

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DJI EUROPE B.V.,
Petitioner,

v.

TEXTRON INNOVATIONS INC.,
Patent Owner.

IPR2022-00162
Patent 9,162,752 B2

Before MICHAEL R. ZECHER, SCOTT A. DANIELS, and
FREDERICK C. LANEY, *Administrative Patent Judges*.

ZECHER, *Administrative Patent Judge*.

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

I. INTRODUCTION

Petitioner, DJI Europe B.V. (“DJI”), filed a corrected Petition requesting *inter partes* review (“IPR”) of claims 1–7, 10, and 12 of U.S. Patent No. 9,162,752 B2 (Ex. 1001, “the ’752 patent”). Paper 3 (“Pet.”). Patent Owner, Textron Innovations, Inc., (“Textron”), filed a Preliminary Response to the Petition. Paper 7 (“Prelim. Resp.”). With our authorization, DJI then filed a Preliminary Reply to Textron’s Preliminary Response. Paper 8 (“Prelim. Reply”). Textron similarly filed a Preliminary Sur-Reply to DJI’s Preliminary Reply. Paper 10 (“Prelim. Sur-Reply”). Taking into account the arguments presented in Textron’s Preliminary Response, DJI’s Preliminary Reply, and Textron’s Preliminary Sur-reply, we determined that the information presented in the Petition established that there was a reasonable likelihood that DJI would prevail with respect to challenging at least one of claims 1–7, 10, and 12 of the ’752 patent as unpatentable. Pursuant to 35 U.S.C. § 314, we instituted this IPR on June 7, 2022, as to all challenged claims and all grounds raised in the Petition. Paper 11 (“Institution Decision” or “Dec. on Inst.”).

During trial, Textron filed a Patent Owner Response (Paper 16, “PO Resp.”), and DJI filed a Reply to the Patent Owner Response (Paper 17, “Pet. Reply”). Textron did not file a Patent Owner Sur-Reply and neither party requested oral argument.

We have jurisdiction under 35 U.S.C. § 6. This decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 1–7, 10, and 12 of the ’752 patent. For the reasons we identify below, we hold that DJI has demonstrated by a preponderance of the evidence that all challenged claims are unpatentable.

A. Real Parties in Interest

DJI states that itself, SZ DJI Technology Co. Ltd., DJI Technology, Inc., iFlight Technology Co. Ltd., and DJI Research LLC are the real parties in interest. Pet. 66. Textron states that itself, Bell Textron Inc., and Textron, Inc. are real parties in interest. Paper 5 (Textron’s Mandatory Notices), 2.

B. Related Matters

The parties indicate that the ’752 patent has been asserted against DJI in *Textron Innovations Inc. v. DJI Europe B.V.*, No. 6:21-cv-00740 (W.D. Tex.). Pet. 67; Paper 5, 2. In addition to this Petition, DJI also filed another petition requesting an IPR challenging a certain subset of claims in U.S. Patent No. 10,243,647 B2 (IPR2022-00163). Paper 5, 2. In IPR2022-00163, we entered adverse judgment against Textron after it filed a statutory disclaimer that disclaimed all the challenged claims. *DJI Europe B.V. v. Textron Innovations Inc.*, IPR2022-00163, Paper 19 (PTAB Feb. 15, 2023) (Judgment).

C. The ’752 Patent

The ’752 patent, titled “Flight Control Laws for Automatic Hover Hold,” issued from U.S. Patent Application No. 13/703,640 (“the ’640 application”), filed on July 15, 2011. Ex. 1001, codes (54), (21), (22). The ’752 patent identifies known problems with brownout conditions (e.g., blinding dust clouds caused by helicopter rotor downwash) during takeoff and landing that has led to several accidents due to the challenging flight conditions, which the ’752 patent seeks to address through “existing aircraft sensors, actuators, and control laws to help the pilot overcome brownout or degraded visual environment (DVE) flight.” *Id.* at 1:19–24, 1:48–53, 2:40–42. The ’752 patent states that its control law architecture “allows the pilot

to maneuver at low speed with minimal compensation and workload.” *Id.* at 2:42–45.

More specifically, the ’752 patent describes an automatic hover hold (“AHH”), translational rate command (“TRC”), and position hold (“PH”), which “are applicable to both fly-by-wire, as well as traditional mechanical flight control systems with partial authority flight control actuators.”

Ex. 1001, 3:9–12. These functions are illustrated in the context of various flight envelopes shown in Figure 1, reproduced below. *Id.* at 2:54–66.

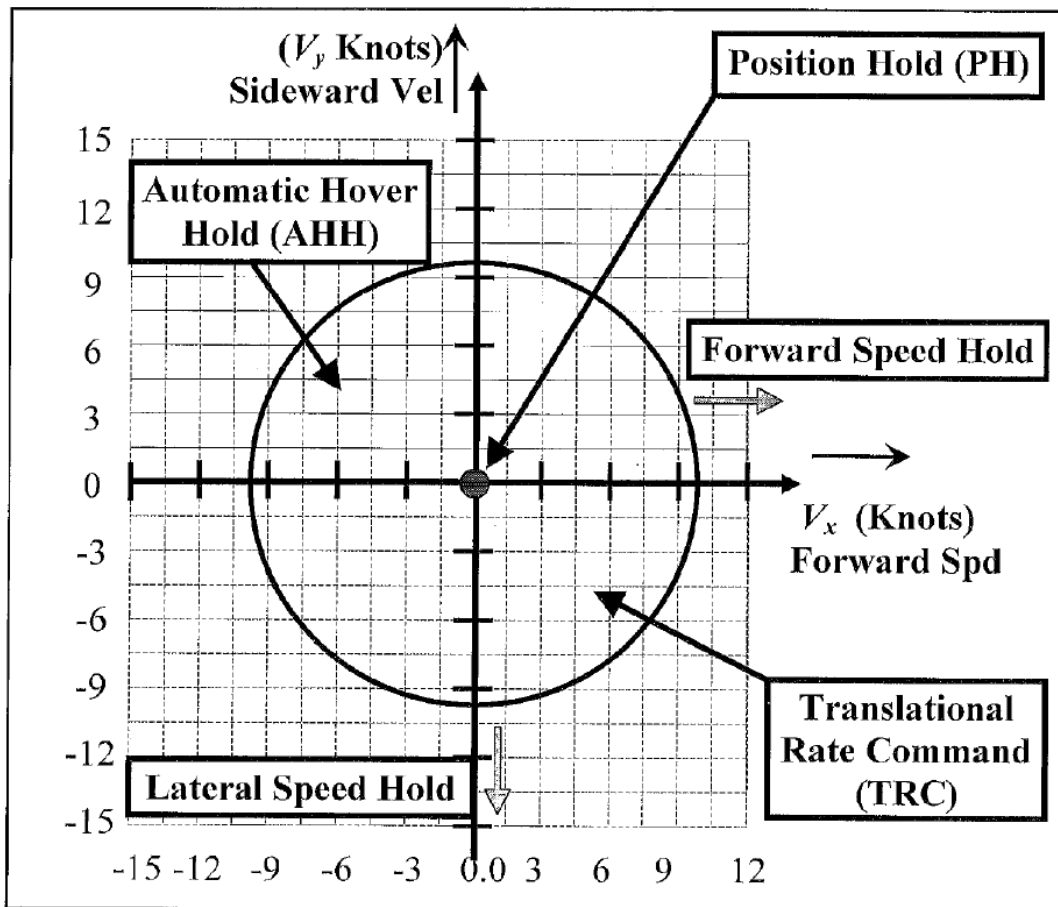


FIG. 1

Figure 1 “shows the automatic hover hold (AHH), translational rate command (TRC), and position hold (PH) regions” in which AHH will

engage if the pilot releases both the longitudinal and lateral controls when groundspeed is less than a set speed (e.g., 10 knots); PH will engage below a second slower groundspeed (e.g., 1 knot), if both the longitudinal and lateral controls are released. *Id.* at 2:6–7, 2:54–61.

The '752 patent explains that, “[o]nce AHH has been engaged, if the pilot moves the longitudinal or lateral control out of the zero force detent position, then the [advanced control laws (CLAWS)] will enter the translational rate command (TRC) mode.” Ex. 1001, 2:61–64. “In this region, the aircraft will fly at a groundspeed proportional to the amount of control displacement,” but the “TRC mode will disengage if the TRC or actual groundspeed exceeds the AHH threshold.” *Id.* at 2:64–3:1. When that occurs, “the CLAWS can enter either an attitude command or rate command mode.” *Id.* at 3:1–3.

The '752 patent discloses that “[t]he AHH mode will smoothly and automatically engage as the rotorcraft decelerates from a higher ground speed to within the default AHH speed range” provided the aircraft’s longitudinal and lateral controllers are in the detent position. Ex. 1001, 3:14–16, 8:23–30, 9:35–61. “Once in the AHH mode, the aircraft will automatically enter a stable hover with the controller in detent.” *Id.* at 8:32–34. “The PH mode will automatically engage when the ground speed is lower than a set ground speed slower than” default AHH speed range set, provided the longitudinal and lateral controllers are in the detent position. *Id.* at 3:16–18, 3:25–26, 9:6–10. The aircraft’s position over the ground in this mode is captured and “tightly held even in the presence of disturbances due to gusty winds or control inputs in the directional or vertical axes.” *Id.* at 9:22–27. Finally, the TRC mode is activated whenever the longitudinal or

lateral controllers are out of the detent position during flight, but within the AHH groundspeed threshold. *Id.* at 2:61–64, 3:18–21. In TRC mode, “the aircraft will fly at a groundspeed proportional to the amount of control displacement” and “will disengage if the TRC or actual groundspeed exceeds the AHH threshold.” *Id.* at 2:64–3:1. When TRC mode is disengaged, movement of the longitudinal or lateral controls will command a different response type, such as attitude command or rate command mode. *Id.* at 2:67–3:3.

D. Challenged Claims

Of the challenged claims, claim 1 is the only independent claim. Independent claim 1 is directed to “[a] method.” Ex. 1001, 11:25. Claims 2–7, 10, and 12 directly or indirectly depend from independent claim 1. *Id.* at 11:47–67, 12:15–20, 12:23–27. Independent claim 1 is illustrative of the challenged claims and is reproduced below with DJI’s bracketing added for reference:

1. [1pre] A method to control hovering flight of a rotary aircraft, the rotary aircraft having a longitudinal controller and a lateral controller, the method comprising:

[1a] defining a first flight envelope having a first groundspeed threshold;

[1b] defining a second flight envelope having a second ground speed threshold, the second flight envelope being defined within the first envelope;

[1c] engaging an automatic hover hold with a control law hover hold architecture as the aircraft enters the first flight envelope;

[1d] engaging an automatic position hold with a control law position hold architecture as the aircraft enters the second flight envelope; and

[1e] interchanging the automatic hover hold and the automatic position hold as the rotary aircraft moves between the first flight envelope and the second flight envelope;

[1f] wherein at least one of the engaging the automatic hover hold and the engaging an automatic position hold is performed in response to at least one of the longitudinal controller and the lateral controller being in a detent position.

Ex. 1001, 11:25–46.

E. Asserted Prior Art References

DJI relies on the prior art references set forth in the table below. Pet. 10–11.

Name¹	Reference	Dates	Exhibit No.
Harding	Development of Modern Control Laws for the AH-64D in Hover/Low Speed Flight	American Helicopter Society International, Inc. (2006)	1005
Rempfer	U.S. Patent No. 3,711,042	issued Jan. 16, 1973	1006
Gold	Design and Pilot Evaluation of the RAH-66 Comanche Selectable Control Modes	NASA Technical Reports Server (2003)	1007
Mansur	Optimization and Piloted Simulation Results of the AH-64D Modern Control Laws	American Helicopter Society International, Inc. (2007)	1008

¹ For clarity and ease of reference, we only list the first named author or inventor.

F. Asserted Grounds of Unpatentability

DJI challenges claims 1–7, 10, and 12 of the ’752 patent based on the grounds of unpatentability set forth in the table below. Pet. 11, 12–64.

Claim(s) Challenged	35 U.S.C. §²	Reference(s)/Basis
1–7, 12	102(b)	Harding
1–7, 12	103(a)	Harding
1–7, 12	103(a)	Harding, Rempfer
3, 10, 12	103(a)	Harding, Gold
3, 10, 12	103(a)	Harding, Rempfer, Gold
4	103(a)	Harding, Mansur
4	103(a)	Harding, Rempfer, Mansur

DJI supports its arguments in the Petition with the testimony of William Singhose, Ph.D. Ex. 1002 (Declaration of Dr. Singhose in support of Petition).

II. ANALYSIS

A. Claim Construction

In an IPR based on a petition filed on or after November 13, 2018, such as here, claim terms are construed using the same claim construction standard as in a civil action under 35 U.S.C. § 282(b). *See* 37 C.F.R. § 42.100(b) (2019). That is, claim terms generally are construed in accordance with their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art, in view of the

² The Leahy-Smith America Invents Act (“AIA”) amended 35 U.S.C. § 103. *See* Pub. L. No. 112-29, 125 Stat. 284, 285–88 (2011). As the application that issued as the ’752 patent was filed before the effective date of the relevant amendments, the pre-AIA version of § 103 applies.

specification and the prosecution history pertaining to the patent at issue. *See id.* The ordinary and customary meaning of a claim term “is its meaning to the ordinary artisan after reading the entire patent,” and “as of the effective filing date of the patent application.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313, 1321 (Fed. Cir. 2005) (en banc).

In its Petition, DJI proposed a construction for the claim term “detent position,” as recited in independent claim 1 of the ’752 patent. Pet. 9–10. In the Institution Decision, we indicated that we need not construe “detent position” for purposes of our preliminary analysis. *See* Dec. on Inst. 17–19. In its Patent Owner Response, Textron for the first time proposed a construction for the claim term “engaging . . . when both the longitudinal controller and the lateral controller are released,” as recited in each of dependent claims 6 and 7. *See* PO Resp. 9–10. We address both claim terms below based on the arguments and evidence presented during trial.

1. “detent position”

In its Petition, DJI argued that the claim term “detent position,” as recited in independent claim 1 of the ’752 patent, should be construed to mean “zero-force position.” Pet. 9. In its Patent Owner Response, Textron cited documentation from the parallel district court case that the parties “agree to construe ‘detent position’ to have its plain and ordinary meaning,” and stated that “there is no dispute between the parties as to the meaning of the term and . . . no explicit construction is necessary.” PO Resp. 8–9 (citing Ex. 2016, 5). Based on the fully developed trial record, there is no readily discernible controversy between the parties that requires us to construe this claim term. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (noting that “we need only construe

terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

2. “*engaging . . . when both the longitudinal controller and the lateral controller are released*”

In its Patent Owner Response, Textron proposed a construction for the following two related limitations: (1) “wherein engaging automatic hover flight within the first envelope is achieved when both the longitudinal controller and the lateral controller are released,” as recited in dependent claim 6; and (2) “wherein engaging a position hold flight is achieved when both the longitudinal controller and the lateral controller are released,” as recited in dependent claim 7. PO. Resp. 9 (citing Ex. 1001, 11:61–57).

Textron proposes that we construe the claim term “engaging . . . when both the longitudinal controller and the lateral controller are released” as requiring two separate controllers, one that controls the longitudinal functions and one that controls the lateral functions. *Id.* at 10. In support of its proposed construction, Textron contends that, “unlike [independent] [c]laim 1, because [dependent] [c]laims 6 and 7 require releasing ‘both the longitudinal controller and the lateral controller’ in order to engage automatic hover hold and/or position hold, respectively, [dependent] [c]laims 6 and 7 also require that the longitudinal controller and the lateral controller be separate controllers.” *Id.* at 9. Relying on a general-purpose dictionary definition, Textron argues its construction is “consistent with the plain and ordinary meaning of [the word] ‘both’ (i.e., ‘used to refer to two people or things together’).” *Id.* at 10 (citing Ex. 2017 (Cambridge Dictionary of American English 2nd ed.)).

In its Reply, DJI contends that we should not adopt Textron's newly proposed construction, but instead we should "apply the term's plain and ordinary meaning, which includes releasing a single stick that acts as both the longitudinal controller and the lateral controller." Pet. Reply 2. DJI argues that "[Textron's] construction contradicts the plain and ordinary language of the claims and improperly excludes the preferred embodiment disclosed in the specification, namely helicopters that have one control stick that acts as both the longitudinal controller and the lateral controller." *Id.*

According to DJI, the intrinsic evidence "makes clear that dependent claims 6 and 7 do not require the longitudinal controller and the lateral controller to be physically separate, as [Textron] argues." Pet. Reply 3 (citing PO Resp. 11, 17); *see also id.* at 4 (arguing the same). DJI argues that Textron's newly proposed construction requires the longitudinal and lateral controllers to be physically separate for each controller to be independently released. *Id.* at 4. DJI argues that Textron's argument in this regard contradicts the plain language of dependent claims 6 and 7, each of which simply requires that "both the longitudinal controller and the lateral controller are released." *Id.* (citing Ex. 1001, 11:61–67). Instead, DJI contends this limitation is satisfied by "a single stick that embodies both the longitudinal controller and the lateral controller [that] is released." *Id.* Stated differently, DJI argues that, if a pilot lets go of a single stick that embodies both the longitudinal and lateral controller, then "the pilot simultaneously releases both the longitudinal controller and the lateral controller, which is consistent with [Textron's] dictionary entry for the word 'both.'" *Id.* (citing Ex. 2017, 3). According to DJI, because the plain and ordinary meaning of releasing the longitudinal and lateral controllers could

encompass a single control stick, then we should not adopt Textron's attempts to limit the claims to require two separate control sticks. *Id.*

Additionally, DJI argues that we should not adopt Textron's narrow construction because the '752 patent neither clearly defines the claim term, nor does it disavow its plain and ordinary meaning. Pet. Reply 5. DJI further argues that Textron's proposed construction is "overly narrow" and notes that Textron does not cite any portion of the '752 patent in support of its construction. *Id.* Instead, DJI contends that the specification of the '752 patent supports its proposed plain and ordinary meaning in which a single stick may embody both the longitudinal and lateral controllers. *Id.* at 5–6. DJI directs us to where the specification uses the word "stick" as a singular element when discussing multiple controls, and contends "[t]he '752 patent, thus, acknowledges that releasing a single stick (e.g., a cyclic stick) to the detent position is the same thing as releasing both the longitudinal controller and the lateral controller to the detent position." *Id.* (citing Ex. 1001, 2:55–61, 3:18–29, 5:21–27, 8:27–30, 8:49–57, 9:6–10, 10:44–47; Ex. 1002 ¶ 65). DJI also directs us to the disclosure in the specification of the "translational rate command mode," and argues "that such a mode 'makes translational movement from a stable hover very easy and intuitive, since the pilot just has to displace *the controller*'—singular—'in the desired direction of movement.'" *Id.* at 6 (quoting Ex. 1001, 2:61–66, 8:50–53).

Finally, DJI contends that Textron's newly proposed construction is contrary to its position taken in the parallel district court case. Pet. Reply 8–10. More specifically, DJI contends that in its infringement contentions filed in the parallel district court case, Textron relies on disclosures from a manual to meet the longitudinal and lateral controllers of independent claim

1, in which a single control stick “can move in multiple axes and control the longitudinal and lateral movement of the drone.” *Id.* at 9 (citing Ex. 1014, 2–3, 26–27). DJI argues that Textron’s final infringement contentions for dependent claims 6 and 7 merely refer back to the analysis for independent claim 1. *Id.* at 9–10. DJI argues that “[Textron’s] reliance on the right stick of the remote control as both the longitudinal controller and the lateral controller for [dependent] claims 6 and 7 undercuts its argument here that these limitations refer to physically separate controllers.” *Id.* at 10.

Based on the fully developed trial record, we agree with DJI that the claim phrase “engaging . . . when both the longitudinal controller and the lateral controller are released” should not be limited to controllers on two separate control sticks. That is, we adopt the plain and ordinary meaning for the phrase “when both the longitudinal controller and the lateral controller are released” and construe this term as encompassing either single control stick or multi-stick control configurations.

We begin with a review of the specification of the ’752 patent. *See Phillips*, 415 F.3d at 1315 (stating that “the specification is ‘the single best guide to the meaning of a disputed term’” (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996))). The “single stick” aspect of our construction finds support in the specification, which consistently reinforces that the lateral and longitudinal controllers may be embodied by a single control stick. Ex. 1001, 2:55–61, 3:18–29, 5:21–27, 8:27–30, 8:49–57, 9:6–10, 10:44–47. As two examples, the specification refers to when the “pilot moves *the control stick*,” and in another, the specification references where, “[i]n the preferred embodiment, the first 0.1–0.2 inch of aircraft stick movement is used to determine whether *the stick* is

in the detent position.” Ex. 1001, 8:49–57, 10:44–47 (emphases added). Textron does not identify explicitly, nor could we find a single instance, where the specification of the ’752 patent references using two control sticks.

Furthermore, we agree with DJI that the word “both” recited in dependent claims 6 and 7 does not require two separate control sticks, but rather refers to releasing both the longitudinal and lateral controllers. The crux of Textron’s argument appears to be that, because dependent claims 6 and 7, unlike independent claim 1, require releasing both the longitudinal and lateral controllers to activate a state, they cannot be embodied by a single stick, stating “if the controllers were not separate, how could they be independently released?” PO Resp. 10. Textron’s argument, however, conflates “controllers” and “sticks.” As we discuss above, the specification of the ’752 patent repeatedly teaches having both the longitudinal and lateral controllers be actuated by a single control stick. Textron does not support its argument with evidence from the specification, nor does it support its position that, when dependent claim 6 and 7 refer to “the longitudinal controller” and “the lateral controller,” they are referring to the separate control sticks to actuate these two different controllers. Instead, dependent claims 6 and 7 are agnostic as to whether the longitudinal and lateral controllers are set up to actuate on a single control stick or on multiple control sticks.

In summary, we accord the claim phrase “engaging . . . when both the longitudinal controller and the lateral controller are released” its plain and ordinary meaning. As we explain above, this includes a single control stick configuration that may embody both the longitudinal and lateral controllers.

Because this construction finds sufficient support in the specification of the '752 patent, we need not resort to the extrinsic evidence to determine the proper construction of the claim term, which, under these particular circumstances, includes a dictionary definition of the word “both.” *See Phillips*, 415 F.3d at 1317 (“[W]hile extrinsic evidence can shed useful light on the relevant art, we have explained that it is less significant than the intrinsic record in determining the legally operative meaning of claim language.”).

B. Anticipation or Obviousness Over the Teachings of Harding

DJI contends that claims 1–7 and 12 of the '752 patent are unpatentable under §§ 102(b) or 103(a) as anticipated by or rendered obvious over teachings of Harding. Pet. 12–49. DJI explains how Harding purportedly describes the subject matter of each challenged claim (*id.*), and relies upon the Declaration of Dr. Singhose to support its positions. *Id.* In its Patent Owner Response, Textron only presents arguments with respect to dependent claims 6 and 7, and does not present declaration testimony in support of its positions. PO Resp. 10–20.

Based on the fully developed trial record, we determine that DJI has shown by a preponderance of the evidence that claims 1–7 and 12 of the '752 patent are unpatentable as anticipated by and rendered obvious over the teachings of Harding. We begin our analysis with the principles of law that generally apply to anticipation and obviousness grounds, an assessment of the level of skill in the art, followed by a brief overview of Harding, and then we address the parties' contentions with respect to the challenged claims.

1. Principles of Law

To establish anticipation, “all of the elements and limitations of the claim must be shown in a single prior reference, arranged as in the claim.” *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001). When evaluating a single prior art reference in the context of anticipation, the reference must be “considered together with the knowledge of one of ordinary skill in the pertinent art.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)). “[T]he dispositive question regarding anticipation[, therefore, i]s whether one skilled in the art would reasonably understand or infer from the [prior art reference’s] teaching’ that every claim element was disclosed in that single reference.” *Dayco Prods., Inc. v. Total Containment, Inc.*, 329 F.3d 1358, 1368 (Fed. Cir. 2003) (alterations in original) (quoting *In re Baxter Travenol Labs.*, 952 F.2d 388, 390 (Fed. Cir. 1991)).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person of 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 skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations, such as commercial success, long-felt but unsolved needs, failure of others, etc.). *Graham v. John Deere Co.*, 383

U.S. 1, 17–18 (1966).³ We analyze the asserted grounds based on anticipation and obviousness with the principles identified above in mind.

2. *Level of Skill in the Art*

Factors pertinent to a determination of the level of ordinary skill in the art include “(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.” *Envtl. Designs, Ltd. v. Union Oil Co. of Cal.*, 713 F.2d 693, 696 (Fed. Cir. 1983) (citing *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 1381–82 (Fed. Cir. 1983)). “Not all such factors may be present in every case, and one or more of these or other factors may predominate in a particular case.” *Id.* at 696–97.

Relying on the testimony of Dr. Singhose, DJI argues a person of ordinary skill in the art at the time of the ’752 patent:

would have had at least the equivalent of a Bachelor’s degree from an accredited institution in mechanical engineering, aerospace engineering, electrical engineering, robotics or any other [similar] discipline covering principles on the design or operation of flight controls for helicopters, drones, or other rotary aircraft, as well as one year of experience working on the design, development, implementation, or operation of such technologies. Significant experience could substitute for formal education, and significant education could substitute for work experience.

³ We note, however, that neither party has introduced evidence regarding objective indicia of non-obviousness.

Pet. 11–12 (citing Ex. 1002 ¶¶ 61–62). In its Patent Owner Response, Textron agrees with the level of skill in the art as proposed by DJI, arguing the following:

a person of ordinary skill in the art . . . at the time of the invention of the '752 Patent would have been someone with at least the equivalent of a Bachelor's degree in mechanical engineering, aerospace engineering, electrical engineering, robotics or similar discipline covering principles of the design or operation of flight controls for helicopters, drones, or other rotary aircraft, as well as one year of experience working on the design, development, implementation, or operation of such technologies. [Textron] also agrees that significant experience could substitute for formal education, and significant education could substitute for work experience.

PO. Resp. 4–5.

Based on the fully developed record, the level of ordinary skill in the art is not disputed and is consistent with our review of the technology and descriptions in the '752 patent and the asserted prior art references. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that “the level of skill in the art is a prism or lens through which a judge, jury, or the Board views the prior art and the claimed invention”). For purposes of this Final Written decision, we adopt DJI’s proposed level skill in the art and apply it in our anticipation/obviousness analysis below.

3. Overview of Harding

Titled “Development of Modern Control Laws for the AH-64D in Hover/Low Speed Flight,” Harding describes modern control laws (MCLAWS) developed for helicopters “to provide improved handling qualities for hover and low speed flight in a degraded visual environment.” Ex. 1005, 1. The MCLAWS are designed to implement response types such

as attitude command attitude hold (ACAH) and translational rate command (TRC) with the goal of applying “the latest technology and analysis tools to develop . . . control laws for improved [helicopter] handling qualities in hover and low speed flight” using a linear flight dynamic model with the control law model to form a closed loop. *Id.* at 2. “The aircraft is made to follow ACAH command models in pitch and roll and a rate command (RC) model in the yaw axis,” with control being achieved “through both feed forward control . . . and response error feedback.” *Id.* at 3. Harding explains the following:

Pilot control inputs produce the ideal response or commanded states through the command models. The commanded states are then used to construct an estimate of the total control input needed to duplicate the response through the inverse plant model. The commanded states are also compared to the measured states to generate feedback error. Together these signals are combined to represent the total control needed to fly the aircraft.

Id. “This overview demonstrates the building blocks or inner loops of MCLAWS on which higher level modes such as TRC, position hold and heading hold are based.” *Id.*

Harding explains that “TRC means the translational ground speed follows the cyclic stick”; in other words, “TRC basically remaps the cyclic control to ground speed relationship.” Ex. 1005, 6. Harding provides the following operational description. “With zero pilot inputs or a centered cyclic stick, TRC commands zero ground speed which is equivalent to position hold (an automatic hover),” “[b]ut a forward push on the stick commands the aircraft to move forward at a ground speed proportional to the stick displacement.” *Id.* A control of this type “is easy to fly because it requires no visual feedback to keep the aircraft upright,” however, “[i]t does

. . . reduce the pilot's perception of control power because the aircraft does not respond aggressively to control inputs.” *Id.* Because this may be objectionable to the pilot, “TRC is implemented as a pilot selectable mode” and “[p]osition hold is implemented as an integral part of TRC.” *Id.* “With the stick centered at the hover trim control position, the commanded ground speed is zero and position hold automatically engages to hold position over the ground”; “[h]eading and altitude hold also come automatically with position hold to provide a three-axis stationary hold in inertial space.” *Id.*

“When the TRC/PH mode is selected, the ground speed feedback loop is closed outside the attitude loop from the ACAH mode.” Ex. 1005, 6. With an equivalent stick command to zero the difference between the commanded and measured ground speed is produced by proportional and integral control, and “[t]he equivalent or pseudo stick command is sent through the ACAH model to produce the appropriate attitude and rate commands to achieve the desired ground speed change.” *Id.* “With this series arrangement, the TRC response is achieved through the ACAH command states.” *Id.* This approach is taken in one step by the position hold mode. *Id.* “When position hold automatically engages, the position feedback loop is closed outside the ground speed feedback loop resulting in the TRC mode being used to hold position.” *Id.* The MCLAWS response type architecture, without the TRC/PH mode selected, provides ACAH below a set ground speed, but with TRC/PH selected, mode blending from ACAH to TRC at a different slower ground speed occurs automatically. *Id.* at 7. And at a different even slower set ground speed, “position hold automatically captures position over the ground.” *Id.* This position is

released and the system reverts to TRC mode when the pilot moves the controls. *Id.*

4. Claim 1

- a. [1pre] – “A method to control hovering flight of a rotary aircraft, the rotary aircraft having a longitudinal controller and a lateral controller, the method comprising”

To the extent the preamble of independent claim 1 is treated as limiting, DJI contends that the preamble is shown by Harding’s description of “an AH-64D Longbow Apache (rotary aircraft) having a ‘cyclic stick.’” Pet. 16 (citing Ex. 1005, 1, 6). DJI contends that the cyclic stick “is a conventional control mechanism used in helicopter cockpits that acts as both a longitudinal controller and a lateral controller.” *Id.* at 16–17 (citing Ex. 1002 ¶ 64). DJI notes, as support, Harding describes “that ‘cyclic control inputs’ maneuver or stabilize the helicopter’s pitch and roll” and that, for the Translational Rate Command (TRC) mode, there is a “stick to ground speed relationship” in which “movement of the longitudinal cyclic affects longitudinal groundspeed and movement of the lateral cyclic affects lateral ground speed.” *Id.* at 17 (citing Ex. 1005, 4, 6–7; Ex. 1002 ¶ 64). DJI additionally notes that, while in TRC mode, Harding describes how “a centered cyclic stick” initiates an automatic hover by TRC commands and, Position Hold (PH) engages when the groundspeed drops below 1 knot. *Id.* (citing Ex. 1005, 6–7). Thus, DJI concludes, Harding describes a system to control hovering flight of a rotary aircraft. *Id.* (citing Ex. 1002 ¶ 64).

Alternatively, to the extent the longitudinal and lateral controller must be separate and distinct structures, DJI contends the difference is merely a “routine and obvious design choice.” Pet. 18 (citing Ex. 1002 ¶ 66). DJI

contends that there are “only a finite number of options exist when designing controllers to control aircraft movement in the longitudinal and lateral directions”—“[c]ontrols for both pitch and roll can be integrated into a single control input, such as a stick, with multiple degrees of freedom (as disclosed in Harding), or implemented into separate control inputs, such as two different sticks, with each controlling either pitch or roll.” *Id.* at 18–19 (citing Ex. 1002 ¶ 66). Because of this limited number of options available, DJI contends that a person of ordinary skill in the art “would have been motivated to try designing a rotary aircraft control system with separate controllers for the longitudinal and lateral directions to suit the different preferences of pilots and would have anticipated success, as a pilot could use one hand to control one stick and the other hand to control the other.” *Id.* at 19 (citing Ex. 1002 ¶ 66).

We have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for limitation [1pre], and we agree with and adopt DJI’s analysis. *See* Pet. 16–19. Accordingly, we find that Harding discloses or teaches limitation [1pre].

b. [1a] – “defining a first flight envelope having a first groundspeed threshold”

DJI contends that limitation [1a] is shown by Harding’s description of a “translational rate command/position hold mode (“TRC/PH”),” which is “a pilot selectable mode” that allows automatic “mode blending from [attitude command attitude hold (‘ACAH’)] to TRC at 12 knots ground speed.” Pet. 19–20 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 67). According to DJI, this is illustrated in Harding’s Figure 7, reproduced below. *Id.*

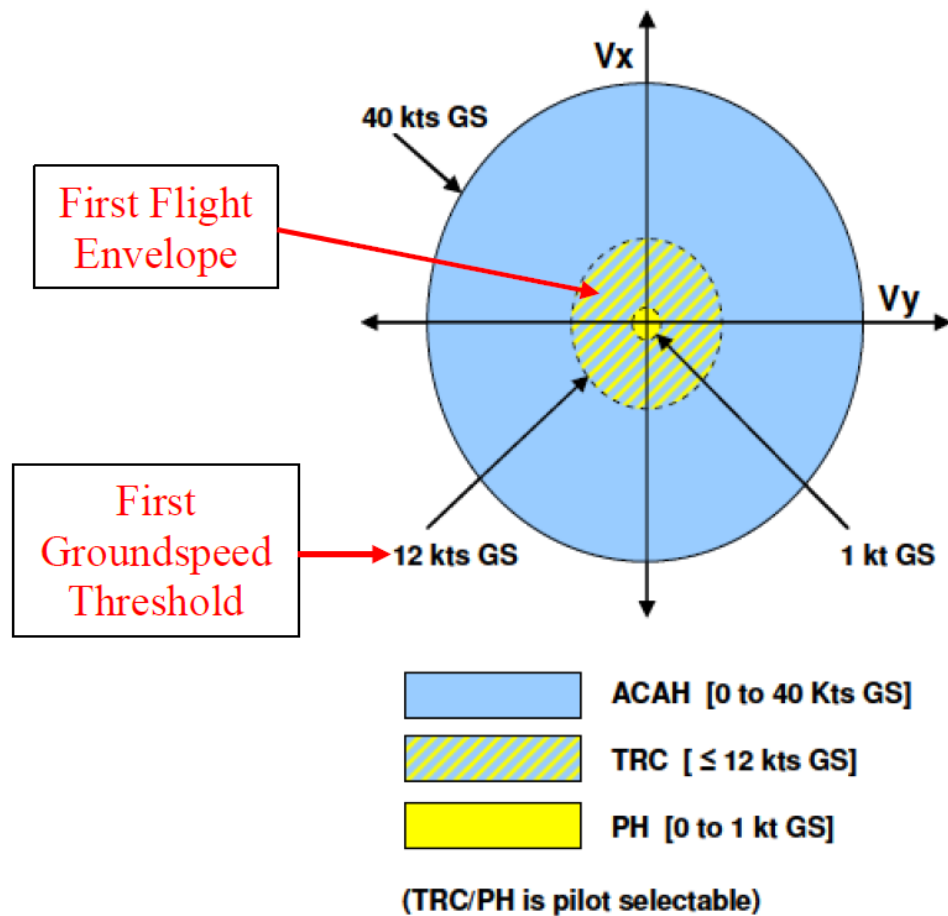


Figure 7. MCLAWS response type architecture

Figure 7 is an annotated illustration (by DJI) showing three concentric circles, with each defined by a groundspeed threshold: (1) the outer circle defined by 40 knots is shaded; (2) the middle circle defined by 12 knots is shaded blue/yellow; and (3) the inner most circle defined by 1 knot is shaded yellow. *Id.* at 20 (Ex. 1005, 7, Fig. 7; Ex. 1002 ¶ 67). DJI contends that the middle blue/yellow shaded area defines “a first flight envelope having a groundspeed threshold of twelve knots.” *Id.* at 19 (citing Ex. 1002 ¶ 67).

We have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for the limitation of [1a], and we

agree with and adopt DJI's analysis. *See* Pet. 19–20. Accordingly, we find that Harding discloses limitation [1a].

c. [1b] – “defining a second flight envelope having a second ground speed threshold, the second flight envelope being defined within the first envelope”

DJI contends Harding discloses limitation [1b] by describing a system where “[b]elow 1 knot, position hold automatically captures position over the ground,” which is also illustrated in Figure 7. Pet. 20–21 (citing Ex. 1005, 7, Fig. 7; Ex. 1002 ¶ 68). DJI provides a differently annotated version of Figure 7, reproduced below.

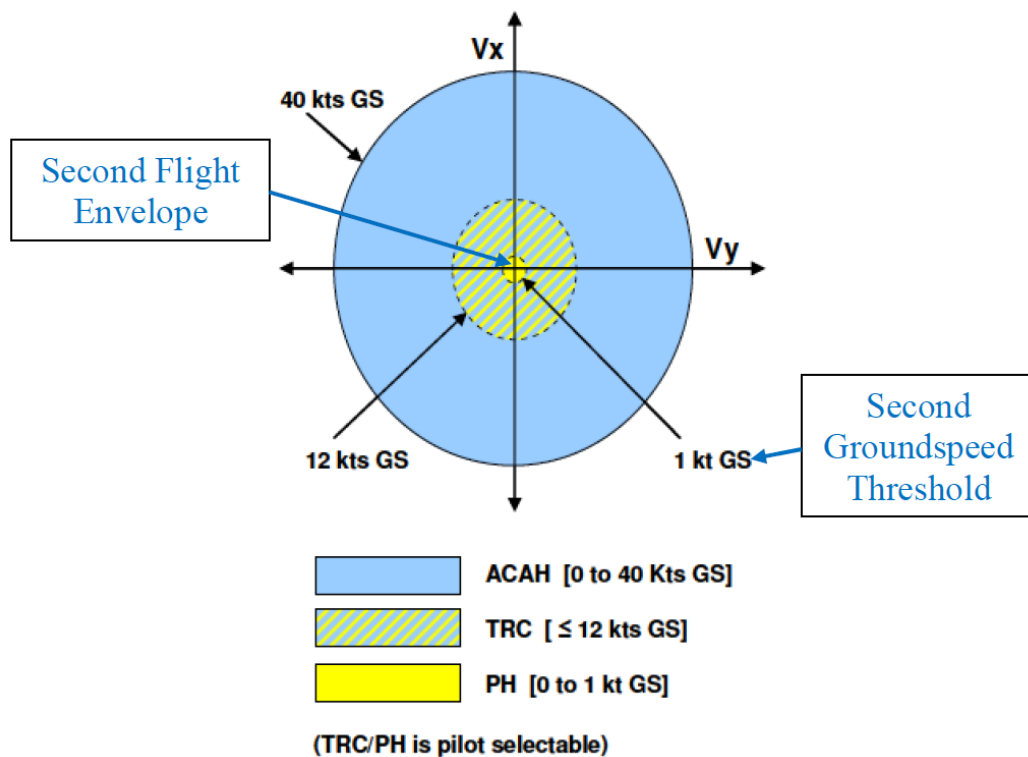


Figure 7. MCLAWS response type architecture

DJI annotates Figure 7 to call out specifically that position hold (PH) is identified by Harding as the yellow shaded inner most circle defined by a second groundspeed of 1 knot, which is within the blue/yellow circle defined

by the first groundspeed of 12 knots. *Id.* at 21. As a result, DJI asserts that Harding discloses defining a second flight envelope having a second groundspeed threshold of 1 knot, the second flight envelope being defined within the first envelope, as recited by limitation [1b]. *Id.* at 21 (Ex. 1005, 7, Fig. 7; Ex. 1002 ¶ 68).

We have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for limitation [1b], and we agree with and adopt DJI’s analysis. *See* Pet. 20–21. Accordingly, we find that Harding discloses limitation [1b].

d. [1c] – “engaging an automatic hover hold with a control law hover hold architecture as the aircraft enters the first flight envelope”

For limitation 1[c], DJI contends Harding describes the recited operation because Harding explains that, “[w]ith TRC/PH selected, mode blending from ACAH to TRC at 12 knots ground speed is automatic” and, “[w]hen in TRC, ‘[w]ith zero pilot inputs or a centered cyclic stick, TRC commands zero ground speed which is equivalent to . . . an automatic hover.’” Pet. 22 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 69). DJI notes that Harding describes using “modern control laws” (“MCLAWS”), “where higher-level modes such as TRC use an ACAH command model for pitch and roll as the inner loops.” *Id.* (citing Ex. 1005, 2–3). DJI contends that Harding explains the following:

For both longitudinal and lateral movement in TRC mode, “the ground speed feedback loop is closed outside the attitude loop from the ACAH mode,” “[p]roportional and integral control produces an equivalent stick command to zero the difference between the commanded and measured ground speed,” and “[t]he equivalent or pseudo stick command is sent through the

ACAH model to produce the appropriate attitude and rate commands to achieve the desired ground speed change.”

Id. at 22–23 (citing Ex. 1005, 6; Ex. 1002 ¶ 70). DJI asserts the loops used for “Longitudinal TRC mode” are depicted in Figure 5 of Harding, reproduced below, to illustrate this functionality. *Id.* 23 (citing Ex. 1005, 6, Fig. 5; Ex. 1002 ¶ 70).

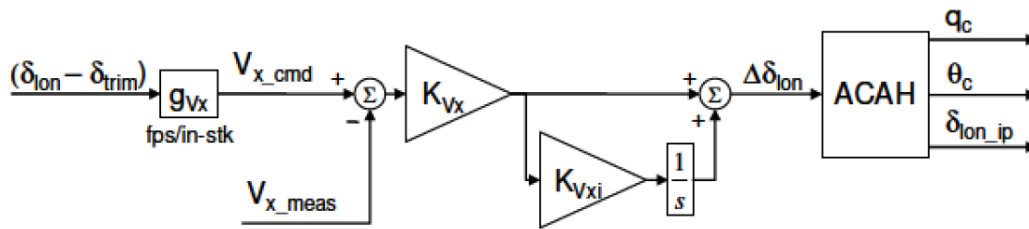


Figure 5. Longitudinal TRC mode

Figure 5 shows a systems-engineering diagram illustrating the operational inputs, outputs, and decisional steps for the Longitudinal TRC mode. *See* Ex. 1005, 6; Ex. 1002 ¶ 70. From these operational details about Harding’s system, DJI contends that “engaging an automatic hover hold with a control law hover hold architecture as the aircraft slows down to 12 knots and enters the first flight envelope with the cyclic stick centered, thereby automatically blending from ACAH to TRC with a commanded ground speed of zero (an automatic hover hold),” would have been a known operation to a person of ordinary skill in the art. Pet. 23 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 71).

We have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for limitation [1c], and we agree with and adopt DJI’s analysis. *See* Pet. 22–23. Accordingly, we find that Harding discloses or teaches limitation 1[c].

- e. [1d] – “engaging an automatic position hold with a control law position hold architecture as the aircraft enters the second flight envelope”*

DJI contends limitation 1[d] is further shown by the operational description in Harding that, “[w]ith the stick centered at the hover trim control position, the commanded ground speed is zero and position hold automatically engages to hold position over the ground,” and “[t]he position hold ‘automatically captures position over the ground’ once the groundspeed drops ‘[b]elow 1 knot.’” Pet. 24 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 72). DJI asserts the following:

[t]he control law architecture for PH mode is similar to the TRC control law architecture discussed above [for limitation [1c]], except with the addition of a position feedback loop: “When position hold automatically engages, the position feedback loop is closed outside the ground speed feedback loop resulting in the TRC mode being used to hold position.”

Id. (citing Ex. 1005, 6; Ex. 1002 ¶ 73). In addition, DJI asserts that the control law architecture in Harding shows “for a heading hold and altitude hold, [they] both automatically engage with position hold ‘to provide a three-axis stationary hold in inertial space’ when PH mode is in effect.” *Id.* (citing Ex. 1005, 6; Ex. 1002 ¶ 73). DJI contends that these operational details demonstrate that Harding “engag[es] an automatic position hold with a control law position hold architecture as the aircraft slows below 1 knot and enters the second flight envelope with the cyclic stick in the detent position, thereby automatically capturing and holding the position over the ground (automatic position hold),” which would have been known operations to a person of ordinary skill. *Id.* (citing Ex. 1005, 6–7; Ex. 1002 ¶ 74).

We have reviewed DJI's arguments and supporting evidence as to how the teachings of Harding account for limitation [1d], and we agree with and adopt DJI's analysis. *See* Pet. 24–25. Accordingly, we find that Harding discloses or teaches limitation 1[d].

f. [1e] – “interchanging the automatic hover hold and the automatic position hold as the rotary aircraft moves between the first flight envelope and the second flight envelope”

DJI contends that limitation [1e] is shown by following operational descriptions from Harding: “[p]osition hold is implemented as an integral part of TRC” and, when in TRC “[w]ith the stick centered at the hover trim control position, the commanded ground speed is zero and position hold automatically engages to hold position over the ground.” Pet. 25 (citing Ex. 1005, 6; Ex. 1002 ¶ 75); *see also* Ex. 1005, 6 (“With zero pilot inputs or a centered cyclic stick, TRC commands zero ground speed which is equivalent to position hold (an automatic hover).”). “Below 1 knot, position hold automatically captures position over the ground” and, “[w]hen position hold automatically engages [below one knot], the position feedback loop is closed outside the ground speed feedback loop resulting in the TRC mode being used to hold position.” *Id.* at 25–26 (citing Ex. 1005, 6–7).

To help visualize this operation, DJI relies on still another annotated version of Figure 7 in Harding, reproduced below.

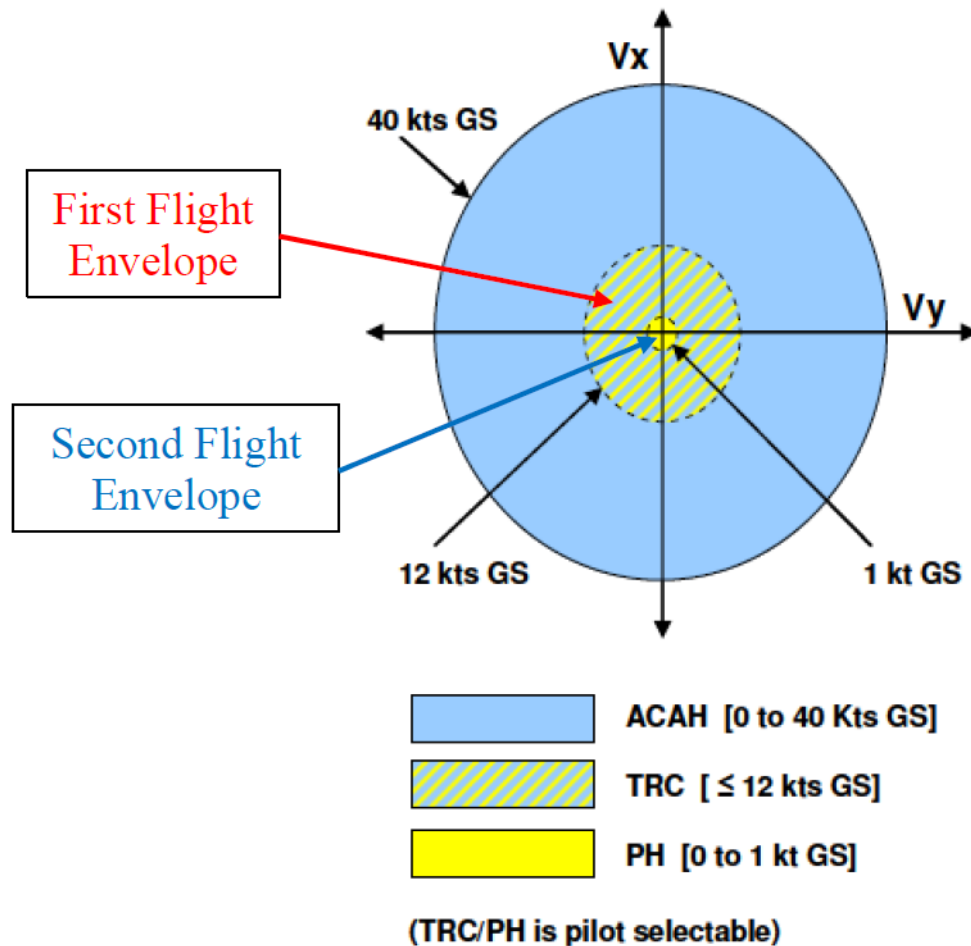


Figure 7. MCLAWS response type architecture

According to DJI, Harding's Figure 7 illustrates position hold is engaged in the second flight envelope represented by the center yellow circle encompassing groundspeeds below 1 knot, which is within the first flight envelope represented by the blue/yellow circle encompassing groundspeeds of less than or equal to twelve knots. Pet. 26 (citing Ex. 1005, Fig. 7; Ex. 1002 ¶ 76). To a person of ordinary skill in the art, DJI asserts, this operational description in Harding shows the following:

that if, for example, the pilot is commanding a groundspeed of five knots in TRC mode and then centers the cyclic stick, the aircraft will enter an automatic hover hold and, when the

groundspeed drops below one knot, will engage the automatic position hold by capturing the position over the ground and holding that position.

Id. at 26–27 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 76). As a result, DJI asserts that “interchanging the automatic hover hold and the automatic position hold as the helicopter decelerates from a groundspeed between 1 and 12 knots (first flight envelope) to a groundspeed below 1 knot (second flight envelope)” would have been a known operation to a person of ordinary skill in the art, as evidenced by Harding. *Id.* at 27 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 77).

We have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for limitation [1e], and we agree with and adopt DJI’s analysis. *See* Pet. 25–27. Accordingly, we find that Harding discloses or teaches limitation [1e].

g. [1f] – “wherein at least one of the engaging the automatic hover hold and the engaging an automatic position hold is performed in response to at least one of the longitudinal controller and the lateral controller being in a detent position”

For limitation [1f], DJI notes that it builds on the automatic hover hold engagement in limitation [1c] and the automatic position hold engagement in limitation [1d] by adding further “that ‘at least one of the longitudinal controller and the lateral controller’ are ‘in a detent position’ when engaging at least one of the automatic hover hold and the automatic position hold.” Pet. 27 (citing Ex. 1001, 8:27–30, 9:6–10, 9:35–61). DJI directs us to the following operational disclosures in Harding: (1) “[w]ith zero pilot inputs or a centered cyclic stick” (i.e., “the stick in the zero-force (detent) position”), “TRC commands zero ground speed which is equivalent

to position hold (an automatic hover),” (2) the “mode blending from ACAH to TRC at 12 knots ground speed is automatic,” and (3) when “[b]elow 1 knot, position hold automatically captures position over the ground.” *Id.* at 27–28 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 78). From these operational characteristics, DJI contends that a person of ordinary skill in the art “would have understood from Harding that the automatic hover hold engages with groundspeed between one and twelve knots and a centered cyclic stick, and the automatic position hold engages with groundspeed below one knot and a centered cyclic stick.” *Id.* at 28 (citing Ex. 1002 ¶ 79). Accordingly, DJI concludes the following:

an automatic hover hold with a control law hover hold architecture is engaged as the helicopter slows down below 12 knots (enters the first flight envelope) and the cyclic stick (longitudinal and lateral controllers) is in the zero-force position, and a position hold with a control law position hold architecture is engaged as the helicopter slows down below 1 knot (enters the second flight envelope) and the cyclic stick (longitudinal and lateral controllers) is in the zero-force position.

Id. at 28 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 79).

We have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for limitation [1e], and we agree with and adopt DJI’s analysis. *See* Pet. 27–28. Accordingly, we find that Harding discloses or teaches limitation [1e].

h. Summary

In summary, we have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for all the limitations of independent claim 1, and we agree with and adopt DJI’s analysis. *See* Pet. 16–28. Accordingly, DJI has demonstrated by a preponderance of the

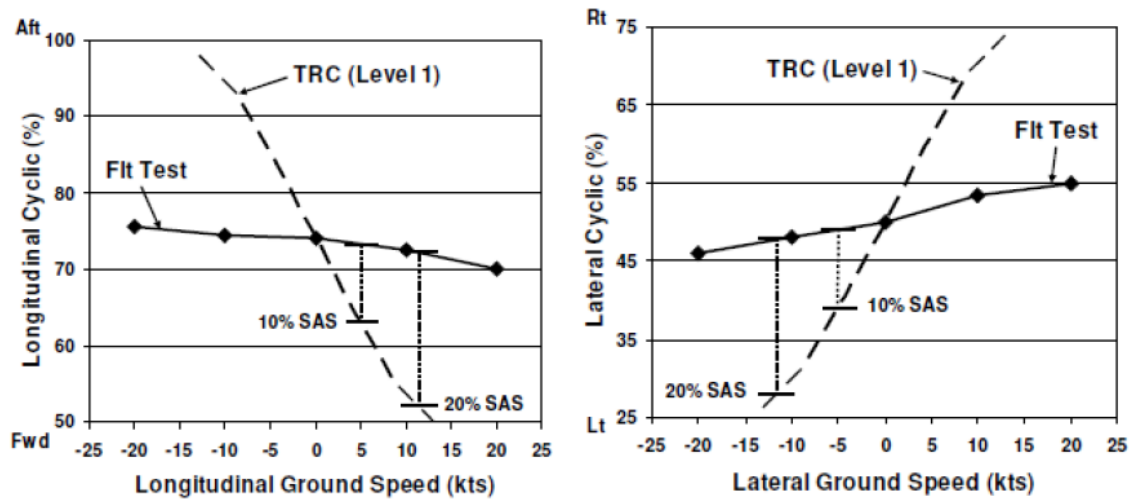
evidence that the subject matter of claim 1 is anticipated by and would have been obvious over the teachings of Harding.

5. Claims 2–5 and 12

DJI also contends that dependent claims 2–5 and 12 of the '752 patent are unpatentable under §§ 102(b) or 103(a) as anticipated by or rendered obvious over the teachings of Harding. Pet. 28–38. DJI explains how the teachings of Harding account for the subject matter of each dependent claim, and provides reasoning as to why a person of ordinary skill in the art would have been prompted to modify the teachings of this reference. *Id.* During trial, Textron does not address separately DJI's arguments and supporting evidence as to how the teachings of Harding account for the additional limitations of dependent claims 2–5 and 12. *See* PO Resp. 10–32.

As one example, claim 2 directly depends from independent claim 1, and further recites “maneuvering the rotary aircraft within the first envelope with a translational rate command, the translational rate command being adapted to control longitudinal flight of the rotary aircraft with movement of the longitudinal controller and lateral flight of the rotary aircraft with movement of the lateral controller.” Ex. 1001, 11:47–53. DJI contends that Harding teaches this limitation because it discloses a translational rate command where ground speed follows the cyclic stick, and that while in TRC, longitudinal movement of the cyclic stick controls longitudinal ground speed and lateral movement of the cyclic stick controls lateral ground speed. Pet. 28–30.

DJI cites Harding's Figure 6, reproduced below.



Ex. 1005, Fig. 6. Figure 6 illustrates the lateral and longitudinal speed of the aircraft as it relates to the displacement percentage of the cyclic stick in the lateral and longitudinal directions. Pet. 29 (citing Ex. 1005, 6; Ex. 1002 ¶ 81). DJI also cites Harding's Figure 7, reproduced below with annotations inserted by DJI.

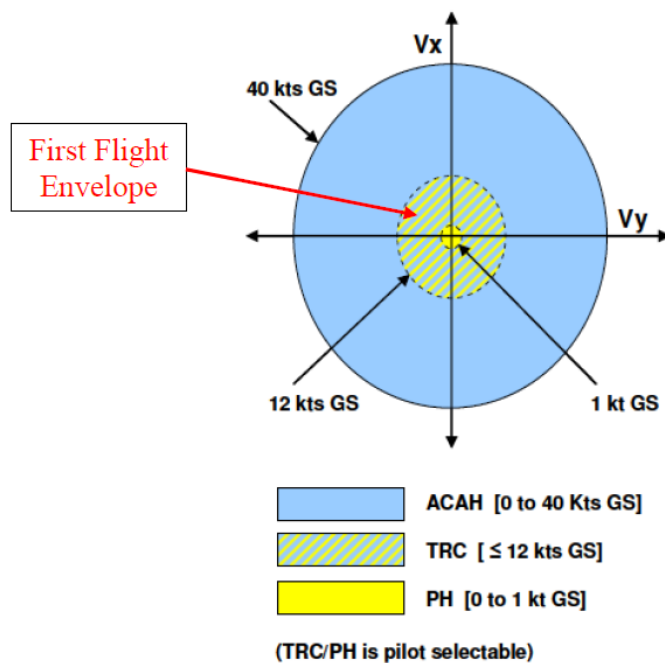


Figure 7. MCLAWS response type architecture

Ex. 1005, Fig. 7. According to DJI, Figure 7 illustrates the aircraft operates in “TRC mode” while in the first envelope, which equates to a groundspeed of less than or equal to 12 knots. Pet. 29–30 (citing Ex. 1005, 7; Ex. 1002, ¶ 81). DJI summarizes that Harding, therefore, discloses maneuvering the aircraft within a first flight envelope where the translational rate command controls the longitudinal and lateral flight of the aircraft via the movement of a cyclic stick. *Id.* at 30–31.

As another example, claim 5 directly depends from independent claim 1, and further recites “wherein the second groundspeed threshold is 1 knot.” Ex. 1001, 11:59–60. DJI contends that Harding teaches this limitation because it discloses that, “[b]elow 1 knot, position hold automatically captures position over the ground.” Pet. 35 (citing Ex. 1005, 35). Relying on the testimony of Dr. Singhose, DJI argues “[a person of ordinary skill in the art] would have understood that this discloses a 1-knot groundspeed threshold for the second groundspeed threshold.” *Id.* (citing Ex. 1002 ¶ 87).

We have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for the additional limitations of these dependent claims, and we agree with and adopt DJI’s analysis. *See* Pet. 28–38. Accordingly, DJI has demonstrated by a preponderance of the evidence that the subject matter of dependent claims 2–5 and 12 are anticipated by and would have been obvious over the teachings of Harding.

6. Claims 6 and 7

Claim 6 directly depends from independent claim 1, and further recites “wherein engaging automatic hover flight within the first envelope is achieved when both the longitudinal controller and the lateral controller are released.” Ex. 1001, 11:61–64. Claim 7 also directly depends from

independent claim 1, and further recites “wherein engaging a position hold flight is achieved when both the longitudinal controller and the lateral controller are released.” *Id.* at 11:66–67.

With respect to dependent claim 6, DJI contends that Harding discloses that while in TRC, “[w]ith zero pilot inputs or a centered cyclic stick, TRC commands zero ground speed which is equivalent to position hold (an automatic hover).” Pet. 35 (citing Ex. 1005, 6). DJI then asserts that “[a person of ordinary skill in the art] would have understood that if the aircraft is flying at a groundspeed within the first flight envelope in TRC mode, releasing the cyclic stick centers the cyclic stick, which commands zero ground speed and thus engages automatic hover flight.” *Id.* (citing Ex. 1002 ¶ 88).

With respect to dependent claim 7, DJI contends that “Harding discloses that the aircraft will capture and hold the position over the ground automatically once the aircraft is below one knot groundspeed and the cyclic stick is in the detent position (both longitudinal and lateral controllers are released).” Pet. 35–36 (citing Ex. 1005, 6–7; Ex. 1002 ¶ 89). DJI argues that Harding discloses “[t]he aircraft will release the position hold and revert back to TRC mode when the cyclic stick is moved out of the detent position,” and that “heading hold and altitude hold ‘also come automatically with position hold to provide a three-axis stationary hold in inertial space.’” *Id.* According to DJI, a person of ordinary skill in the art would have understood that, when the aircraft is “flying below one knot in TRC mode, releasing the cyclic stick (the longitudinal and lateral controllers) centers the cyclic stick, which commands zero ground speed and thus engages position

hold flight by capturing and holding the aircraft's position over the ground.”
Id. (citing Ex. 1005, 6–7; Ex. 1002 ¶ 89).

In its Patent Owner Response, Textron contends that Harding does not teach the limitations of dependent claims 6 and 7 because DJI fails to show that Harding discloses that the longitudinal and lateral controllers are effectively operated using two separate control sticks. PO Resp. 10–20. That is, Textron argues that DJI's arguments fail to show that Harding discloses the limitations of dependent claims 6 and 7 under Textron's proposed construction. *See id.* Instead, Textron contends the disclosures in Harding relied upon by DJI “merely suggest[] commanding position hold when a single cyclic stick is released.” *Id.* at 12.

Turning to obviousness, Textron argues that DJI “fails to identify, let alone explain, why a [person of ordinary skill in the art] would have been motivated to modify *Harding* or that a [person of ordinary skill in the art] could have done so with a reasonable expectation of success.” PO Resp. 15. Textron contends DJI “does not even identify what modification it would propose making to *Harding*” and, therefore, cannot establish a single-reference obviousness ground based on Harding. *Id.* According to Textron, DJI's proposed single-reference obviousness ground based on Harding must show “a skilled artisan would have been motivated to make the proposed modifications and would have had a reasonable expectation of success in doing so.” *Id.* at 14. Textron attempts to preempt DJI's alternate argument that “it would have been obvious to use two physically-separate control sticks instead of a single cyclic stick” by arguing that DJI “provides no reasoning as to why that modification would have been obvious, let alone why a [person of ordinary skill in the art] would have been motivated to

modify *Harding* to include two separate control sticks or that a [person of ordinary skill in the art] could have done so with a reasonable expectation of success.” *Id.* at 16.

In its Reply, DJI contends that, under either of the proposed constructions, *Harding* discloses or teaches the limitations of dependent claims 6 and 7. Pet. Reply 10–14. DJI argues that *Textron*’s only argument “that *Harding* does not disclose the limitations of [dependent] claims 6 and 7 is that *Harding* discloses a ‘cyclic stick’ that is released to perform the claimed ‘engaging,’ rather than ‘separate controllers.’” *Id.* DJI, however, notes that, during Dr. Singhose’s deposition, he testified that “a cyclic controller ‘is basically a joystick’ where the components that detect forward and backward movement of the controller are ‘physically separate from the components that detect the lateral motion.’” *Id.* at 11–12 (citing Ex. 2015, 34:19–35:6). DJI contends Dr. Singhose’s deposition testimony demonstrates how *Harding*’s cyclic stick can embody both longitudinal and lateral controllers. *Id.* at 12.

DJI further argues that, even under *Textron*’s proposed construction, *Harding* renders obvious the limitations of dependent claims 6 and 7. Pet. Reply 12–14. DJI contends that, with respect to dependent claim 6, *Textron* “does not dispute that *Harding* discloses that engaging automatic hover flight within the first envelope is achieved when the cyclic stick is released” or, with respect to dependent claim 7, that “*Harding* discloses that engaging a position hold flight is achieved when the cyclic stick is released.” *Id.* at 12 (citing PO Resp. 21–22; Pet. 47–48). According to DJI, *Textron*’s sole argument is that *Harding* does not disclose or teach two separate control sticks instead of a single control stick. *Id.* DJI argues, however, that the

Petition discussed the possibility of two different control sticks instead of one, noting “the [P]etition stated that ‘[c]ontrols for both pitch and roll can be integrated into a single control input, such as a stick, with multiple degrees of freedom (as disclosed in Harding), or implemented into separate control inputs, such as two different sticks, with each controlling either pitch or roll.’” *Id.* at 13 (quoting Pet. 18–19) (citing Ex. 1002 ¶ 66). DJI further identifies where in the Petition it relies on the supporting testimony of its declarant, Dr. Singhose, to explain “that a [person of ordinary skill in the art] would have been motivated to try this alternative configuration, in view of the finite number of options.” *Id.* (citing Pet. 18; Ex. 1002 ¶ 66). DJI explains that, although these arguments were brought up in the context of independent claim 1, they equally apply to its analysis of dependent claims 6 and 7, noting that “these claims rely on [independent] claim 1’s recitation of ‘the longitudinal controller and the lateral controller’ for antecedent basis” and, therefore, the Petition “demonstrate[s] that Harding [teaches dependent] claims 6 and 7 for the same reasons stated as for [independent] claim 1.” *Id.* at 13–14.

Based on the fully developed trial record, we agree with DJI that Harding teaches “engaging automatic hover flight” (dependent claim 6) and “engaging a position hold” (dependent claim 7) when “both the longitudinal controller and the lateral controller are released.” Ex. 1001, 11:61–67. First, as we discuss previously, we disagree with Textron that these limitations require two separate control sticks for the longitudinal and lateral controllers. *See supra* Section II.A.2 (analyzing the parties’ claim construction positions). Under the proper construction, a single control stick is capable of releasing “both the longitudinal controller and the lateral

controller.” Harding discloses a single cyclic stick that actuates both the longitudinal and lateral controller. As some examples, Harding discloses the following: (1) “the aircraft attitude follows the pilot’s *cyclic stick*,” (2) “TRC means the translational ground speed follows the *cyclic stick*,” and (3) “[w]ith zero pilot inputs or a centered *cyclic stick*.” Ex. 1005, 4, 6 (emphasis added). As DJI explains in its Petition, and Textron does not dispute, Harding’s cyclic stick “is a conventional control mechanism used in helicopter cockpits that acts as both a longitudinal controller and a lateral controller.” Pet. 16–17 (citing Ex. 1005, 1, 6; Ex. 1002 ¶ 64).

Turning first to dependent claim 6, Harding discloses, in relevant part, the following:

TRC means the translational ground speed follows the cyclic stick. A step input to the cyclic stick produces a step response in the aircraft’s translational ground speed. With zero pilot inputs or a centered cyclic stick, TRC commands zero ground speed which is equivalent to position hold (an automatic hover).

Ex. 1005, 6. Based on this cited disclosure, we find that Harding discloses engaging an automatic hover hold when both the longitudinal and lateral controllers are released. More specifically, we find that Harding’s disclosure that “[w]ith zero pilot inputs or a centered cyclic stick, TRC commands zero ground speed which is equivalent to position hold (an automatic hover)” discloses or teaches that releasing a single cyclic stick that acts as both the longitudinal and lateral controllers activates “an automatic hover hold.”

Turning now to dependent claim 7, Harding discloses, in relevant part, the following:

Position hold is implemented as an integral part of TRC. With the stick centered at the hover trim control position, the

commanded ground speed is zero and position hold automatically engages to hold position over the ground . . . The position hold mode takes the same approach one step further. When position hold automatically engages, the position feedback loop is closed outside the ground speed feedback loop resulting in the TRC mode being used to hold position . . . With TRC/PH selected, mode blending from ACAH to TRC at 12 knots ground speed is automatic. Below 1 knot, position hold automatically captures position over the ground. When the controls are moved, position is released and the system reverts back to TRC mode.

Ex. 1005, 6–7. Based on this cited disclosure, we find that Harding discloses or teaches that, when the stick is centered, “position hold automatically engages.” As we discuss above, this means when the single cyclic stick with both the longitudinal and lateral controllers is released, automatic position hold is engaged.

Alternatively, we agree with DJI that, even under Textron’s proposed construction, Harding renders obvious the limitations of dependent claims 6 and 7. We agree with DJI’s argument in the Petition that there are a limited number of possible control inputs, such as using two control sticks instead of using a single control stick. Pet. 16–19 (citing Ex. 1002 ¶ 66). DJI provides un rebutted declarant testimony that explains why a person of ordinary skill in the art, in view of the finite number of options, “would have been motivated to try [a two control stick configuration] ‘to suit the different preferences of pilots and would have anticipated success, as a pilot could use one hand to control one stick and the other hand to control the other.’” Pet. 19 (citing Ex. 1002 ¶ 66). We agree with this supporting testimony because it logically demonstrates that DJI’s proposed modification of using two control sticks instead of a single control stick would have been a routine and obvious design choice, and that a person of ordinary skill in the art would

have had a reasonable expectation of success in doing so. *See Uber Techs., Inc. v. X One, Inc.*, 957 F.3d 1334, 1340 (Fed. Cir. 2020) (holding that, when a person of ordinary skill in the art has two predictable choices for the desired outcome, the decision amounts to a simple design choice and, therefore, § 103(a) bars the patentability of each variation); *see also ACCO Brands Corp. v. Fellowes, Inc.*, 813 F.3d 1361, 1367 (Fed. Cir. 2016) (explaining when an “ordinary [skilled] artisan would . . . be left with two design choices . . . [e]ach of these two design choices is an obvious combination of prior-art elements”); *Slot Speaker Techs., Inc. v. Apple Inc.*, 680 Fed. Appx. 932, 941 (Fed. Cir. 2017) (holding that expert testimony of “a routine design choice” amounts to substantial evidence that supports the Board’s finding underlying its obviousness conclusion).

In summary, we have reviewed DJI’s arguments and supporting evidence as to how the teachings of Harding account for the additional limitations of dependent claims 6 and 7, and we agree with and adopt DJI’s analysis. *See* Pet. 35–36; Pet. Reply 10–14. Accordingly, DJI has demonstrated by a preponderance of the evidence that the subject matter of dependent claims 6 and 7 are anticipated by and would have been obvious over the teachings of Harding.

C. Obviousness Over the Combined Teachings of Harding and Rempfer

DJI also contends that 1–7 and 12 of the ’752 patent are unpatentable under § 103(a) as obvious over the combined teachings of Harding and Rempfer. Pet. 38–49. DJI contends that the teachings of Harding and Rempfer account for the subject matter of each challenged claim, and provides reasoning as to why a person of ordinary skill in the art would have been prompted to combine the teachings of these references. *Id.* Textron

argues that a person of ordinary skill in the art would not have been motivated to combine the teachings of Harding and Rempfer, and presents arguments as to why this proposed combination fails to disclose the limitations of dependent claims 6 and 7. PO Resp. 20–32. Textron does not address separately DJI’s arguments and supporting evidence as to how the combined teachings of Harding and Rempfer account for all the limitations of independent claim 1 and dependent claims 2–5 and 12. *See id.*

Based on the fully developed trial record, we determine that DJI has shown by a preponderance of the evidence that claims 1–7 and 12 of the ’752 patent are unpatentable as obvious over the combined teachings of Harding and Rempfer. We begin our analysis with a brief overview of Rempfer and then we address DJI’s contentions with respect to the challenged claims.

1. Overview of Rempfer

Rempfer generally relates to an aircraft control system in which “longitudinal acceleration and course rate commands are derived from a manual control stick to control translational velocity of the aircraft along a flight path.” Ex. 1006, code (57). Rempfer discloses its “longitudinal channel is an acceleration command channel with velocity holding capability,” and that the controls are “operated by the pilot [using] longitudinal center stick 12.” *Id.* at 2:46–50, Fig. 1. Rempfer also discloses that, when center stick 12 “is displaced from its central detent position, a translational acceleration command with respect to the ground is produced.” *Id.* at 2:50–53. Furthermore, Rempfer discloses that, “[w]hen . . . longitudinal center stick 12 is in its central or detent position corresponding

to zero acceleration command, the helicopter maintains the ground speed [stored].” *Id.* at 3:40–43.

In addition to disclosing the control scheme maintaining a stored ground speed, Rempfer also teaches a lateral control channel with “a course rate command system with a course hold capability. In a manner similar to the longitudinal channel, the pilot commands course rate by displacing his lateral center stick 42 from its central detent position.” Ex. 1006, 3:44–49. Rempfer further discloses, “[w]hen . . . lateral center stick 42 is in its central or detent position corresponding to zero course rate, the helicopter maintains the course indicated at the output of integrator 46.” *Id.* at 4:30–34. Integrator 46 is used to set a course command for the aircraft. *Id.* at 3:57–60.

2. *Rationale to Combine*

DJI contends that a person of ordinary skill in the art would have been motivated to “modify Harding’s cyclic stick in view of Rempfer to use two physically separate control sticks, one for controlling longitudinal movement and one for controlling lateral movement.” Pet. 40–41 (citing Ex. 1002 ¶ 94). According to DJI, “both Harding and Rempfer disclose helicopters having pilot control inputs for longitudinal and lateral motion,” and “a [person of ordinary skill in the art] would have understood that the configuration of control sticks in a helicopter is a matter of pilot preference.” *Id.* at 41–42 (citing Ex. 1002 ¶ 96). DJI contends that, instead of using Harding’s cyclic stick that controls movement along the longitudinal and lateral directions, it “would have been obvious to . . . have one stick for longitudinal control and one stick for lateral control, as taught by Rempfer,” in part because, “having physically separate longitudinal and lateral

controllers . . . would reduce the risk of applying force in an unintended direction while moving a cyclic stick.” *Id.* at 42.

Relying on the testimony of Dr. Singhose, DJI contends that a person of ordinary skill in the art making this proposed modification would have had a reasonable expectation of success “because such configurations were well known prior to the ’752 [patent’s] priority date and Rempfer discloses using such a configuration in a helicopter.” Pet. 42–43 (citing Ex. 1002 ¶ 97). Additionally, DJI contends implementing Harding’s response modes, including automatic hover hold and position hold, would be possible when using Rempfer’s two separate sticks because “Rempfer already discloses that both the longitudinal center stick and the lateral center stick have a ‘detent position’ that causes the helicopter to hold certain behavior.” *Id.* (citing Ex. 1006, 3:40–43, 4:30–33; Ex. 1002 ¶ 97). DJI also argues that Rempfer discloses that “[p]lacing the longitudinal center stick in the detent position maintains the helicopter’s groundspeed,” while “[p]lacing the lateral center stick in the detent position maintains the helicopter’s course.” *Id.* at 43 (quoting Ex. 1006, 3:40–43, 4:30–33). DJI, therefore, concludes that a person of ordinary skill in the art would “have had a reasonable expectation that any of Harding’s response modes predicated on a centered cyclic stick could be implemented when Rempfer’s [two] separate sticks are released to the detent position.” *Id.* (citing Ex. 1002 ¶ 97).

In response, Textron contends that a person of ordinary skill in the art would not have been motivated to combine the teachings of Harding and Rempfer in the manner proposed by DJI because “*Rempfer* does not teach engaging an automatic hover hold when both the longitudinal center stick and the lateral center stick are released to the detent position.” PO Resp. 24.

Textron argues that DJI mischaracterizes the disclosures of Rempfer, which merely discloses “***maintaining*** the current ground speed and current lateral course of the aircraft when each of the longitudinal and lateral center sticks are in detent.” *Id.* Textron argues that, because Rempfer’s disclosure teaches maintaining the current ground speed instead of entering a hover hold as Harding teaches, “a [person of ordinary skill in the art] would not have been motivated to modify *Harding* to include the longitudinal and lateral center sticks (and the respective movement responses) taught in *Rempfer*.” *Id.*

Textron contends that the teachings in Rempfer that teach a different default response when entering detent than the teaching of Harding relied on by DJI effectively equate to Rempfer “teach[ing] away from entering automatic hover hold when both of its longitudinal and lateral control sticks are released to detent.” PO Resp. 24–25. Therefore, according to Textron, “[m]odifying *Harding* to incorporate the separate longitudinal and lateral control sticks (and operation of those control sticks) would render *Harding* inoperable for its intended purpose.” *Id.* at 25.

In its Reply, DJI argues that Rempfer does not teach away from the proposed combination, and that a person of ordinary skill in the art would have been motivated to combine the teachings of Rempfer with those of Harding. Pet. Reply 16–21. DJI contends that teaching away requires a showing that a person of ordinary skill in the art “would be discouraged from following the path set out in the reference,” and that if a reference ““merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into’ the claimed invention, that does not constitute a teaching away.” *Id.* at 17

(quoting *Meiresonne v. Google, Inc.*, 849 F.3d 1379, 1382 (Fed. Cir. 2017)).

DJI argues that the teachings of Rempfer “do not even rise to the level of expressing a general preference for an alternative configuration, let alone a teaching away.” *Id.* at 17–18.

Moreover, DJI contends that Textron’s motivation to combine arguments lack expert testimony, and Textron merely relies on attorney argument for its position why “a [person of ordinary skill in the art] would have been discouraged from using a longitudinal controller and a lateral controller that are physically separate in place of Harding’s cyclic stick or how doing so would make Harding ‘inoperable for its intended purpose.’” Pet. Reply 20 (citing PO Resp. 24–25). DJI contends that Textron provides no evidentiary support for its argument that “modifying Harding to use Rempfer’s ‘separate longitudinal and lateral control sticks (and operation of those control sticks) would render Harding inoperable for its intended purpose (*i.e.*, commanding zero groundspeed to hold the aircraft’s position over the ground when the cyclic stick is released).” *Id.* DJI counters that, under its proposed modification of Harding, “[a]ll that would change is that the pilot would use separate control sticks for longitudinal and lateral movement instead of a single cyclic stick” and, therefore, “Harding would remain operable for all of the same functions as those performed with its cyclic stick.” *Id.* at 20–21.

We have reviewed DJI’s arguments and supporting evidence as to why a person of ordinary skill in the art would have been motivated to combine the dual cyclic sticks of Rempfer with the control scheme of Harding, and we agree with and adopt DJI’s analysis. *See* Pet. 40–43; Pet. Reply, 16–21. In the Petition, DJI explained in detail, with supporting

testimony from its declarant, why a person of ordinary skill in the art would have been motivated to make the proposed combination. For example, according to DJI, a person of ordinary skill in the art would have understood that using “physically separate longitudinal and lateral controllers, as taught by Rempfer, would reduce the risk of applying force in an unintended direction while moving a cyclic stick.” Pet. 42 (citing Ex. 1002 ¶ 96). In his declaration, Dr. Singhose testifies that other prior art at the time of the invention of the ’752 patent identified that using a single control stick had a “tendency to ‘drift aft’ during a sidestep task,” and that this tendency could be mitigated by physically separating the longitudinal and lateral controllers. Ex. 1002 ¶ 96 (citing Ex. 1008, 12). Based on the unrebutted testimony from Dr. Singhose, we agree with DJI that “only a finite number of options exist when designing controllers to control aircraft movement in the longitudinal and lateral directions” and that a “[person of ordinary skill in the art] would have been motivated to try designing a rotary aircraft control system with separate controllers for the longitudinal and lateral directions to suit the different preferences of pilots.” Pet. 18–19 (citing Ex. 1002 ¶ 66).

For the aforementioned reasons, we find that DJI and its declarant persuasively show that Harding’s aircraft control system would function as intended, regardless of whether it uses a single control stick or two control sticks, and that a person of ordinary skill in the art would have been motivated to make this change. Furthermore, we note that, although DJI has identified sufficient reasons why a dual control stick configuration may be superior in certain situations to a single control stick, this does not undermine our analysis as to the single-reference obviousness ground based on Harding. This is because it is well-settled that a preferred combination or

device is not required to provide a motivation for the current invention. *See, e.g., Novartis Pharm. Corp. v. West-Ward Pharm. Int’l Ltd.*, 923 F.3d 1051, 1059 (Fed. Cir. 2019) (“[O]ur case law does not require that a particular combination must be the preferred, or the most desirable, combination described in the prior art in order to provide motivation for the current invention.”); *PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1197–98 (Fed. Cir. 2014) (holding that it is not necessary to show that a combination is “the *best* option, only that it be a *suitable* option”).

Textron’s primary argument against DJI’s proposed combination of Harding and Rempfer is that Rempfer teaches away from Harding because the default behaviors of these two aircraft control systems vary. PO Resp. 23–26. We disagree with Textron for two reasons. First, we find that Rempfer does not teach away from Harding. The relevant standard for teaching away is that “[a] reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994). We will not, however, “read into a reference a teaching away from a process where no such language exists.” *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1364 (Fed. Cir. 2006). Here, Textron argues that, because Rempfer teaches maintaining a stored speed while in detent instead of entering a hover hold, Rempfer actually teaches away from “entering automatic hover hold.” PO Resp. 24–25. In our view, these teachings in Rempfer do not rise to the level of a teaching away because no such language exists. Indeed, Textron does not direct us to, nor can we find, a

disclosure in Rempfer that indicates the dual control stick configuration could not be used with a different control scheme, such as one that enters automatic hover hold, nor does Rempfer teach that the dual control stick configuration could not be implemented using other aircraft control systems.

Second, we disagree with Textron's framing of the modification DJI proposes. Textron appears to argue that DJI proposes keeping Rempfer's control scheme, in which the two control sticks of Rempfer do not enter an automatic hover or position hold. *See* PO Resp. 22–31. Contrary to Textron's arguments, the record shows that, under DJI's proposed modification, a person of ordinary skill in the art would have used Rempfer's dual stick control stick configuration to implement Harding's automatic hover or position hold control scheme. Pet. 42–43; Pet. Reply 18–20. More specifically, DJI asserts the following:

[A person of ordinary skill in the art] would have had a reasonable expectation that Harding's response modes, including automatic hover hold and position hold, could be implemented using Rempfer's separate longitudinal and lateral sticks because Rempfer already discloses that both the longitudinal center stick and the lateral center stick have a "detent position" that causes the helicopter to hold certain behavior.

Pet. 42–43 (citing Ex. 1006, 3:40–43, 4:30–33; Ex. 1002 ¶ 97). As DJI explains, and we agree, a person of ordinary skill in the art would have been motivated to implement Harding's control scheme, including automatic hover hold and position hold, using Rempfer's physically separate longitudinal and lateral control sticks, because Rempfer teaches two control sticks that are capable of holding certain behavior while in a "detent position."

In summary, DJI has demonstrated by a preponderance of the evidence that a person of ordinary skill in the art would have been motivated to combine the teachings of Harding and Rempfer with a reasonable expectation of success.

3. Claims 1–5 and 12

DJI contends that independent claim 1, and dependent claims 2–5 and 12, of the '752 patent are unpatentable under § 103(a) as rendered obvious over the combined teachings of Harding and Rempfer. Pet. 37–49. Outside of its contention that a person of ordinary skill in the art would not have been motivated to combine the teachings of Harding and Rempfer discussed above, Textron does not address separately DJI's arguments and supporting evidence as to how the combined teachings of Harding and Rempfer account for the limitations of independent claim 1 or dependent claims 2–5 and 12. *See* PO Resp. 10–32.

With respect to independent claim 1, DJI relies upon the same teaching identified in its anticipation/obviousness grounds based on Harding discussed above, and supplements several limitations with additional teachings from Rempfer. *See supra* Section II.B.4. We address the limitations where DJI relies on additional teachings from Rempfer in turn.

For limitation [1pre], DJI contends Rempfer “teaches a helicopter having both a ‘longitudinal center stick 12’ for controlling movement in the longitudinal direction and a ‘lateral center stick 42’ for controlling movement in the lateral direction.” Pet. 43–44 (citing Ex. 1006, 2:45–53, 3:44–49). DJI argues that, to the extent independent claim 1 “requires the longitudinal controller to be physically separate from the lateral controller, it would have been obvious to modify Harding to use Rempfer's longitudinal

center stick for movement in the longitudinal direction and [Rempfer's] lateral center stick for movement in the lateral direction.” *Id.* (citing Ex. 1002 ¶ 98). For limitation [1f], DJI contends that Rempfer discloses “that certain behavior is predicated on each of the longitudinal center stick and the lateral center stick being in the ‘detent position.’” *Id.* at 44–45 (citing Ex. 1006, 3:40–43, 4:30–33). DJI further argues that, to the extent independent claim 1 “requires the longitudinal controller to be physically separate from the lateral controller,” Harding’s disclosure of engaging the automatic hover hold and engaging the automatic position hold would effectively operate in the same way, except these functions “would be performed in response to both the longitudinal center stick and lateral center stick being in a detent position.” *Id.* at 45 (citing Ex. 1002 ¶ 101). With respect to dependent claims 2–5 and 12, DJI primarily relies upon the same teaching identified in its anticipation/obviousness grounds based on Harding discussed above. *See* Pet. 16–49.

We have reviewed DJI’s arguments and supporting evidence as to how the combined teachings of Harding and Rempfer account for the additional limitations of these claims, and we agree with and adopt DJI’s analysis. *See* Pet. 38–49. Accordingly, DJI has demonstrated by a preponderance of the evidence that the subject matter of independent claim 1 and dependent claims 2–5 and 12 would have been obvious over the combined teachings of Harding and Rempfer.

4. Claims 6 and 7

In addition to the reasons discussed previously with regards to the anticipation/obviousness grounds based on Harding alone, *see supra* Section II.B.5, DJI contends that the combined teachings of Harding and Rempfer

teach the additional limitations of claims 6 and 7. *See* Pet. 47–49. DJI argues that Rempfer teaches an aircraft with both “a ‘longitudinal center stick 12’ and a ‘lateral center stick 42,’” and that Rempfer discloses that “certain behavior is predicated on each of the longitudinal center stick and the lateral center stick being in the ‘detent position.’” *Id.* (citing Ex. 1006, 2:45–53, 3:44–49, 4:30–33). DJI further argues that, to the extent dependent claim 6 requires “the longitudinal controller to be physically separate from the lateral controller, [this limitation] it would have been obvious over Harding in view of Rempfer,” primarily because Rempfer discloses two physically separate control sticks (i.e., longitudinal center stick 12 and lateral center stick 42) that are capable of being modified to run Harding’s aircraft control system. *Id.* at 47–48 (citing Ex. 1002 ¶ 108).

In its Patent Owner Response, Textron argues that neither Harding nor Rempfer alone teach the limitations of dependent claims 6 and 7 “when both the longitudinal controller and the lateral controller are released.”

PO Resp. 22. Textron argues that Rempfer “teaches that ‘the helicopter maintains the ground speed at the output of integrator’ when ‘the longitudinal center stick [] is in its central or detent position.’” *Id.* (citing Ex. 1006, 3:40–43). Textron argues this means “because the current ground speed of the helicopter is maintained (*e.g.*, kept constant), the aircraft will not enter into a hover hold.” *Id.* (citing Ex. 2015, 70:12–21 (Dr. Singhose agreeing that Rempfer maintains the current speed instead of entering into hover hold)). Textron contends that because, in its view, neither Harding nor Rempfer individually disclose the limitations of dependent claims 6 and 7, DJI’s proposed combination of Harding and Rempfer cannot account for these limitations. *Id.* at 23.

In its Reply, DJI argues that it did not rely on the teachings of Harding or Rempfer individually to disclose the limitations of dependent claims 6 and 7, but rather relied on the combination of Harding and Rempfer to account for these limitations. Pet. Reply 15. DJI explains that, with respect to dependent claim 6, “engaging automatic hover flight within the first envelope, as disclosed in Harding, would be achieved when both the longitudinal center stick and lateral center stick are released such that they return to their detent positions, which Harding’s control laws would interpret as equivalent to Harding’s centered cyclic stick.” *Id.* at 15 (citing Pet. 48). Similarly, DJI explains that, with respect to dependent claim 7, “engaging a position hold flight, as disclosed in Harding, would be achieved when both the longitudinal center stick and the lateral center stick are released such that they return to their detent positions, which Harding’s control laws would interpret as equivalent to Harding’s centered cyclic stick.” *Id.* at 16 (citing Pet. 49).

Based on the fully developed trial record, we agree with DJI that the combined teachings of Harding and Rempfer account for “engaging automatic hover flight” (dependent claim 6) and “engaging a position hold” (dependent claim 7) when “both the longitudinal controller and the lateral controller are released.” Ex. 1001, 11:61–67. First, as we discuss previously, our construction of dependent claims 6 and 7 does not require a specific number of sticks to actuate the longitudinal and lateral controllers, and is equally applicable to single or multi-stick control schemes. *See supra* Section II.A.2 (discussing claim construction positions). Applying this construction, we find that Harding discloses the additional limitations of dependent claims 6 and 7. *See supra* Section II.B.5. Additionally, in our

analysis above, we find that DJI has shown that a person of ordinary skill in the art would have been motivated to combine the teachings of Harding and Rempfer. *See supra* Section II.C.2. As DJI explains, the primary difference between the ground based on the combination of Harding and Rempfer and the grounds based on Harding alone, is that the combination would use two separate cyclic sticks to actuate the longitudinal and lateral controllers. This difference does not alter our analysis for these dependent claims. We find that DJI has shown that Harding's aircraft control system would still function as intended, even if modified to include Rempfer's longitudinal center stick 12 and lateral center stick 42 and, therefore, would still satisfy the limitations of dependent claims 6 and 7.

Additionally, we agree with DJI that, even under Textron's proposed construction, the combined teachings of Harding and Rempfer still account for the limitations of dependent claims 6 and 7. Textron does not dispute, and we agree, that Rempfer teaches a helicopter having both a "longitudinal center stick 12" and a "lateral center stick 42." *See* PO Resp. 21. Indeed, Rempfer discloses a "longitudinal center stick 12 [with a] central or detent position corresponding to zero acceleration command," and a "lateral center stick 42 [with a] central or detent position corresponding to zero course rate." Ex. 1006, 3:40–42, 4:30–31. Accordingly, as DJI explains, the combination of Harding and Rempfer would have separate longitudinal and lateral control sticks as required by Textron's construction. *See* Pet. 41–42. Textron's only remaining argument is that a person of ordinary skill in the art would not have been motivated to make this combination. As we discuss above, we find that DJI has shown that a person of ordinary skill in the art would have been motivated to modify the teachings of Harding with those of

Rempfer in the manner proposed in the Petition with a reasonable expectation of success. *See supra* Section II.C.2.

We have reviewed DJI's arguments and supporting evidence as to how the combined teachings of Harding and Rempfer account for the additional limitations of dependent claims 6 and 7, and we agree with and adopt DJI's analysis. *See* Pet. 47–49; Pet. Reply 10–21. Accordingly, DJI has demonstrated by a preponderance of the evidence that the subject matter of dependent claims 6 and 7 would have been obvious over the combined teachings of Harding and Rempfer.

D. Obviousness Over the Combined Teachings of Harding and Gold, and the Combined Teachings of Harding, Rempfer, and Gold

DJI also contends that dependent claims 3, 10, and 12 of the '752 patent are unpatentable under § 103(a) as obvious over the combined teachings of Harding and Gold, and the combined teachings of Harding, Rempfer, and Gold. Pet. 49–62. DJI contends that the teachings of Harding, Rempfer, and Gold account for the subject matter of each challenged claim, and provides reasoning as to why a person of ordinary skill in the art would have been prompted to combine the teachings of these references. *Id.* Apart from its contention that a person of ordinary skill in the art would not have been motivated to combine the teachings of Harding and Rempfer discussed above, *see supra* Section II.C.2, Textron does not address separately DJI's arguments and supporting evidence as to how the combined teachings of Harding, Rempfer and Gold account for all the limitations of dependent claims 8–10. *See* PO Resp. 10–32.

Based on the fully developed trial record, we determine that DJI has shown by a preponderance of the evidence that dependent claims 3, 10, and

12 of the '752 patent are unpatentable as obvious over the combined teachings of Harding and Gold, as well as over the combined teachings of Harding, Rempfer, and Gold. We begin our analysis with a brief overview of Gold and then we address DJI's contentions with respect to the challenged claims.

1. Overview of Gold

Gold generally relates to the control laws for a Comanche helicopter, where the control laws "(Velocity Stabilization / Hover Hold and Altitude Hold) . . . provide the additional stabilization and control augmentation needed when flying in a Degraded Visual Environment (DVE)." Ex. 1007, 419. Gold discloses the control laws include "Selectable Modes design," which includes "Velocity Stabilization (VELSTAB) and Altitude Hold (ALTHLD)" that "can be engaged anywhere in the flight envelope in order to respond to changing flight/visual conditions or when reduced pilot workload is desired." *Id.* The first selectable control mode "VELSTAB provides air and ground referenced Velocity Hold, Hover Hold with linear Velocity Command, and ground referenced Low Speed Turn Coordination." *Id.* The second selectable control mode "ALTHLD provides either radar or barometric referenced Altitude Hold with automatic reference switching and Rate of Climb Command." *Id.*

Gold's Figure 1 is reproduced below.

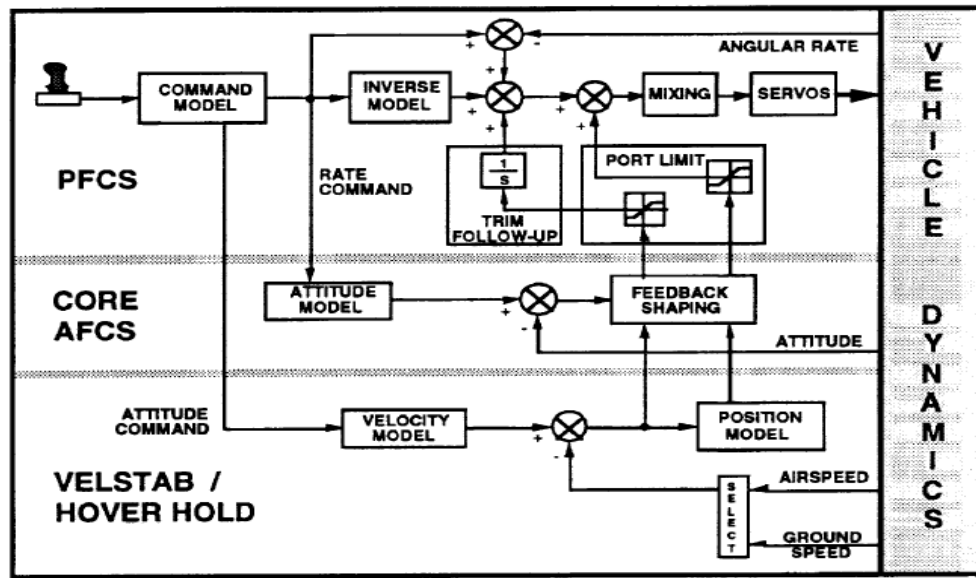


FIGURE 1. COMANCHE LONGITUDINAL CONTROL LAWS

Ex. 1007, Fig. 1. Figure 1 provides a block diagram of the VELSTAB control scheme, which demonstrates that “pilot inputs are passed through appropriate command shaping” to generate a “command vector [that] is mapped into actuator position commands through mixing to drive the control surfaces.” *Id.* at 419–420. Gold further discloses the pilot engages VELSTAB mode “manually by pressing the VEL/HVR HOLD switch on the [Automatic Flight Control System] control panel.” *Id.* at 421.

With respect to Hover Hold mode, Gold discloses “Hover Hold is enabled whenever the VELSTAB mode is engaged and Hover Hold engages when groundspeed, pitch and roll rates, longitudinal and lateral linear accelerations, and pitch and roll stick commands are all small.” Ex. 1007, 421. Gold describes the velocity command response is activated at “groundspeeds of less than ± 5 kts making it easier for the pilot to precisely position the aircraft in DVE conditions.” *Id.* Furthermore, Gold describes that the command scheme will change from “velocity command to attitude

command occurs when the pilot commands a velocity that exceeds the 5 kt threshold or when the pilot applies a large cyclic input.” *Id.*

2. *Claims 3, 10, and 12*

As one example, claim 3 directly depends from independent claim 1, and further recites “disengaging the translational rate command as the aircraft groundspeed exceeds the first groundspeed threshold.” Ex. 1001, 11:55–56. DJI contends that, to the extent that “Harding does not expressly disclose or render obvious a way to disengage the translational rate command to reenter ACAH [attitude command attitude hold] mode, a [person of ordinary skill in the art] would have looked to Gold for guidance.” Pet. 56 (citing Ex. 1002 ¶ 118). DJI further contends that Gold discloses “automatically transitioning from velocity command (TRC) to attitude command ‘when the pilot commands a velocity that exceeds the 5 kt threshold or when the pilot applies a large cyclic input.’” *Id.* (citing Ex. 1007, 421). Relying on the testimony of Dr. Singhose, DJI argues “it would have been obvious to disengage TRC and engage ACAH when the helicopter’s groundspeed exceeds the first groundspeed threshold.” *Id.* (citing Ex. 1002 ¶ 118).

In another example, claim 10 directly depends from independent claim 1, and further recites “wherein the translational rate command mode engages if the movement of the lateral controller is less than a predetermined displacement value; and wherein the an attitude command mode engages if the movement of the lateral controller is greater than a predetermined displacement value.” Ex. 1001, 12:15–20. DJI contends that, to the extent that “Harding does not disclose a way to engage TRC when the stick displacement is less than a predetermined displacement value and to engage

ACAH when the stick displacement is greater than a predetermined displacement value, a [person of ordinary skill in the art] would have looked to Gold for guidance.” Pet. 57–58 (citing Ex. 1002 ¶ 120). DJI argues Gold discloses these features. *Id.* at 58. More specifically, DJI contends “Gold discloses a velocity command/position hold response when in Hover Hold,” and that Gold discloses “automatically switching from this response mode to an attitude command response mode ‘when the pilot commands a velocity that exceeds [a groundspeed] threshold or when the pilot applies a large cyclic input.’” *Id.* (citing Ex. 1007, 421). According to DJI, “[a person of ordinary skill in the art] would have understood Gold discloses this transition from velocity command to attitude command depending on the displacement of the cyclic stick.” *Id.* (citing Ex. 1002 ¶ 120). DJI contends this means, when “the pilot applies a small cyclic input, the helicopter remains in velocity command (TRC),” and when the “pilot applies ‘a large cyclic input,’ it quickly breaks out of Hover Hold and engages attitude command.” *Id.* (citing Ex. 1007, 421; Ex. 1002 ¶ 120).

Turning to rationale to combine, DJI contends that, when considering the teachings of Gold it identifies above, a person of ordinary skill in the art would have been motivated “to combine Harding (or Harding as modified by Rempfer) and Gold to provide ways for disengaging TRC mode, including by commanding a velocity that exceeds the first groundspeed threshold or by applying a large enough displacement of the longitudinal or lateral controller to switch to an attitude command mode, as taught by Gold.” Pet. 53–55 (citing Ex. 1002 ¶¶ 112–116; Ex. 1007, 421). According to DJI, “[a person of ordinary skill in the art] would have understood that Gold’s VC/PH mode is similar to Harding’s TRC because VC/PH commands a velocity response

in the longitudinal or lateral direction (translational rate) upon movement of the cyclic stick, just like Harding's TRC." *Id.* at 53 (citing Ex. 1002 ¶ 113; Ex. 1007, 421–422).

DJI further contends that "Gold discloses details about how to transition from a velocity command response (TRC) to an attitude command response," and "[a person of ordinary skill in the art] would have understood that Gold provides conventional and beneficial ways to disengage its velocity command mode, as it is linked to the amount of displacement of the pilot's controls." Pet. 53–54 (citing 1002 ¶¶ 113–114). DJI argues "it would have been obvious in view of Gold to allow a large pilot input to the longitudinal and/or lateral controllers to disengage TRC mode and enter ACAH to 'allow[] the pilot to break out of Hover Hold quickly.'" *Id.* (quoting Ex. 1007, 421). Relying on the testimony of Dr. Singhose, DJI then argues "[a person of ordinary skill in the art] would have been motivated to include both ways of disengaging TRC to either smoothly enter attitude command in the first scenario or to more aggressively move the helicopter away from its current position." *Id.* (citing Ex. 1002 ¶ 115).

DJI also contends there would have been a reasonable expectation of success in "using [Gold's] techniques to switch between modes" in Harding's aircraft control system. Pet. 55 (citing Ex. 1002 ¶ 116). According to DJI, different "ways of disengaging TRC were well known before the '752 [patent's] priority date, as demonstrated by other prior art references disclosing similar ways to disengage TRC," and that implementing "Harding's control laws would similarly be able to switch between modes based on movement/displacement of the longitudinal and

lateral controller, as it already does so between PH and TRC.” *Id.* (citing Ex. 1002 ¶¶ 115, 116).

During trial, Textron does not address separately DJI’s arguments and supporting evidence as to how the combined teachings of Harding and Gold, or the combined teachings of Harding, Gold, and Rempfer, account for the additional limitations of dependent claims 3, 10, and 12. *See* PO Resp. 10–32. We have reviewed DJI’s arguments and supporting evidence as to how the combined teachings of Harding and Gold, and the combined teachings of Harding, Gold, and Rempfer, account for the additional limitations of these dependent claims, and we agree with and adopt DJI’s analysis. *See* Pet. 49–62. Accordingly, DJI has demonstrated by a preponderance of the evidence that the subject matter of dependent claims 3, 10, and 12 would have been obvious over the combined teachings of Harding and Gold, and the combined teachings of Harding, Gold, and Rempfer.

E. Obviousness Over the Combined Teachings of Harding and Mansur, and the Combined Teachings of Harding, Rempfer and Mansur

DJI also contends that dependent claim 4 of the ’752 patent is unpatentable under § 103(a) as obvious over the combined teachings of Harding and Mansur, and the combined teachings of Harding, Mansur, and Rempfer. Pet. 62–65. DJI contends that the teachings of Harding, Mansur, and Rempfer account for the subject matter of claim 4, and provides reasoning as to why a person of ordinary skill in the art would have been prompted to combine the teachings of these references. *Id.* Apart from its contention that a person of ordinary skill in the art would not have been motivated to combine the teachings of Harding and Rempfer discussed above, *see supra* Section II.C.2, Textron does not address separately DJI’s

arguments and supporting evidence as to how the combined teachings of Harding, Mansur, and Rempfer account for all the limitations of dependent claim 4. *See* PO Resp. 10–32.

Based on the fully developed trial record, we determine that DJI has shown by a preponderance of the evidence that dependent claim 4 of the ’752 patent is unpatentable as obvious over the combined teachings of Harding and Mansur, as well as over the combined teachings of Harding, Mansur, and Rempfer. We begin our analysis with a brief overview of Mansur and then we address DJI’s contentions with respect to the challenged claims.

1. Overview of Mansur

Mansur generally relates to the “modern control laws (MCLAWS) for the [helicopter] to provide improved handling qualities for hover/low speed flight in a degraded visual environment.” Ex. 1008, 1. Mansur discloses its “control laws are aimed at providing both attitude command attitude hold (ACAH) and translational rate command (TRC) response types using the existing partial authority stability augmentation system (SAS).” *Id.* Mansur further discloses that, when “TRC/PH [is] selected, the system automatically transitions from ACAH to TRC as the aircraft’s total ground speed goes below 10 knots.” *Id.* at 2.

2. *Claim 4*

Claim 4 directly depends from independent claim 1, and further recites “wherein the first groundspeed threshold is 10 knots.” Ex. 1001, 11:57–58. DJI contends that Harding itself discloses “a first groundspeed threshold of 12 knots in one embodiment and 5 knots in another.” Pet. 63–64 (citing Ex. 1005, 6–7). DJI further contends that, to the extent Harding’s disclosures are not sufficient, Mansur discloses “a first groundspeed threshold of 10 knots.” *Id.* (citing Ex. 1002 ¶ 126; Ex. 1008, 2). DJI argues Mansur discloses that, when “TRC/PH [is] selected, the system automatically transitions from ACAH to TRC as the aircraft’s total ground speed goes below 10 knots.” *Id.* (citing Ex. 1008, 2).

Turning to rationale to combine, DJI contends that, when considering the teachings of Mansur it identifies above, a person of ordinary skill in the art “would have been motivated to use routine optimization or design variation based on pilot preference to arrive at a first groundspeed threshold of 10 knots.” Pet. 64 (citing Ex. 1002 ¶ 128). DJI contends that “Harding discloses that both five and twelve knots are suitable first groundspeed thresholds based on the amount of authority SAS,” and “Mansur, which discloses a control law architecture with both TRC and ACAH response modes for the same helicopter as Harding, expressly discloses a first groundspeed threshold of 10 knots.” *Id.* at 64–65. DJI also argues that there would have been a reasonable expectation of success “that 10 knots would be a suitable and effective first groundspeed threshold both because Mansur discloses a 10-knot threshold and because it falls in between the two feasible first groundspeed thresholds disclosed in Harding.” *Id.* at 64–65 (citing Ex. 1002 ¶ 128).

During trial, Textron does not address separately DJI's arguments and supporting evidence as to how the combined teachings of Harding and Mansur, or the combined teachings of Harding, Mansur, and Rempfer, account for the additional limitation of dependent claim 4. *See* PO Resp. 10–32. We have reviewed DJI's arguments and supporting evidence as to how the combined teachings of Harding and Mansur, and the combined teachings of Harding, Mansur, and Rempfer, account for the additional limitation of this dependent claim, and we agree with and adopt DJI's analysis. *See* Pet. 62–65. Accordingly, DJI has demonstrated by a preponderance of the evidence that the subject matter of dependent claim 4 would have been obvious over the combined teachings of Harding and Mansur, and the combined teachings of Harding, Mansur, and Rempfer.

III. CONCLUSIONS⁴

Based on the fully developed record, DJI has demonstrated by a preponderance of the evidence that claims 1–7, 10, and 12 of the '752 patent are unpatentable. A summary of our conclusions is set forth in the table below.

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–7, 12	102(b)	Harding	1–7, 12	
1–7, 12	103(a)	Harding	1–7, 12	
1–7, 12	103(a)	Harding, Rempfer	1–7, 12	
3, 10, 12	103(a)	Harding, Gold	3, 10, 12	
3, 10, 12	103(a)	Harding, Rempfer, Gold	3, 10, 12	
4	103(a)	Harding, Mansur	4	
4	103(a)	Harding, Rempfer, Mansur	4	
Overall Outcome			1–7, 10, 12	

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

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claims 1–7, 10, and 12 of the '752 patent are held to be unpatentable; and

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

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