners persuade us that Louvel teaches “an electrical-power system attached to the flying hovercraft and electrically coupled to the set of thrusters” (Ex. 1001, 16:28–29). Pet. 9 (labeling this portion of claim 8 as “8c”), 32 (citing Ex. 1004 ¶ 60 for “[l]imitation 1c”), 40 (correlating arguments for “1c” with “8c”).

We find that Louvel teaches an “electric rechargeable battery (80) which allows to supply enough current to the five electric motors of the aircraft.” Ex. 1004 ¶ 60; *see also id.* ¶ 35 (stating that a “gyroscopic rotor is driven by a fifth electric motor (51)”). We, therefore, determine that Louvel teaches “an electrical-power system attached to the flying hovercraft and electrically coupled to the set of thrusters,” as recited by claim 8. Ex. 1001, 16:28–29.

4. *“a control system that is attached to the RC flying hovercraft and operably connected to the thrusters and that automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the RC flying hovercraft”*

Petitioners persuade us that Louvel teaches “a control system that is attached to the RC flying hovercraft and operably connected to the thrusters and that automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the RC flying hovercraft” (Ex. 1001, 16:30–34). Pet. 9 (labeling this portion of claim 8 as “8d”), 32–

33 (citing Ex. 1004 ¶¶ 42–44, 88–91, 98 for “[l]imitation 1d”), 40 (correlating arguments for “1d” with “8d”).

In particular, we find that Louvel teaches calculating “values of current to be driven through each electric motor” (Ex. 1004 ¶ 90), the “calculation is intended to perform the flight control on a stable attitude for the aircraft” (*id.*), “[t]hese calculations, intended to correct the required values, according to the handle position, are performed simultaneously altogether and the calculation limits the unbalance introduced by the information coming from the handle position sensors” (*id.* ¶ 118), and “if the information supplied by the sensor (62) indicates that the aircraft is tilting towards the rear, then the correction consists in increasing the speed of the propeller 12, decreasing the speed of the propeller 10” while “speeds of the propellers 11 and 13 remain unchanged” (*id.* ¶ 98; *see also id.* ¶¶ 97, 101, 104, 105 (describing similar changes for tilts in other directions and rotations)).

Therefore, we determine that Louvel teaches a control system that is attached to the flying hovercraft, operably connected to the thrusters and automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the flying hovercraft, as required by claim 8. Ex. 1001, 16:30–34.

5. *“the control system including at least a three dimensional, three-axis sensor system and associated control circuitry that dynamically determines a gravitational reference other than by dead reckoning alone for use by the control system in automatic control of said thrusters to maintain stabilization of the RC flying hovercraft in the desired orientation that is responsive to radio frequency (RF) communications from the RC controller”*

Petitioners persuade us that Louvel and Jimenez teach:

the control system including at least a three dimensional, three-axis sensor system and associated control circuitry that dynamically determines a gravitational reference other than by dead reckoning alone for use by the control system in automatic control of said thrusters to maintain stabilization of the RC flying hovercraft in the desired orientation that is responsive to radio frequency (RF) communications from the RC controller.

(Ex. 1001, 16:34–42). Pet. 10 (labeling this portion of claim 8 as “8e”), 34–35 (citing Ex. 1006 ¶¶ 24, 25, 31, 35, Fig. 3 for “[l]imitation 1e”), 40 (correlating arguments for “1e” with “8e”).

As discussed above, we find that Louvel teaches a control system that is attached to the flying hovercraft, operably connected to the thrusters and automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the flying hovercraft. We further find that Louvel teaches a “control system including at least a three dimensional, three-axis sensor system and associated control circuitry that dynamically determines a gravitational reference other than by dead reckoning alone for use by the control system.” See Pet. 32–33 (citing Ex. 1004 ¶¶ 42–44, 88–91, 98 for “[l]imitation 1d”).

In particular, we find that Louvel teaches its “aircraft is fitted with three attitude sensors whose purpose is to provide information for the closed loop control” (Ex. 1004 ¶ 42), the aircraft also has “two tilt sensors” (*id.* ¶ 43), and it further includes “sensor (61)” that “measures the roll tilt angle” and “sensor (62)” that “measures the pitch tilt angle” (*id.* ¶ 44). See also *id.* ¶ 91 (teaching “[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.”); *see also* 2d Condon Decl. ¶ 14 (stating “[o]ne skilled in the art would understand the term *orientation* to mean ‘the angular displacement of a body with respect to an inertial gravitational frame of reference’”).

We also credit Prof. Chowdhary’s testimony that a “gravitational reference is derived from ‘data coming from the various sensors’ – not based on any previous position (*e.g.*, by dead reckoning).” 1st Chowdhary Decl. ¶ 94; *see also id.* ¶ 95. Thus, we determine that Louvel teaches a “control system including at least a three dimensional, three-axis sensor system and associated control circuitry that dynamically determines a gravitational reference other than by dead reckoning alone for use by the control system in automatic control of said thrusters to maintain stabilization of the RC flying hovercraft in the desired orientation,” as required by claim 8. Ex. 1001, 16:30–40.

Also, as discussed above, we find that Louvel teaches handling unit 4 for communicating a desired tilting or rotation of its aircraft that includes information based on its handle position. Thus, Louvel teaches that its control system is responsive to communication from its controller, as required by claim 8. Ex. 1001, 16:40–42. As for the requirements for a “radio controller (RC) flying hovercraft,” “RC controller,” and “radio frequency (RF) communication,” we find that Jimenez teaches an RF transmitter (Ex. 1006 ¶¶ 24, 25, 31, 35, Figs. 2A, 2B, 3) that “is used by the pilot to transmit flight . . . commands to the blimp 1” by “us[ing] joy stick 26 to change the direction and/or elevation of the blimp 1” (*id.* ¶ 35) and a RF receiver (*id.* ¶ 35, Fig. 3). Jimenez also states that its “blimp includes conventional radio frequency remote control means known to the art for controlling vertical and horizontal flight patterns.” *Id.* ¶ 14.

Petitioners contend, and we agree, that Louvel and Jimenez are combinable because each is from the same field of endeavor and directed to control of a remote device with a handheld controller and an aerial device. Pet. 36 (citing 1st Chowdhary Decl. ¶¶ 107–109; Ex. 1004, Abstract, ¶ 1; Ex. 1006, Abstract, ¶ 2). We credit Prof. Chowdhary’s testimony that Louvel and Jimenez are in the “same narrow field of endeavor: control of a remote device with a handheld controller” and that “[i]mplementing the features of Jimenez . . . in the flying saucer described by Louvel would have been within the skillset of a person of ordinary skill in the art.” 1st Chowdhary Decl. ¶ 107 (citing Ex. 1004 Abstract, ¶ 1; Ex. 1006 ¶ 2); *see also* PO Resp. 29 (stating the “field of the present invention is admittedly the field of remote control aircraft”). Furthermore, based on our findings above, Jimenez itself evidences that it was within ordinary skill to implement RF communication in a remotely controlled device. Ex. 1006 ¶ 14 (“For illustration purposes only, a . . . toy blimp is used as an example to describe the teachings of this invention.”), ¶ 42 (“It is understood that the same principles explained here can be applied to other types of remotely controlled toys, including model airplanes.”).

Petitioners assert that one of ordinary skill in the art would have had reason to incorporate Jimenez’s RF communication feature into Louvel’s system. Pet. 35 (citing 1st Chowdhary Decl. ¶¶ 107–109; Ex. 1004, Abstract, ¶ 1; Ex. 1006, Abstract, ¶ 2). Petitioners contend that, because Louvel teaches an RC controller that is connected to the aircraft by flexible cable and Jimenez teaches “an alternative design choice that does not require a physical connection – radio transmission,” the wireless configuration of Jimenez would alleviate Louvel’s increasing cable weight as its aircraft lifts.

Pet. 35–36 (citing Ex. 1004 ¶¶ 25, 92; Ex. 1006 ¶ 35). Petitioners, thus, assert that it would have been obvious to “modify Louvel to use RF communication because doing so would be using a known technique to a known device ready for improvement to yield predictable results” and that the “interchangeability of wired and wireless communications was well known.” *Id* at 36. (citing 1st Chowdhary Decl. ¶ 108).

Based on the preceding, we determine that the combination of Louvel and Jimenez teaches or suggests the recitation of:

the control system including at least a three dimensional, three-axis sensor system and associated control circuitry that dynamically determines a gravitational reference other than by dead reckoning alone for use by the control system in automatic control of said thrusters to maintain stabilization of the RC flying hovercraft in the desired orientation that is responsive to radio frequency (RF) communications from the RC controller.

Ex. 1001, 16:34–42.

6. *“a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation received from the RC controller is based on at least a two dimensional, two-axis sensed orientation of the RC controller itself”*

Petitioners persuade us that Louvel, Jimenez, and Thomas teach “a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation received from the RC controller is based on at least a two dimensional, two-axis sensed orientation of the RC controller itself” (Ex. 1001, 16:43–48). Pet. 10 (labeling this portion of claim 8 as “8f”), 36–37 (citing Ex. 1005, Abstract, 1:7–9, 1:29–31, 1:43–45,

2:11–23, 3:3–13, 3:62–65, 4:9–13 for “[l]imitation 1f”), 40 (correlating arguments for “1f” with “8f”). For the reasons discussed above in Section III.E.5, we determine that Louvel combined with Jimenez teaches or suggests “a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft,” as recited by claim 8. Ex. 1001, 16:43–45.

Regarding “wherein the desired orientation received from the RC controller is based on at least a two dimensional, two-axis sensed orientation of the RC controller itself” (*id.* at 16:45–48), we find that Thomas teaches a “hand-held control device detecting multiple degrees of freedom of movement” (Ex. 1005, 1:7–9), a “hand-held joystick able to detect at least six degrees of freedom of movement” (*id.* at 1:29–31), a “free-standing hand-held enclosure 10” (*id.* at 2:12), “enclosure 10 rigidly support[ing] two sets of three mutually-perpendicular accelerometers” (*id.* at 2:12–14), “[e]ach one of these accelerometers 11–16 [] responsive to acceleration along a single axis” (*id.* at 2:19–20), and each accelerometer “generat[ing] an electrical signal indicating linear acceleration . . . along this particular single axis” (*id.* at 2:21–23). *See also* PO Resp. 18 (stating that Thomas discloses a “hand-held controller with accelerometer sensors used to detect the ‘motion’ of the controller” and “using the accelerometer sensors to detect the motion of the hand-held enclosure (10)”); Ex. 1034, 135:5–15 (Patent Owner’s declarant answering “I would imagine that it was known” in response to “a two-axis accelerometer could be used to sense the orientation of an object, that was known way before the ’239 and ’532 patents, correct?”), 159:3–4 (Patent Owner’s declarant stating “it’s fair to describe [Thomas] as a handheld controller”). We also find that Thomas teaches that

a “wireless RF transmitter may be employed, transmitting the signals generated by the accelerometers 11–16 to a receiver in the computer 28.” Ex. 1005, 3:63–65; *see also* Ex. 1034, 162:15–17 (Patent Owner’s declarant agreeing that the controller in Thomas can use a wireless transmitter).

Petitioners assert, and we agree, that Louvel and Thomas are combinable because each is the same field of endeavor and directed to control of a remote device with a handheld controller and an aerial device. Pet. 38 (citing 1st Chowdhary Decl. ¶¶ 109; Ex. 1004 Abstract, ¶ 1; Ex. 1005, 1:8–10, 4:12–13). We credit Prof. Chowdhary’s testimony that Louvel and Thomas are in the “same narrow field of endeavor: control of a remote device with a handheld controller.” 1st Chowdhary Decl. ¶ 107 (citing Ex. 1004 ¶ 1; Ex. 1005, 1:8–10); *see also* PO Resp. 29 (stating the “field of the present invention is admittedly the field of remote control aircraft”); 2d Condon Decl. ¶ 29 (“*Thomas* teaches that the signal to the device under control is responsive to the **motion** of the hand-held control device.”). Moreover, Thomas indicates that it takes advantage of “miniature accelerometers in a hand-held joystick” as an alternative to “past joysticks of various kinds” that “generally comprise a lever with a handle at one end” with its other end “attached to linkages, potentiometers, tensiometers or accelerometers” so that “[m]ovement of the handle . . . generates electrical signals which stimulate an electrical object.” Ex. 1005, 1:11–17, 1:29–30; *see also id.* at 4:16–18, 4:25–26 (listing other applications).

Petitioners assert that a person of ordinary skill in the art also would have had reason to incorporate Thomas’s controller into Louvel’s system. Pet. 38 (citing 1st Chowdhary Decl. ¶ 109; Ex. 1004, Abstract, ¶¶ 1, 50–53, Fig. 5B; Ex. 1005, 1:8–10, 2:11–13, 4:12–13). Petitioners assert that “[a]s a

matter of common sense,” a person of ordinary skill “would have employed the user-friendly input system disclosed in Thomas . . . in place of the generic handle-based controller disclosed in Louvel” and the proposed combination “would have been a routine design choice.” *Id.* at 38–39 (citing 1st Chowdhary Decl. ¶ 110). Petitioners also assert that Thomas improves on joysticks like the one of Louvel, and there are no unexpected results from its proposed combination because Louvel’s controller is used to control an aircraft in the same manner described in Thomas. *Id.* (citing 1st Chowdhary Decl. ¶¶ 75, 110; Ex. 1004 ¶ 7; Ex. 1005, 1:11–13).

Record evidence supports Petitioners’ position that modifying Louvel to include the hand-held enclosure of Thomas would have been routine design choice, that Thomas improves on joysticks like the one of Louvel, and that there are no unexpected results from its proposed combination. Pet. 38–39. Thomas states that “[i]n the past joysticks of various kinds have been used” that “comprise a lever with a handle at one” and the “other end of the lever is attached to . . . potentiometers” so that “[m]ovement of the handle . . . generates electrical signals which stimulate an electrical object.” Ex. 1005, 1:11–17. Unlike the “past joysticks of various kinds,” Thomas utilizes “accelerometers of various kinds in small packages some of which incorporate electronic signal processing” in a “hand-held joystick able to detect at least six degrees of freedom of movement.” *Id.* at 1:26–31. Thomas also states “[i]n another application the hand-held joystick may be used in place of a . . . joystick” and the “hand-held joystick may be used to control robots.” *Id.* at 4:16–18, 4:25–26.

Similar to the “past joysticks” comprising “potentiometers” described by Thomas, “movements of the handle inside the handling unit” of Louvel

“make the analog voltage change according to the handle position.” Ex. 1004 ¶ 82, Fig. 8. Therefore, Thomas itself indicates that its joystick is an alternative to the handling unit of Louvel and that Thomas improves on joysticks like the one of Louvel. See Ex. 1005, 1:11–17, 1:26–31, 4:16–18, 4:25–26. Thomas and Louvel, thus, support Petitioners’ rationales of routine design choice and that Thomas improves on joysticks like Louvel.

We also credit Prof. Chowdhary’s testimony that “[i]mplementing the features of . . . Thomas in the flying saucer described by Louvel would have been within the skillset of a person of ordinary skill in the art.” 1st Chowdhary Decl. ¶ 107 (citing Ex. 1004 ¶ 1; Ex. 1005, 1:8–10). We agree with Petitioners that there would be no unexpected results from combining Louvel and Thomas because the Louvel controller is used to control an aircraft in a same manner described in Thomas. Pet. 39 (citing 1st Chowdhary Decl. ¶ 120; Ex. 1004 ¶ 7; Ex. 1005 at 1:11–13); *see also* Ex. 1005, 4:16–18 (stating “[i]n another application the hand-held joystick may be used in place of a . . . joystick”).

Thus, we determine that one of ordinary skill in the art would have reason to combine Louvel and Thomas so that “the desired orientation received from the RC controller is based on at least a two dimensional, two-axis sensed orientation of the RC controller itself,” as recited by claim 8. Ex. 1001, 16:45–48. Therefore, based on the preceding, we determine that Louvel, Thomas, and Jimenez teach or suggest “a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation received from the RC controller is based on at least a two

dimensional, two-axis sensed orientation of the RC controller itself” (Ex. 1001, 16:43–48).

7. *“a sensor system in the control system of the RC flying hovercraft configured to dynamically determine an actual orientation of the RC flying hovercraft, the sensor system including at least a three-dimensional, three-axis sensor”*

Petitioners persuade us that Louvel teaches “a sensor system in the control system of the RC flying hovercraft configured to dynamically determine an actual orientation of the RC flying hovercraft, the sensor system including at least a three-dimensional, three-axis sensor” (Ex. 1001, 16:49–53). Pet. 10 (labeling this portion of claim 8 as “8g”), 32–33 (citing Ex. 1004 ¶¶ 42–44, 88–91, 98 for “[l]imitation 1d”), 40 (correlating arguments for “1d” with “8g”).

For the reasons discussed in connection with the recitation “a control system including at least a three dimensional, three-axis sensor system . . . for use by the control system in automatic control of said thrusters to maintain stabilization of the RC flying hovercraft in the desired orientation,” we are persuaded that Louvel teaches “a sensor system in the control system of the RC flying hovercraft configured to dynamically determine an actual orientation of the RC flying hovercraft, the sensor system including at least a three-dimensional, three-axis sensor,” as recited by claim 8. Ex. 1001, 16:49–53; *see also* Ex. 1004 ¶ 42 (Louvel teaching its “aircraft is fitted with three attitude sensors whose purpose is to provide information for the closed loop control”), ¶ 43 (Louvel teaching “two tilt sensors”), ¶ 44 (Louvel teaching “sensor (61)” that “measures the roll tilt angle” and “sensor (62)” that “measures the pitch tilt angle”), ¶ 91 (Louvel teaching “[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.”).

Therefore, we determine that Louvel teaches “a sensor system in the control system of the RC flying hovercraft configured to dynamically determine an actual orientation of the RC flying hovercraft, the sensor system including at least a three-dimensional, three-axis sensor” (Ex. 1001, 16:49–53).

8. *“wherein the control system in the RC flying hovercraft automatically and dynamically controls a thrust produced by each of the thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in response to the desired orientation received from 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 control of moment-to-moment balance and stabilization of the RC flying hovercraft”*

Petitioners persuade us that Louvel teaches:

wherein the control system in the RC flying hovercraft automatically and dynamically controls a thrust produced by each of the thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in response to the desired orientation received from 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 control of moment-to-moment balance and stabilization of the RC flying hovercraft.

(Ex. 1001, 16:54–64). Pet. 10 (labeling this portion of claim 8 as “8h”), 41–42 (referring to the same reasons discussed in connection with limitations 1d-1g and citing Ex. 1004 ¶¶ 90, 93, 97–101).

For the reasons discussed in connection with the recitation “a control system that is attached to the RC flying hovercraft and operably connected to the thrusters and that automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the RC flying hovercraft,” we are persuaded that Louvel teaches the “wherein” clause of claim 8. Ex. 1001, 16:54–64; *see* Ex. 1004 ¶ 90 (Louvel teaches calculating “values of current to be driven through each electric motor” and the “calculation is intended to perform the flight control on a stable attitude for the aircraft”), ¶ 98 (“if the information supplied by the sensor (62) indicates that the aircraft is tilting towards the rear, then the correction consists in increasing the speed of the propeller 12, decreasing the speed of the propeller 10” while “speeds of the propellers 11 and 13 remain unchanged”), ¶ 118 (Louvel teaches that “[t]hese calculations, intended to correct the required values, according to the handle position, are performed simultaneously altogether and the calculation limits the unbalance introduced by the information coming from the handle position sensors”).

We additionally find that Louvel teaches “control of moment-to-moment balance and stabilization of the RC flying hovercraft.” *See* Ex. 1004 ¶ 119 (Louvel teaching its “close loop calculus is performed at each moment in real time.”); 2d Condon Decl. ¶ 53 (“‘Moment-to-moment’ refers to a generally dynamic process that is neither completely instantaneous nor completely continuous.”). Therefore, we determine that Louvel teaches the wherein clause quoted above. Ex. 1001, 16:54–64.

F. Dependent Claims 9–12 and 14

Claim 9 depends from claim 8 and recites “wherein the RC flying hovercraft further comprises a foam body housing the thrusters within a

perimeter of the foam body.” Ex. 1001, 16:65–67. We agree with Petitioners and find that Louvel teaches that its aircraft has a “protection casing [] made of flexible plastic material” (Ex. 1004 ¶ 39) and its four propellers are positioned within a perimeter of a housing body (*id.* Figs. 2, 3). Pet. 44–45 (citing 1st Chowdhary Decl. ¶ 114; Ex. 1004 ¶ 39, Figs. 2, 3). We credit Prof. Chowdhary’s testimony that a “person of ordinary skill at the time the ’532 patent was filed would understand that foam is a type of ‘flexible plastic material.’” 1st Chowdhary Decl. ¶ 114.

Claim 10 also depends from claim 8 and recites “wherein the RC flying hovercraft further comprises a foam body housing the thrusters within a perimeter of the foam body, wherein the foam body includes structure defining a plurality of ducts, and wherein each one of the plurality of ducts corresponds to one of the set of thrusters.” Ex. 1001, 17:1–6. In addition to the findings above for claim 9 regarding a foam body and thrusters within a perimeter of the body, we find that Louvel teaches that its protection casing includes the required ducts corresponding to the thrusters. Ex. 1004 ¶¶ 35–38, Fig. 3; Pet. 45–46 (citing 1st Chowdhary Decl. ¶ 116; Ex. 1004 ¶¶ 35–38, Fig. 3). We also credit Prof. Chowdhary’s testimony that a “person of ordinary skill in the art at the time of the invention of the ’532 patent would have readily understood that the propeller arrangement disclosed by Louvel functions as a ducted fan.” 1st Chowdhary Decl. ¶ 116.

Claim 11 depends from claim 8 and recites “wherein the RC flying hovercraft further comprises a foam body housing the thrusters within a perimeter of the foam body, wherein the foam body includes structure defining a plurality of ducts, and wherein each one of the plurality of ducts corresponds to one of the set of thrusters, and wherein each one of the

plurality of ducts includes a screen cover disposed on a surface of the foam body such that air flows through the screen cover of each duct and the duct, and such that the at least one blade of each thruster is protected by its duct's screen cover.” Ex. 1001, 17:7–16. In addition to the findings above for claim 9 regarding a foam body and thrusters within a perimeter of the body and for claim 10 regarding the protection casing including ducts corresponding to the thrusters, we find that Louvel teaches ducts including screen covers “disposed on a surface of the foam body such that air flows through the screen cover of each duct and the duct, and such that the at least one blade of each thruster is protected by its duct's screen cover.” See Ex. 1004 ¶¶ 22, 38, Figs. 11, 12; Pet. 47–48 (citing Ex. 1004 ¶¶ 22, 38, Figs. 11, 12).

Claim 12 depends from claim 8 and recites “wherein the communications received from the RC controller include the desired orientation of the RC flying hovercraft and an intended motion in which the flying hovercraft is to be directed without any additional communications being required for control of moment-to-moment balance and stabilization of the RC flying hovercraft.” Ex. 1001, 17:17–23. We agree with Petitioners and find that Louvel teaches the limitations of claim 12. Ex. 1004 ¶¶ 90, 93, 97–101; Pet. 48–49 (citing Ex. 1004 ¶¶ 90, 93, 97–101). Moreover, for the reasons discussed above in Sections III.E.4 and III.E.8, we determine that Louvel teaches the limitations of claim 12.

Claim 14 recites that the system of claim 8 “further compris[es] the RC controller.” Ex. 1001, 17:29–30. We agree with Petitioners that Louvel, Thomas, and Jimenez teach the limitations of claim 14 (Pet. 50–51) for the reasons discussed above in Sections III.E.1, III.E.5, and III.E.6.

G. Dependent Claims 10 and 11

Petitioners contend that dependent claims 10 and 11 are obvious in view of Louvel, Thomas, Jimenez, and Yavnai. Pet. 17, 52–55. Louvel, Thomas, and Jimenez are discussed above in Sections III.B, III.C, and III.D.

1. Yavnai (Ex. 1007)

Yavnai relates to “remotely-controlled unmanned mobile devices adapted to function as a robot scout.” Ex. 1007, 1:6–10. The unmanned mobile device (“UMD”) includes a “ducted rotor having a plurality of propellers.” *Id.* at 1:50–52. Figure 1(a) of Yavnai is reproduced below.

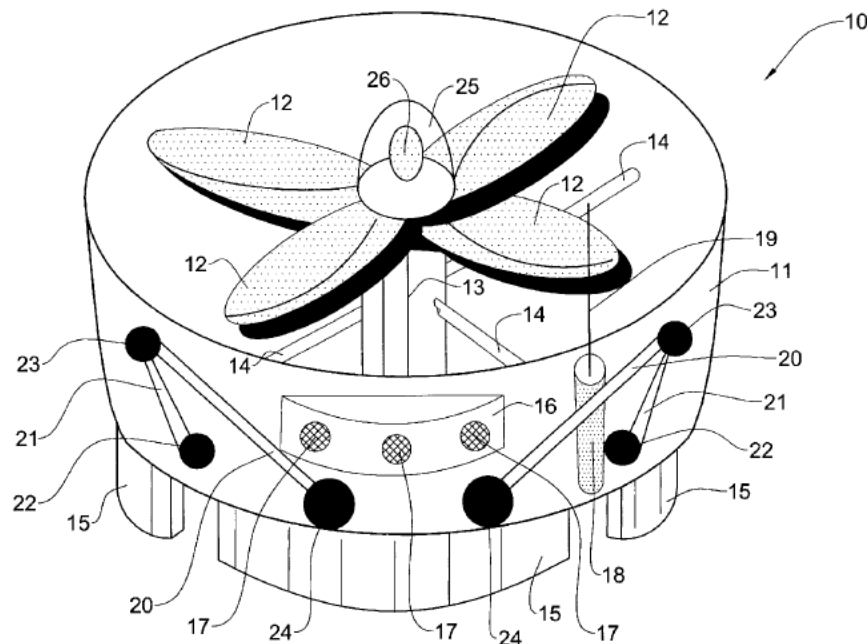


FIG. 1A

Figure 1(a) is a perspective view of an unmanned mobile device. *Id.* at 4:19–21. UMD 10 has toroidal duct 11 surrounding rotor and propeller assembly 12. *Id.* at 4:56–58. The structure “creates a ducted aerodynamic fan blowing an air stream through the duct which acts to propel the UMD.” *Id.* at 4:60–62.

2. Claims 10 and 11

Claim 10 requires the system of claim 8 to “further comprise[] a foam body housing the thrusters within a perimeter of the foam body, wherein the foam body includes structure defining a plurality of ducts, and wherein each one of the plurality of ducts corresponds to one of the set of thrusters.” Ex. 1001, 17:1–6. Claim 11 requires the system of claim 8 to “further comprise[] a foam body housing the thrusters within a perimeter of the foam body, wherein the foam body includes structure defining a plurality of ducts, and wherein each one of the plurality of ducts corresponds to one of the set of thrusters, and wherein each one of the plurality of ducts includes a screen cover disposed on a surface of the foam body such that air flows through the screen cover of each duct and the duct, and such that the at least one blade of each thruster is protected by its duct’s screen cover.” Ex. 1001, 17:7–16. For reasons above in Section III.F, we agree with Petitioners that Louvel teaches the limitations of claims 10 and 11.

Petitioners also argue, and we agree, that Yavnai teaches the limitations of claims 10 and 11. Pet. 52–53 (citing Ex. 1007, 1:50–53, 2:15–19, 4:56–65, 5:12–17, 5:19–22, Fig. 1B). Petitioners also contend that a person of ordinary skill “would have recognized that the directed propellers of Louvel would benefit from ducts,” such as reducing losses in thrust and shielding propellers from human contact. Pet. 53–54 (citing 1st Chowdhary Decl. ¶¶ 187–190; Ex. 1004 ¶¶ 1, 29; Ex. 1007, 1:42–48, 1:53–54, 3:20–27). We find that Yavnai supports Petitioners’ reasons for combining Yavnai with the system of Louvel, Thomas, and Jimenez with a reasonable expectation of success. Ex. 1007, 1:53–54 (“ducted fan is aerodynamically efficient and is sage because of its unexposed rotor blades”). Thus, we

determine that Louvel, Thomas, Jimenez, and Yavnai would have rendered obvious claims 10 and 11.

H. Dependent Claim 13

Petitioners contend that dependent claim 13 is obvious in view of Louvel, Thomas, Jimenez, and Carroll. Pet. 17, 56–59. Louvel, Thomas, and Jimenez are discussed above in Sections III.B, III.C, and III.D.

1. Gabai (Ex. 1008)

Gabai relates to “toys used in conjunction with a computer system.” Ex. 1008 ¶ 1. Figure 56 of Gabai is reproduced below.

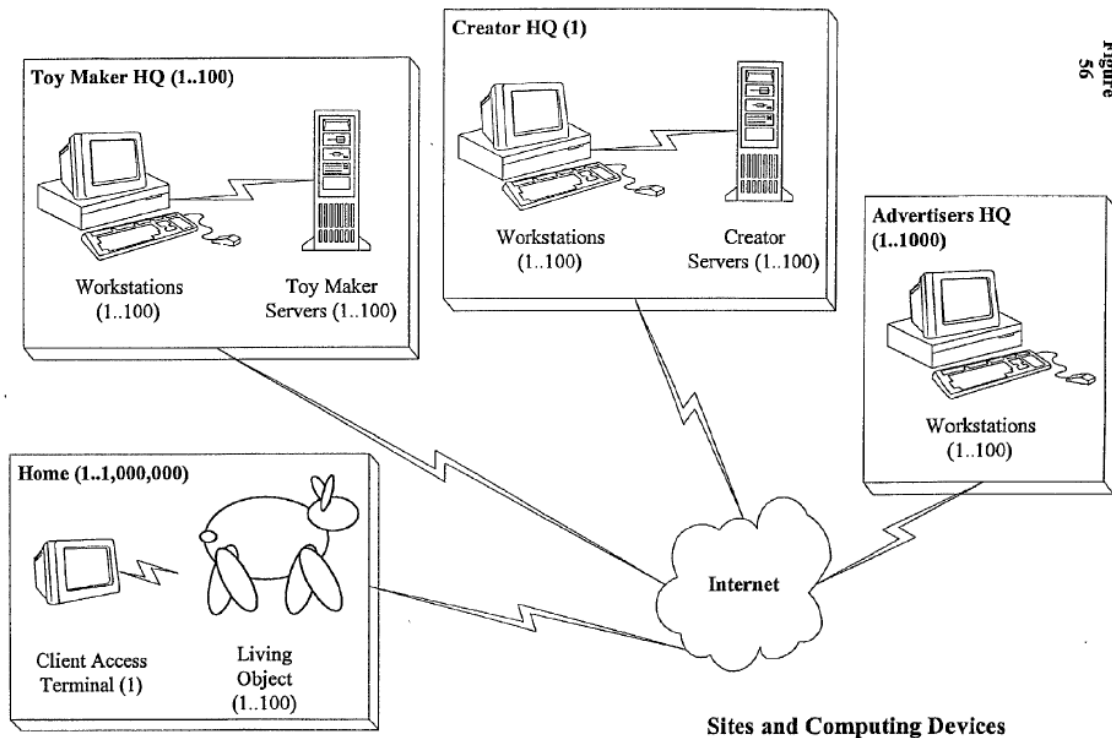


Figure 56 shows a Living Object Internet Service System (“LOIS”). *Id.* ¶ 108. Gabai states that “Software Updates . . . are the latest version of LOIS client software” that are “pushed and installed automatically.” *Id.* ¶ 692.

2. Claim 13

Claim 13 depends from claim 8 and recites “wherein the communications received from the RC controller selectively include software updates for the control system from the web via an Internet connection.” Ex. 1001, 17:25–28. Petitioners argue, and we agree, that Gabai teaches its limitations. Pet. 57–58 (citing Ex. 1008 ¶¶ 15, 16, 59, 60, 119, 120, 613–673, 691, 692, Figs. 41, 44, 56). We find that the cited portions of Gabai teaches the limitations of claim 13. Ex. 1008 ¶¶ 15, 16, 59, 60, 119, 120, 613–673, 691, 692, Figs. 41, 44, 56.

Petitioners also argue that one of ordinary skill in the art would have had reason to modify Louvel to include the software updating feature of Gabai. Pet. 58–59 (citing Ex. 1008 ¶ 14). Petitioners contend that the “type of messages that are sent over the communications channel is a design choice” and that Gabai demonstrates “software updates from the Internet were known to be one of the many types of messages that could [be] sent over the communications channel.” Pet. 59 (citing 1st Chowdhary Decl. ¶ 212). Petitioners also contend that “periodically updating software through the RC controller would allow the control system to incorporate improvements without connecting the hovercraft to a physical port” and modifying Louvel with Gabai “would have been within the ability” of a person of ordinary skill in the art. *Id.* We further credit Prof. Chowdhary’s testimony as to why Gabai would have been combined with Louvel, Thomas, and Jimenez with a reasonable expectation of success. 1st Chowdhary Decl. ¶ 212.

Therefore, we determine that Louvel, Thomas, Jimenez, and Gabai would have rendered obvious claim 13.

I. Patent Owner's Response

1. Petitioners' Asserted Rationales

Patent Owner responds that Petitioners' combination of Louvel, Thomas, and Jimenez would not have been common sense, routine design choice, or result in the joystick of Thomas performing the same function as Louvel. PO Resp. 23, 24 (citing Pet. 39; Dec. on Inst. 22; 1st Chowdhary Decl. ¶ 120). Patent Owner contends that separating acceleration due to gravity from acceleration due to motion precludes a simple substitution. PO Resp. 24–25 (citing Ex. 2017 ¶ 47). Patent Owner also argues that “the proposed combination of *Thomas* with *Louvel* should use the control scheme of Fig. 3, *not* Fig. 1” and that the embodiment shown in Figure 3 of Thomas confirms that more than common sense is required because the embodiment of Figure 3 of Thomas is for controlling an aircraft. PO Resp. 26. Patent Owner asserts that “[t]here is no evidence or argument in the Petition supporting why the proposed combination of the embodiment of Fig. 1 of *Thomas* would be the design choice.” *Id.*

As discussed above, Thomas indicates that its joystick is an alternative to the handling unit of Louvel and that Thomas improves on joysticks like the one of Louvel. Ex. 1005, 1:11–17, 1:26–31, 4:16–18, 4:25–26; *see also* Pet. Reply 8 (stating Petitioners “never argued that the claims are obvious based on a ‘simple substitution’”), 10 (stating that “Petitioners ***do not rely*** on the embodiment described by Figure 3 in any way”).

We find that Thomas teaches either of its embodiment shown in Figure 1 (asserted by Petitioners) or Figure 3 (asserted by Patent Owner as the one that should be combined with Louvel) would be an alternative to

Louvel's handling unit. In view of the complete record, Petitioners persuade us that one of ordinary skill would have picked the embodiment shown in Figure 1 for the reasons given above in Section III.E.6.

Patent Owner also responds that Thomas has not been cited in the field of remote control aircraft but has been cited in the field of computer control and video gaming systems. PO Resp. 29–30 (citing 2d Condon Decl. ¶ 48). Patent Owner, thus, argues that Thomas was not a known substitute or design choice in the field of remote control aircraft and that one of ordinary skill in the art would not have considered Thomas as a substitute or routine design choice “for addressing the complex problems of designing a remote-control aircraft system.” *Id.* at 30.

As discussed above, Thomas indicates that its joystick is an alternative to joysticks like the handling unit of Louvel and that Thomas improves on joysticks like the one of Louvel. *See* Ex. 1005, 1:11–17, 1:26–31, 4:16–18, 4:25–26; *see also* Ex. 1034, 36:16–19 (In response to “you’d agree with me, then, that the video game controllers and drone controllers are relevant to each other,” Patent Owner’s declarant answering “[t]hey can be in certain circumstances.”). The complete record persuades us that one of ordinary skill in the art would have considered Thomas as a known design choice. *See also* Pet. Reply 8 (stating Petitioners “never argued that the claims are obvious based on a ‘simple substitution’”).

2. *Figure 3 of Thomas*

Patent Owner further responds that, during prosecution of the application that issued as the ’532 patent, the Examiner considered a reference with a pilot control similar to the one shown in Figure 3 of Thomas. PO Resp. 27 (citing Ex. 1001, 3:40–46; Ex. 2004, 166). Patent

Owner contends that both that reference and the Figure 3 embodiment of Thomas teach “Pilot Control” which “involve[s] different factors and considerations than references that teach Remote Control (*Louvel* and *Jimenez*)” because of the “addition of a human as part of an onboard control scheme” and thus, Thomas and Louvel would not be “alternative equivalent routine design choices or simple substitutions.” PO Resp. 28 (citing 2d Condon Decl. ¶ 48). Patent Owner also faults Petitioners for not explaining fully how the embodiment of Figure 3 of Thomas would be combined with Louvel. PO Resp. 28–29.

As discussed above in Section III.E.6, Petitioners rely on the embodiment shown in Figure 1 of Thomas. Pet. 37 (citing portions of Thomas related to Figure 1); *see also* PO Resp. 26 (arguing “[t]here is no evidence or argument in the Petition supporting why the proposed combination of the embodiment of Fig. 1 of *Thomas* would be the design choice.”); Pet. Reply 10 (stating that “Petitioners ***do not rely*** on the embodiment described by Figure 3 in any way”). In view of our determination that the complete record supports Petitioners’ combination of Louvel, Thomas, and Jimenez, arguments directed to Figure 3 of Thomas do not address directly Petitioners’ combination based on Figure 1 of Thomas (*see* Pet. 37) and thus, fail to rebut Petitioners’ position regarding the claim at issue.

Patent Owner also argues that the “commands sent on control cables from the computer to the aircraft in the aircraft controller embodiment of *Thomas* are the set of ‘net acceleration’ signals.” PO Resp. 40 (citing 2d Condon Decl. ¶ 27). Petitioners, however, cite to the embodiment of Figure 1, not the aircraft controller embodiment. *See* Pet. 37; Pet. Reply 10

(“Petitioners ***do not rely*** on the embodiment described by Figure 3 in any way.”).

3. Orientation of the RC Controller

Patent Owner additionally responds that the combination of Louvel, Thomas, and Jimenez “would not yield a solution in which the orientation of the craft mimics the orientation of the RC controller.” PO Resp. 34. In particular, Patent Owner argues that (1) none of the references include the word “orientation” (*id.* (citing 2d Condon Decl. ¶¶ 27, 40)), (2) Petitioners do not explain how Louvel and Thomas teach the claimed “orientation” control scheme (*id.* at 34–35), and (3) Louvel teaches that the “control commands sent on the control wires of *Louvel* from the controller to the craft is a set of proportional voltage signals that represent the ‘position’ of the pivotable handle relative its base” (*id.* at 38 (citing 2d Condon Decl. ¶ 20)).

Claim 8 does not require explicitly that the “orientation of the craft mimics the orientation of the RC controller.” Instead, claim 8 requires “a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation . . . is based on at least a two dimensional, two-axis sensed orientation of the RC controller itself.” Ex. 1001, 16:43–48.

Also, as discussed above, we find that Louvel teaches a “handling unit (4) . . . handled by the user and [] linked to the control unit (3)” (Ex. 1004 ¶ 26, Figs. 1, 5), that “tilting of the aircraft towards the [front, rear, right, or left sides] is achieved by pushing [or pulling] the handle towards [that] direction” (*id.* ¶¶ 51, 52, Fig. 5), and that rotation of the aircraft is achieved by turning the handle in the desired direction (*id.* ¶¶ 52, 53, Fig. 5). We

additionally find that Thomas teaches the translations and rotations of hand-held enclosure 10 can be identified uniquely and the resulting generated signals indicate linear movement or rotation. Ex. 1005, 2:60–62, 3:3–6, 3:10–14; 2d Condon Decl. ¶ 29.

The complete record persuades us that Petitioners’ proposed combination would result in tilting or rotation of Louvel’s aircraft in response to the sensed translations and rotations of enclosure 10 of Thomas. For example, moving or rotating hand-held enclosure 10 of Thomas would generate a signal based on enclosure 10 moving or rotating to a new position and would be communicated to the aircraft of Louvel which would cause it to tilt or rotate accordingly. Ex. 1005, 2:60–62, 3:3–6, 3:10–14; Ex. 1034, 160:7–11, 161:13–17. Thus, Petitioners’ proposed combination would result in “communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation . . . is based on at least a two dimensional, two-axis sensed orientation of the RC controller itself,” as required by claim 8. Ex. 1001, 16:44–48; *see also* Ex. 1034, 149:11–14 (Patent Owner declarant, in response to “would you agree with me, then, that on at least some level, movement and orientation are related concepts,” answering “[t]hey are derivatives of each other”).

Patent Owner also responds that Louvel uses a “position” control scheme (PO Resp. 42–43), that the ’532 patent uses the orientation of its handheld RC controller (*id.* at 44–45 (citing Ex. 1001, Fig. 3; 2d Condon Decl. ¶¶ 23–24)), that Thomas uses a “motion” control scheme (*id.* at 46–48 (citing Ex. 1006, Fig. 1)), and that the combination of Louvel and Thomas does not produce the “orientation” control scheme required by claim 8 (*id.* at 48–51 (citing Ex. 1004 ¶ 91; 2d Condon Decl. ¶ 30)). *See also id.* at 16–22

(describing the control schemes of Louvel, Thomas, and Jimenez) (citing Ex. 1004, Figs. 1, 5; Ex. 1005, 4:9–26, 3:3–25, 4:34–57, Figs. 1, 3; Ex. 1006 ¶¶ 32, 35, Figs. 2, 2A; 2d Condon Decl. ¶¶ 24, 30, 31, 40).

The complete record, however, persuades us that Petitioners’ proposed combination of Louvel, Thomas, and Jimenez would have rendered obvious claim 8. Claim 8 does not require expressly an “orientation” control scheme. As discussed above, claim 8 requires “communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation . . . is based on at least a two dimensional, two-axis sensed orientation of the RC controller itself.” Ex. 1001, 16:44–48. Petitioners persuade us that their proposed combination of Louvel, Thomas, and Jimenez would have rendered obvious claim 8.

4. Gravitational Frame of Reference

Patent Owner responds that Thomas does not determine any kind of gravitational frame of reference. PO Resp. 40–42 (citing 2d Condon Decl. ¶¶ 34–38). However, as discussed above in Section III.E.5, Petitioners rely on Prof. Chowdhary’s testimony, which we credited, that a “gravitational reference is derived from ‘data coming from the various sensors’ – not based on any previous position (*e.g.*, by dead reckoning).” 1st Chowdhary Decl. ¶ 94. Patent Owner’s argument on this point also focuses on an embodiment in Thomas not cited by Petitioners. See PO Resp. 40–42; Pet. 37; Pet. Reply 10.

5. Prosecution of the Related ’580 Patent

Patent Owner also argues that a reference cited in the prosecution of the application that issued as the related ’580 patent (U.S. Patent No. 5,453,758, iss. Sept. 26, 1995 (Ex. 2015) (“Sato”)) teaches away from using

gravity as an input for a motion control scheme. PO Resp. 31–34 (citing Ex. 2014, 24, 42, 44, 86; Ex. 2015). Patent Owner argues that Sato describes a hand-held controller similar to Thomas (*id.* at 32–33 (citing Ex. 1005, 3:24–26, 4:50–53; Ex. 2015, 7:7–15, 7:23–33, Figs. 12(a), 12(b))) with a “floating detecting means” that indicates “gravity is something to be avoided and the tilt or angles of the controller relative to gravity are things to be ignored” (*id.* at 33 (citing Ex. 2015, 2:4–14, 7:1–15)). Patent Owner also argues that “Sato is also evidence against the unsupported allegation that substituting the motion control scheme of *Thomas* for the position control scheme would be a routine design choice.” *Id.* at 34 (citing 2d Condon Decl. ¶ 49).

Petitioners do not rely on the references to teach anything similar to the “floating detecting means” like Sato. *See* Pet. 33–43. Even assuming Sato can be said to teach away, according to Patent Owner’s arguments (PO Resp. 32–34), Sato would teach away from using a “floating detecting means,” which is not a part of Petitioners’ proposed combination (*see* Pet. 30–42). Further, Thomas itself indicates that it improves on joysticks like the one of Louvel. *See* Ex. 1005, 1:11–17, 1:26–31, 4:16–18, 4:25–26.

Patent Owner further responds that prosecution of the related ’580 patent considered Louvel, Thomas, Jimenez, and the evidence and arguments of this proceeding. PO Resp. 30–31 (citing Ex. 2011, 130–132). Patent Owner argues that, according to the Examiner, “further modifications to *Louvel* along the lines argued for in the proposed combination would constitute impermissible hindsight.” *Id.*; *see also id.* at 31 (quoting Ex. 2011, 8). Patent Owner also argues that the Reasons for Allowance issued for the ’580 patent confirms that Louvel and Thomas do not yield claim 10. PO Resp. 51–52 (quoting Ex. 2011, 7–8). Patent Owner contends that,

because the Examiner considered the embodiment shown in Figure 3 of Thomas, one of ordinary skill in the art also would look to that embodiment. *Id.* at 52.

The record provides insufficient support that the claims of the '580 patent have the same scope as claim 8. Patent Owner even states that “these Reasons for Allowance were focused on the added claim limitations that are part of the Contingent Motion to Amend” (PO Resp. 52), thus indicating that the claims of the '580 patent are not the same scope as claim 8. *See also* Pet. Reply 2 (arguing that the “Examiner explicitly premised allowance on two claim limitations” not present in claim 10); Tr. 38:5–11 (Patent Owner’s counsel indicating that the claims were different).

J. Conclusion as to Claims 8–14

For the foregoing reasons, we determine that Petitioners have shown by a preponderance of the evidence that claims 8–12 and 14 are unpatentable over Louvel, Thomas, and Jimenez; claims 10 and 11 are unpatentable over Louvel, Thomas, Jimenez, and Yavnai; and claim 13 is unpatentable over Louvel, Thomas, Jimenez, and Gabai.

IV. CONTINGENT MOTION TO AMEND

Patent Owner filed a Contingent Motion to Amend (Paper 26, “Mot.”)⁷. Patent Owner states that “[i]f the Board finds original independent claim 8 unpatentable . . . Patentee respectfully requests the Board to grant this Contingent Motion to Amend the '532 patent.” Mot. 4.

⁷ *See also* Paper 28 (correcting certain citations from Ex. 1006 to Ex. 1005 or from Ex. 1007 to Ex. 1006).

Because the Federal Circuit stated in *Aqua Products*, 872 F.3d at 1327, that the “PTO may not place the burden on the patentee,” the parties requested, and we authorized, new briefing (Paper 43), and a Petitioners’ Brief in Opposition to Patent Owner’s Contingent Motion to Amend (Paper 47, “Pet. Opp.”), Patent Owner Reply to Petitioner Opposition to Contingent Motion to Amend (Paper 48, “PO Reply to Opp.”), and Petitioners’ Sur-Reply Brief in Opposition to Patent Owner’s Contingent Motion to Amend (Paper 51, “Pet. Sur-Reply”) were filed⁸. See also “Guidance on Motions to Amend in view of *Aqua Products*” 3 (Nov. 21, 2017) (https://www.uspto.gov/sites/default/files/documents/guidance_on_motions_to_amend_11_2017.pdf) (“[A]ny party may request briefing changes or additional briefing,” and the “Board generally will permit supplemental briefing regarding the patentability of substitute claims proposed in a motion to amend, if requested.”) (“Guidance”).

Also, the record shows that both parties understand that the burden with respect to Patent Owner’s Contingent Motion to Amend is not on Patent Owner. Pet. Opp. 4 (quoting “the PTO may not place that burden on the patentee”); PO Reply to Opp. 4 (quoting “the PTO may not place that burden [of persuasion with respect to the patentability of amended claims] on the patentee”).

⁸ Patent Owner requested authorization to file a motion to strike or expunge the Third Chowdhary Declaration (Ex. 1035), but the parties subsequently agreed to keep in the record the Second and Third Chowdhary Declarations (Exs. 1030, 1035) and Papers 38 and 47. Paper 49, 2–4. Therefore, because the parties reached an agreement to keep the Third Chowdhary Declaration in the record, a motion to strike or expunge was not authorized.

Having determined that claim 8 is unpatentable, we turn to Patent Owner's Contingent Motion to Amend.

A. Proposed Substitute Claims 25–31

Patent Owner proposes substitute claim 25 for independent claim 8. Mot. 4. Patent Owner also proposes substitute claims 26–31 for, respectively, claims 9–14. Proposed substitute claim 25 recites, with underlined material indicating language added to original claim 8 and strikethroughs indicating deleted language:

Proposed Substitute Claim 25. A system that includes a radio controlled (RC) flying hovercraft controlled by a handheld RC controller separate and remote from the RC flying hovercraft, the system comprising:

- an RC flying hovercraft that includes a set of generally downwardly directed thrusters, each thruster including at least one blade driven by an electrically powered motor to provide aerodynamic lift for the RC flying hovercraft;

- an electrical-power system attached to and positioned in the flying hovercraft and electrically coupled to the set of thrusters;

- a control system that is attached to and positioned in the RC flying hovercraft and operably connected to the thrusters and that automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the RC flying hovercraft, the control system including at least a three dimensional, three-axis sensor system and associated control circuitry that dynamically determines a gravitational reference other than by dead reckoning alone for use by the control system in automatic control of said thrusters to maintain stabilization of the RC flying hovercraft in the desired orientation that is responsive to radio frequency (RF) communications from the RC controller;

- a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation received from the RC controller is based on at least a

two dimensional, two-axis sensed orientation of the RC controller sensed by dynamically sensing a gravitational reference and a relative tilt of the RC controller with respect to the gravitational reference itself;

a sensor system in the control system of the RC flying hovercraft configured to dynamically determine an actual orientation of the RC flying hovercraft, the sensor system including at least a three-dimensional, three-axis sensor; and

wherein the control system in the RC flying hovercraft automatically and dynamically controls a thrust produced by each of the thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in response to the desired orientation received from 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 control of moment-to-moment balance and stabilization of the RC flying hovercraft such that on a moment-to-moment basis the actual orientation of the RC flying hovercraft mimics the sensed orientation of the RC controller.

Mot. 25–27. Proposed substitute claims 26–31 only change the dependency of original claims 9–14 from claim 8 to claim 25. *See* Mot. 27–28.

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

“[I]f a patent owner files a motion to amend . . . and that motion meets the requirements of 35 U.S.C. § 316(d) . . . , the Board will proceed to determine whether the substitute claims are unpatentable by a preponderance of the evidence based on the entirety of the record, including any opposition made by the petitioner.” Guidance 2. Also, “patent owner still must meet the requirements for a motion to amend under 37 C.F.R. § 42.121.” *Id.*

During an *inter partes* review, “patent owner may file 1 motion to amend the patent” and “[f]or each challenged claim, propose a reasonable number of substitute claims.” 35 U.S.C. § 316(d)(1). Patent Owner filed

only one motion to amend (Paper 26) that proposes one substitute claim for each of the claims at issue. *See* Mot. 7–8 (“For each original claim, Patentee proposes only one substitute claim” and “therefore fits the ‘presumption . . . that only one substitute claim would be needed to replace each challenged claim.’”). Patent Owner, thus, meets the requirements of 35 U.S.C. § 316(d)(1).

Proposed substitute claims in an *inter partes* review “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). In its Contingent Motion to Amend, Patent Owner states, and we agree, that “proposed substitute independent system claim 25 retains all features of the original independent system claim 8” and that the “only claim limitations added are clarifying limitations that, under a broadest reasonable interpretation (BRI) construction, only narrow the claim scope.” Mot. 7.

Pursuant to 37 C.F.R. § 42.121(b), a motion to amend in an *inter partes* review must set forth “[t]he support in the original disclosure of the patent for each claim that is added or amended” and the “[t]he support in an earlier-filed disclosure for each claim for which benefit of the filing date of the earlier filed disclosure is sought.” *See also* Guidance 2 (stating a “motion to amend must set forth written description support and support for the benefit of a filing date in relation to each substitute claim, and respond to grounds of unpatentability involved in the trial.”).

In its Motion to Amend, Patent Owner explains where written description support can be found for the subject matter of proposed substitute claim 25 in originally filed Application No. 13/092,940 (Ex. 1002, 315–381) (“the ’940 application”), which issued as the ’532 patent (Ex.

1001, (21)). Mot. 8–12 (citing Ex. 1002, 315–381); PO Reply to Opp. 24. Patent Owner also sets forth support in an earlier-filed application (Application No. 10/526,153) for which benefit of the filing date of the earlier disclosure can be established. Mot. 12 (citing Ex. 2001). *See also* Ex. 1001 (60) (indicating “division of application No. 10/526,153”).

After reviewing Patent Owner’s arguments and the disclosures of the ’940 application that issued as the ’532 patent, we conclude that Patent Owner has made a sufficient showing that proposed substitute claim 25, as a whole, has written description support in the disclosure of the application as filed. Mot. 9–11 (citing Ex. 1002); Ex. 1002, 315–381. For example, regarding the added limitation “sensed by dynamically sensing a gravitational reference and a relative tilt of the RC controller with respect to the gravitational reference,” we determine that adequate written support is provided by the disclosure in the ’940 application that 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. 1002, 328). Also, for the added limitation “such that on a moment-to-moment basis the actual orientation of the RC flying hovercraft mimics the sensed orientation of the RC controller,” we determine that adequate written support is provided by the disclosure that the “one-handed bee controller also includes an XY sensor arrangement and associated control circuitry that allows the craft to mimic the position of the controller in terms of yaw, pitch, roll and lateral flight maneuvers” (*id.* at 324).

Regarding the earlier-filed disclosure, Patent Owner cites to Exhibit 2001. That exhibit, however, is the publication of, and not the originally

filed disclosure of, Application No. 10/526,153. *See also* Paper 20, 4 (stating “[c]itation should be made to the original disclosure of the application, as filed”); Pet. Opp. 23–24; Pet. Sur-Reply 11–12 (arguing Patent Owner failed to provide any support to any application to which priority is claimed). For purposes of this Decision, we need not make a determination that proposed substitute claim 25 has support in an earlier-filed disclosure because we are satisfied that it has support in the ’940 application and therefore, can proceed to analyzing the patentability of proposed substitute claim 25 based on the entirety of the record. Also, there is no argument that the asserted references would not be prior art because of the filing date of Application No. 10/526,153.

Additionally, we agree with Petitioners that Patent Owner did not set forth expressly written description support for proposed substitute claims 26–31. Mot. 8–12. Because proposed substitute claims 26–31 only change the dependency from claim 8 to proposed substitute claim 25, Patent Owner apparently relies on claims 26–31 already having been determined to have written description during prosecution of the ’532 patent. For purposes of considering Patent Owner’s Contingent Motion to Amend substantively in view of the entirety of the record, we consider proposed substitute claims 26–31 to have written description support in the ’940 application.

For the foregoing reasons, we determine that Patent Owner’s Contingent Motion to Amend meets the requirements of 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121.

C. Patentability of Proposed Substitute Claims 25–31

Having determined that the Contingent Motion to Amend meets the requirements of 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121, we analyze

whether proposed substitute claims 25–31 are unpatentable by a preponderance of the evidence based on the entirety of the record.

Petitioners argue that proposed substitute claim 25 is unpatentable over Louvel, Kroo, Jimenez, and Sato or over Louvel, Kroo, Jimenez, and Nagamitsu. Pet. Opp. 4–21; *see also* PO Reply to Opp. 2 (stating that “these secondary references represent the closest prior art”). Petitioners also argue that proposed substitute claims 26–31 are unpatentable over each of their proposed combinations further modified by Gabai. Pet. Opp. 5, 21–23. In support of their arguments, Petitioners cite to Louvel, Kroo, Jimenez, Sato, Nagamitsu, Gabai, and the Third Chowdhary Declaration (Ex. 1037). *See id.*; Pet. Sur-Reply 4–11. Patent Owner replies with citations to the asserted references and the Second Condon Declaration (Ex. 2013). *See* PO Reply to Opp. 5–23.

“[I]f a patent owner files a motion to amend . . . and that motion meets the requirements of 35 U.S.C. § 316(d) . . . , the Board will proceed to determine whether the substitute claims are unpatentable by a preponderance of the evidence based on the entirety of the record, including any opposition made by the petitioner.” Guidance 2. “In light of the *Aqua Products* decision, the Board will not place the burden of persuasion on a patent owner with respect to the patentability of substitute claims presented in a motion to amend.” *Id.*

As discussed below, the parties’ disputes are related to the scope and content of the prior art, differences between proposed substitute claim 25 and the prior art, and Petitioners’ rationales for combining the asserted references. The parties do not dispute the level of ordinary skill in the art,

and have not directed us to any objective evidence of nonobviousness for proposed substitute claims 25–31.

For the reasons below, we determine that proposed substitute claims 25–31 are unpatentable by a preponderance of the evidence based on the entirety of the record because the asserted references teach or suggest each limitation of proposed substitute claims 25–31, a person of ordinary skill in the art would have had a reason to combine the teachings of the asserted references, and a person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of the asserted references.

1. Claim Construction

Patent Owner states that “[f]or purposes of the proposed substitute claim 25, Patentee does not propose any further constructions of the added claim limitations.” Mot. 14. Patent Owner, however, provides its suggestions for the plain and ordinary meaning of “gravitational reference,” “relative tilt,” “moment-to-moment basis,” and “mimic.” *Id.* at 14–15 (citing 2d Condon Decl. ¶¶ 51–54). In view of the entirety of the record, we determine that express interpretations of any term is not necessary.

2. Level of Ordinary Skill

Patent Owner states that it “generally agrees with Petitioners that a person of ordinary skill . . . would possess a Bachelor’s of Science degree in aeronautical or electrical engineering with at least two years of practical experience in the design and development of remote control aircraft.” Mot. 14 (citing Pet. 13; 1st Condon Decl. ¶ 13). For the same reasons given above in Section III.A, we apply the agreed to level of skill (“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”) and note again that any differences in the parties’ asserted level of ordinary skill would not affect our analysis.

3. Nagamitsu (*Ex. 1028*)

Nagamitsu relates to a simulator. *Ex. 1028*, 1:8. Figure 4 of Nagamitsu is reproduced below.

FIG. 4

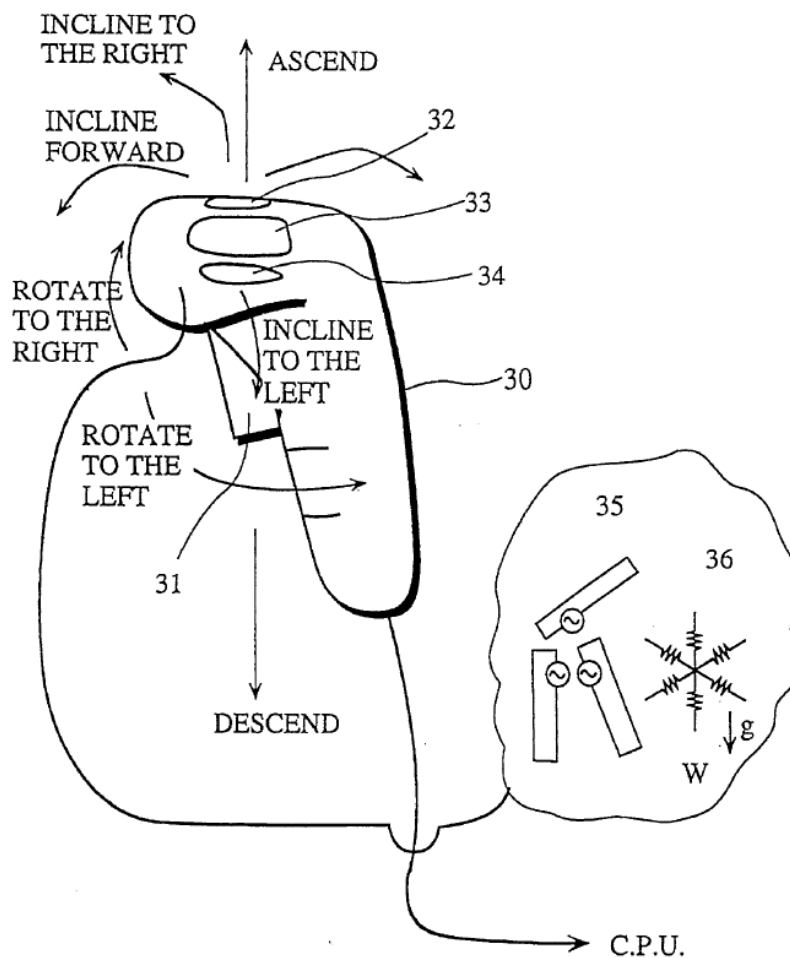


Figure 4 shows a 3-D input unit 30. *Id.* at 10:41–43, 12:10–11. Input unit 30 “is of a configuration similar to a grip of a pistol” and “a magnetism

detecting pointer 35 and an accelerometer 36 are installed therein for each direction in 3-D.” *Id.* at 12:12–13, 12:18–19.

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 device 30 with respect to the magnetic field indicated by arrows in FIG. 4 can be detected.”

Id. at 12:20–26.

4. Kroo (Ex. 1029)

Kroo describes “[m]icro air vehicles (MAVs)” with “microelectronics and microelectromechanical systems (MEMs).” Ex. 1029, 503⁹. Kroo “focuses on mesoscale systems—devices larger than microscopic, yet significantly smaller than conventional air vehicles.” *Id.* at 504. Kroo describes prototypes with motors driven by batteries. *Id.* at 506, 513–514.

5. Analysis of Proposed Substitute Claim 25

Based on our factual findings regarding Louvel, the entirety of the record persuades us that Louvel teaches a “system that includes a radio controlled (RC) flying hovercraft controlled by a handheld RC controller separate and remote from the RC flying hovercraft” for the reasons discussed above in Section III.E.1, “an RC flying hovercraft that includes a set of generally downwardly directed thrusters, each thruster including at least one blade driven by an electrically powered motor to provide aerodynamic lift for the RC flying hovercraft” for the reasons discussed above in Section III.E.2, and “a sensor system in the control system of the

⁹ Like Petitioners, instead of the exhibit page numbers, we cite to the page numbers of Kroo.

RC flying hovercraft configured to dynamically determine an actual orientation of the RC flying hovercraft, the sensor system including at least a three-dimensional, three-axis sensor” for the reasons discussed above in Section III.E.7. *See also* Pet. Opp. 5 (citing Ex. 1004 Abstract, ¶¶ 1, 24–26, 29, 30, 38, 42–44, 49, 51–53, 88–98, Figs. 1, 2, 5), 18–19 (citing Ex. 1004 Abstract, ¶¶ 1, 24–26, 29, 30, 38, 49, 51–53, Figs. 1, 2, 5).

Also, based on our factual findings from Louvel and Jimenez, the entirety of the record persuades us that the combination of Louvel and Jimenez teaches:

the control system including at least a three dimensional, three-axis sensor system and associated control circuitry that dynamically determines a gravitational reference other than by dead reckoning alone for use by the control system in automatic control of said thrusters to maintain stabilization of the RC flying hovercraft in the desired orientation that is responsive to radio frequency (RF) communications from the RC controller

for the reasons given above in Section III.E.5. *See also* Pet. Opp. 5 (citing Ex. 1004 ¶¶ 42–44, 88–98; Ex. 1006 Abstract, ¶¶ 2, 24, 25, 31, 35, Fig. 3), 19–20 (citing Ex. 1004 ¶¶ 42–44, 88–91, 98; Ex. 1006 ¶¶ 24, 25, 31, 35, Fig. 3). The entirety of the record also supports that one of ordinary skill in the art would have had reason to combine Louvel and Jimenez with a reasonable expectation of success in combining these references. Pet. 36; Pet. Opp. 21–22 (citing Ex. 1004 Abstract, ¶¶ 1, 25, 92; Ex. 1006 Abstract, ¶¶ 2, 35; 3d Chowdhary Decl. ¶¶ 51, 52); Ex. 1004 Abstract, ¶¶ 1, 25, 92; Ex. 1006 Abstract, ¶¶ 2, 14, 35, 42; 1st Chowdhary Decl. ¶¶ 107–109; 3d Chowdhary Decl. ¶¶ 51, 52.

The entirety of the record persuades us that Petitioners’ proposed combination of Louvel and Jimenez further modified by Kroo teaches “an

electrical-power system attached to and positioned in the flying hovercraft and electrically coupled to the set of thrusters” and “a control system that is attached to and positioned in the RC flying hovercraft and operably connected to the thrusters and that automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the RC flying hovercraft,” as required by proposed substitute claim 25. Mot. 25–26; Pet. Opp. 5 (citing Ex. 1004 ¶¶ 42–44, 60, 88–98; Ex. 1029, 506, 507, 509, 513–515, Fig. 2), 7–8 (citing Ex. 1029 at 506, 509, 513–515, Fig. 2; 3d Chowdhary Decl. ¶¶ 20–22). As discussed above in Sections III.E.3 and III.E.4, we find that Louvel teaches an electrical power system attached to a flying hovercraft and electrically coupled to a set of thrusters and a control system attached to the flying hovercraft and operably connected to the thrusters to control automatically a thrust produced by each thruster in order to maintain automatically a desired orientation. Ex. 1004 ¶¶ 60, 90, 91, 97, 98, 101, 104, 105.

We also find that Kroo teaches “[m]icro air vehicles (MAVs)” (Ex. 1029, 503) that are “significantly smaller than conventional air vehicles” (*id.* at 504) with motors driven by batteries (*id.* at 506, 513–514). Moreover, we find that Jimenez teaches positioning printed circuit board/chassis 4 into gondola 3 of a toy blimp. Ex. 1006 ¶ 33 (“the assembly of the printed wired circuit board/chassis 4 into gondola 3 . . . attached under the body 1 of the toy blimp”), ¶ 35 (“flight commands are supplied . . . to the flight control module 39 which interprets which motors 5, 6, and/or 7 are to be energized and in what direction”), Figs. 2, 3 (showing flight control module 39 as part of printed wired circuit board/chassis 4); *see also id.* ¶ 14 (“For illustration purposes only, a . . . toy blimp is used as an example to describe the

teachings of this invention.”), ¶ 42 (“It is understood that the same principles explained here can be applied to other types of remotely controlled toys, including model airplanes.”).

Petitioners assert that one of ordinary skill in the art would have been motivated to modify further Louvel and Jimenez with Kroo to “realiz[e] greater simplicity and substantial weight savings” and “greater freedom of movement.” Pet. Opp. 9–11 (citing Ex. 1004 ¶ 60; Ex. 1029 at 504, 515; 3d Chowdhary Decl. ¶¶ 35, 36).

The entirety of the record persuades us that Petitioners provide articulated reasoning with rational underpinning for further modifying Louvel and Jimenez with Kroo. Ex. 1004 ¶ 60; Ex. 1029 at 504, 515; 3d Chowdhary Decl. ¶¶ 35, 36. Thus, we determine that Petitioners’ proposed combination of Louvel, Jimenez, and Kroo would have included “an electrical-power system attached to and positioned in the flying hovercraft and electrically coupled to the set of thrusters” and “a control system that is attached to and positioned in the RC flying hovercraft and operably connected to the thrusters and that automatically controls a thrust produced by each thruster in order to automatically maintain a desired orientation of the RC flying hovercraft,” as recited by proposed substitute claim 25.

The entirety of the record persuades us that Petitioners’ proposed combination of Louvel, Jimenez, and Kroo further modified by Nagamitsu teaches the newly amended limitation:

a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft, wherein the desired orientation received from the RC controller is based on at least a two dimensional, two-axis sensed orientation of the RC controller sensed by dynamically sensing a gravitational

reference and a relative tilt of the RC controller with respect to the gravitational reference

Mot. 26; Pet. Opp. 16–17 (citing Ex. 1028, 12:10–30, 15:26–46, 16:26–54, Fig. 4). For the reasons discussed above in Section III.E.6, the entirety of the record persuades us that Louvel and Jimenez teach “a radio receiver configured to receive communications from the RC controller, the communications including a desired orientation of the RC flying hovercraft.” Ex. 1006 ¶¶ 14, 24, 25, 31, 35, 42, Figs. 2A, 2B, 3.

We find that Nagamitsu teaches that its 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. Ex. 1028, 12:10–30, Fig. 4; 3d Chowdhary Decl. ¶ 21. The entirety of the record persuades us that Nagamitsu teaches using that sensor system in input unit 30 to sense at least a two dimensional, two-axis sensed orientation of the handheld structure sensed by dynamically sense a gravitational reference and a relative tilt of input unit 30 with respect to the gravitational reference. See Ex. 1028, 12:10–30, Fig. 4; 3d Chowdhary Decl. ¶ 21; Ex. 1034, 149:11–14 (Patent Owner’s declarant, in response to “would you agree with me, then, that on at least some level, movement and orientation are related concepts,” answering “[t]hey are derivatives of each other”); 2d Condon Decl. ¶ 51 (“‘Gravitational reference’ refers to the use of the gravity vector as a component of a reference frame . . . the term would be understood as the downward direction on Earth.”), ¶ 52 (“‘Relative tilt’ . . . refers to an orientation of an object relative to gravity or the downward direction.”),. Thus, we determine that the proposed combination of Louvel, Nagamitsu,

and Jimenez would have included a “desired orientation received from the RC controller [] based on at least a two dimensional, two-axis sensed orientation of the RC controller sensed by dynamically sensing a gravitational reference and a relative tilt of the RC controller with respect to the gravitational reference,” as required by proposed substitute claim 25.

The entirety of the record persuades us that Petitioners’ proposed combination of Louvel, Jimenez, and Kroo further modified by Nagamitsu teaches the newly amended limitation:

wherein the control system in the RC flying hovercraft automatically and dynamically controls a thrust produced by each of the thrusters to achieve and selectively maintain the actual orientation of the RC flying hovercraft in response to the desired orientation received from 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 control of moment-to-moment balance and stabilization of the RC flying hovercraft such that on a moment-to-moment basis the actual orientation of the RC flying hovercraft mimics the sensed orientation of the RC controller.

Mot. 26–27; Pet. Opp. 17 (citing Ex. 1028, 15:25–52, 16:26–64, Fig. 9; 3d Chowdhary Decl. ¶ 34).

We find that Nagamitsu teaches input unit 30 controls a “soft-robot” “on a moment-to-moment basis” and “mimics said sensed orientation of said handheld structure of said RC controller.” See Pet. Opp. 19 (citing Ex. 1028, 15:25–52, 16:26–64, Fig. 9; 3d Chowdhary Decl. ¶ 30); 2d Condon Decl. ¶ 53 (“‘Moment-to-moment’ refers to a generally dynamic process that is neither completely instantaneous nor completely continuous.”), ¶ 54 (“‘Mimic’ refers to generally corresponding some aspect of the behavior of one thing relative to another.”).

Moreover, we find that Louvel teaches that its “close loop calculus is performed at each moment in real time.” Ex. 1004 ¶ 119. Louvel alone, thus, indicates that the actual orientation of its aircraft corresponds to its control system on a “moment-to-moment basis.” *See also* 2d Condon Decl. ¶ 53 (stating “[m]oment-to-moment’ refers to a generally dynamic process that is neither completely instantaneous nor completely continuous”).

Petitioners assert, and we agree, that Nagamitsu is combinable with the other asserted references because each is in the same field of endeavor. Pet. Opp. 17 (citing Ex. 1028, 15:25–52; 3d Chowdhary Decl. ¶ 47); *see also* PO Resp. 26 (stating the “field of the present invention is admittedly the field of remote control aircraft”); 3d Chowdhary Decl. ¶ 47. Also, as discussed above, Kroo teaches “[m]icro air vehicles (MAVs)” (Ex. 1029, 503) that are “significantly smaller than conventional air vehicles” (*id.* at 504).

Petitioners also assert that a person of ordinary skill in the art would have further modified Louvel, Jimenez, and Kroo with Nagamitsu because the modification would have been (1) a simple, predictable substitution and (2) obvious to try. Pet. Opp. 20–21 (citing Ex. 1004 ¶¶ 50–53, Fig. 5B; 3d Chowdhary Decl. ¶¶ 48, 49). The entirety of the record persuades us that Petitioners’ reasons for modifying its proposed combination to include the input unit of Nagamitsu constitute sufficient articulated reasoning having rational underpinning. We find that Nagamitsu teaches that its input unit 30 can be used similar to a “joy stick of a TV game or a control stick of a helicopter.” Ex. 1028, 15:25–52; *see also* Ex. 1034, 36:16–19 (In response to “you’d agree with me, then, that the video game controllers and drone controllers are relevant to each other,” Patent Owner’s declarant answering

“[t]hey can be in certain circumstances.”). We also credit Prof. Chowdhary’s testimony that modifying further based on the teachings of Nagamitsu would have been a simple, predictable substitution and obvious to try because of well-known benefits, such as “more freedom of movement” and “more natural control,” and other advantages. 3d Chowdhary Decl. ¶¶ 48, 49. We also credit Prof. Chowdhary’s testimony that a person of ordinary skill in the art would have had a reasonable expectation of success when combining Louvel and Nagamitsu. 3d Chowdhary Decl. ¶ 50. Thus, we determine that Petitioners’ proposed combination of Louvel, Jimenez, Kroo, and Nagamitsu would have rendered obvious proposed substitute claim 25.

Additionally, the entirety of the record persuades us that Louvel, Thomas, and Jimenez would have rendered obvious proposed substitute claim 25. Like Nagamitsu, we find that Thomas teaches a hand-held controller that includes accelerometers in each of three perpendicular directions. PO Resp. 18; Ex. 1005, 1:7–9, 1:29–31, 2:12–14, 2:19–23; 2d Condon Decl. ¶ 29 (“*Thomas* utilizes centrifugal forces to measure rotational velocity, measured in radians per second or degrees per second, as the motion input of the hand-held control device.”). Nagamitsu evidences that it was known in the art that one of the accelerometers in Thomas can detect a gravitational reference. Thus, the combination of Louvel, Thomas, and Jimenez would have rendered obvious proposed substitute claim 25, including the “sensed orientation of the RC controller sensed by dynamically sensing a gravitational reference and a relative tilt of the RC controller with respect to the gravitational reference.”

Also, we find that Louvel teaches a “close loop calculus is performed at each moment in real time” (Ex. 1004 ¶ 119), and thus, teaches “on a moment-to-moment basis the actual orientation of the RC flying hovercraft mimics the sensed orientation of the RC controller,” as required by proposed substitute claim 25. Therefore, based on the findings discussed here and in Section III.E, we also determine that the combination of Louvel, Thomas, and Jimenez would have rendered obvious proposed substitute claim 25.

6. Analysis of Proposed Substitute Claims 26–31

Based on our factual findings regarding Louvel, the entirety of the record persuades us that Louvel teaches the limitations of proposed substitute claims 26–29 for the reasons discussed above in Section III.F. *See also* Pet. Opp. 5 (citing Ex. 1004 ¶¶ 22, 35–39, 90, 93, 97–101 Figs. 2, 3, 11, 12).

Also, based on our factual findings regarding Louvel and Gabai, the entirety of the record persuades us that these references teach the limitations of proposed substitute claim 30 for the reasons discussed in Section III.G. *See also* Pet. Opp. 5 (citing Ex. 1008 ¶¶ 15, 16, 119–120, 613–673, 691, 692, Figs. 41, 42, 56). The entirety of the record also supports Petitioners’ rationale for combining Louvel, Nagamitsu, Kroo, Jimenez, and Gabai. Pet. 35–36 (citing 1st Chowdhary Decl. ¶¶ 107–109; Ex. 1004 Abstract, ¶¶ 1, 25, 92; Ex. 1006 Abstract, ¶¶ 2, 35); 58–59 (citing 1st Chowdhary Decl. ¶ 212; Ex. 1004 Abstract; Ex. 1008 ¶¶ 14, 58); Pet. Opp. 8–11 (citing Ex. 1004 ¶ 60; Ex. 1029 at 504, 515; 3d Chowdhary Decl. ¶¶ 35, 36), 17–18 (citing Ex. 1004 ¶¶ 50–53, Fig. 5B; Ex. 1028, 15:25–52; 3d Chowdhary Decl. ¶¶ 47–49), 21–22 (citing Ex. 1004 Abstract, ¶¶ 1, 25, 92; Ex. 1006 Abstract, ¶¶ 2, 35; 3d Chowdhary Decl. ¶ 52), 22–23 (citing Ex. 1004 Abstract; Ex. 1008 ¶¶

14, 58; 3d Chowdhary Decl. ¶ 53); 1st Chowdhary Decl. ¶ 212; Ex. 1004 Abstract, ¶¶ 1, 25, 50–53, 60, 92, Fig. 5B; Ex. 1006 Abstract, ¶¶ 2, 35; Ex. 1008 ¶¶ 14, 58; Ex. 1028, 15:25–52; Ex. 1029 at 504, 515; 3d Chowdhary Decl. ¶¶ 35, 36, 47–49, 52, 53.

Furthermore, based on our factual findings regarding Louvel and Jimenez, the entirety of the record persuades us that these references teach the limitations of proposed substitute claim 31 for the reasons discussed in Section III.F. *See also* Pet. Opp. 5 (citing Ex. 1004 Abstract, ¶¶ 1, 7, 25, 51–53, 92, Fig. 5B; Ex. 1006 Abstract, ¶¶ 2, 24, 25, 31, 35, Fig. 3). The entirety of the record also supports Petitioners’ rationale for combining Louvel, Nagamitsu, Kroo, and Jimenez. Pet. 35–36 (citing 1st Chowdhary Decl. ¶¶ 107–109; Ex. 1004 Abstract, ¶¶ 1, 25, 92; Ex. 1006 Abstract, ¶¶ 2, 35); Pet. Opp. 8–11 (citing Ex. 1004 ¶ 60; Ex. 1029 at 504, 515; 3d Chowdhary Decl. ¶¶ 35, 36), 17–18 (citing Ex. 1004 ¶¶ 50–53, Fig. 5B; Ex. 1028, 15:25–52; 3d Chowdhary Decl. ¶¶ 47–49), 21–22 (citing Ex. 1004 Abstract, ¶¶ 1, 25, 92; Ex. 1006 Abstract, ¶¶ 2, 35; 3d Chowdhary Decl. ¶ 52); 1st Chowdhary Decl. ¶¶ 107–109; Ex. 1004 Abstract, ¶¶ 1, 25, 50–53, 60, 92, Fig. 5B; Ex. 1006 Abstract, ¶¶ 2, 35; Ex. 1028, 15:25–52; Ex. 1029 at 504, 515; 3d Chowdhary Decl. ¶¶ 35, 36, 47–49, 52.

Moreover, based on the findings discussed here and in Section III.E, we also determine that the combination of Louvel, Thomas, Jimenez, and Gabai would have rendered obvious proposed substitute claims 26–31.

7. Patent Owner Reply to Petitioners’ Opposition

Patent Owner replies that Nagamitsu teaches a motion-based controller with a magnetic reference, not a gravitational frame of reference. PO Reply to Opp. 15 (citing Ex. 1028, 13:52–53, 14:44–45). Patent Owner

also replies that “the frame of reference used by *Nagamitsu* is a **magnetic field**, not a gravitational reference.” PO Reply to Opp. 16 (citing Pet. Opp. 16 with full quote from Ex. 1028, 12:10–30). Patent Owner further replies that Petitioners have misconstrued the teachings of *Nagamitsu* as to what its accelerometer senses and that *Nagamitsu* does not teach a gravitational frame of reference. PO Reply to Opp. 16–17 (citing Pet. Opp. 17).

For the reasons discussed above, we find that *Nagamitsu* teaches accelerometers 36 that detect a direction of gravity, thus teaching the “gravitational reference” of claim 8. Ex. 1028, 12:22–23 (“detecting [a] direction of the gravity and acceleration by the accelerometer 36”). Also, claim 8 recites “gravitational reference,” not “gravitational frame of reference.” Even if claim 8 required a “gravitational frame of reference,” the record persuades us that detecting with respect to a direction of gravity can include detecting with respect to a gravitational frame of reference. Ex. 1028, 12:10–30, Fig. 4; Ex. 1034, 149:11–14 (Patent Owner declarant, in response to “would you agree with me, then, that on at least some level, movement and orientation are related concepts,” answering “[t]hey are derivatives of each other”); 3d Chowdhary Decl. ¶ 22; 2d Condon Decl. ¶ 51 (“‘Gravitational reference’ refers to the use of the gravity vector as a component of a reference frame . . . the term would be understood as the downward direction on Earth.”).

Patent Owner additionally replies that *Nagamitsu* does not teach controlling an RC craft to mimic the orientation of an RC controller. PO Reply to Opp. 18–19 (citing Pet. Opp. 17; Ex. 1028, 15:25–52, 16:26–51, 28:31–36). The entirety of the record, however, persuades us that Louvel, *Nagamitsu*, Kroo, and Jimenez teach “on a moment-to-moment basis the

actual orientation of the RC flying hovercraft mimics the sensed orientation of the RC controller.” See Ex. 1004 ¶ 119 (“The whole close loop calculus is performed at each moment in real time.”); Ex. 1028, 15:25–52, 16:26–64, Fig. 9; 3d Chowdhary Decl. ¶ 30; 2d Condon Decl. ¶ 54 (“‘Mimic’ refers to generally corresponding some aspect of the behavior of one thing relative to another.”).

Patent Owner also asserts that Petitioners have not set forth a sufficient rationale for combining Nagamitsu with Louvel by citing to its Patent Owner Response. PO Reply to Opp. 19–21 (citing PO Resp. 23–30 (arguments against the rationale for the combination of Louvel, Thomas, and Jimenez)). Our rules, however, do not permit incorporating arguments by reference from one document into another document. 37 C.F.R. § 42.6(a)(3) (“Arguments must not be incorporated by reference from one document into another document.”); *see also* Paper 18, 3 (stating “Patent Owner’s counsel ha[s] read the Board’s requirements regarding electronic filing at 37 C.F.R. §§ 42.6 and 42.63”). Also, Patent Owner’s arguments directed to Louvel, Thomas, and Jimenez are irrelevant because it fails to address Nagamitsu. Even if those arguments were properly presented and directly addressed the proposed combination of Louvel, Nagamitsu, Kroo, and Jimenez, the entirety of the record supports Petitioners’ position that one of ordinary skill in the art would have had reason to combine Louvel with Nagamitsu. Pet. Opp. 18–21; Ex. 1028, 15:25–52; Ex. 1034, 36:16–19; 3d Chowdhary Decl. ¶¶ 41–44.

Patent Owner further asserts that the proposed combination of Louvel, Nagamitsu, Kroo, and Jimenez would not arrive at an orientation control scheme, as required by proposed substitute claim 25. PO Reply to Opp. 22–

23 (citing PO Resp. 36–38 (arguing Louvel uses a position control scheme, not an orientation control scheme), 47–50 (arguing against the combination of Louvel and Thomas); Ex. 1004 ¶ 91, Figs. 1, 5; 2d Condon Decl. ¶ 30 (discussing the hand-held control device of Thomas)). As discussed above, 37 C.F.R. § 42.6(a)(3) does not permit incorporating arguments by reference from one document into another document. Moreover, these arguments address the combination of Louvel, Thomas, and Jimenez, not the proposed combination of Louvel, Nagamitsu, Kroo, and Jimenez. Even if these arguments were applied to the combination of Louvel, Nagamitsu, Kroo, and Jimenez, proposed substitute claim 25 does not require expressly an orientation control scheme, only “on a moment-to-moment basis the actual orientation of the RC flying hovercraft mimics the sensed orientation of the RC controller.” See 2d Condon Decl. ¶ 54 (“‘Mimic’ refers to generally corresponding some aspect of the behavior of one thing relative to another.”).

D. Conclusion as to Proposed Substitute Claims 25–31

In view of the entirety of the evidence, we determine that proposed substitute claims 25–31 are not patentable over Louvel, Nagamitsu, Kroo, and Jimenez by a preponderance of the evidence. We also determine by a preponderance of the evidence that proposed substitute claim 25 is not patentable over Louvel, Thomas, and Jimenez and that proposed substitute claims 26–31 are not patentable over Louvel, Thomas, Jimenez, and Gabai. We need not, and do not, reach whether proposed substitute claims 25–31 are unpatentable over Louvel, Sato, Kroo, and Jimenez. We, therefore, deny Patent Owner’s Contingent Motion to Amend.

V. CONCLUSION

For the foregoing reasons, based on the full record before us, we determine that Petitioners have demonstrated, by a preponderance of the evidence, that claims 8–14 of the '532 patent are unpatentable.

Also, based on the entirety of the record, a preponderance of the evidence demonstrates that proposed substitute claims 25–31 are unpatentable, and thus, Patent Owner's Contingent Motion to Amend is denied.

VI. ORDER

Accordingly, it is:

ORDERED that claims 8–14 of U.S. Patent No. 9,073,532 B2 have been shown, by a preponderance of the evidence, to be unpatentable;

FURTHER ORDERED that, based on the entirety of the record, proposed substitute claims 25–31 have been shown, by a preponderance of the evidence, to be unpatentable, and therefore, Patent Owner's Contingent Motion to Amend 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.

IPR2016-01559
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