UNITED STATES PATENT AND TRADEMARK OFFICE

BMW OF NORTH AMERICA, LLC, and FORD MOTOR COMPANY,
Petitioners,

v.

CARRUM TECHNOLOGIES, LLC
Patent Owner.

IPR2019-00903
Patent 7,512,475 B2

Before LYNNE H. BROWNE, PATRICK R. SCANLON, and
JON B. TORNQUIST, *Administrative Patent Judges*.

TORNQUIST, *Administrative Patent Judge*.

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

I. INTRODUCTION

A. Background and Summary

BMW of North America, LLC ("Petitioner") filed a Petition (Paper 1, "Pet.") requesting an *inter partes* review of claims 1–12 of U.S. Patent No. 7,512,475 B2 (Ex. 1001, "the '475 patent"). Carrum Technologies, LLC ("Patent Owner") filed a Preliminary Response to the Petition (Paper 6). Upon review of the parties' arguments and supporting evidence, we instituted an *inter partes* review of all claims and grounds asserted in the Petition (Paper 9, "Institution Decision" or "Inst. Dec.").

Patent Owner subsequently filed a Patent Owner's Response (Paper 13, "PO Resp."), Petitioner filed a Reply (Paper 15, "Pet. Reply), and Patent Owner filed a Sur-reply (Paper 18, "Sur-reply").

On April 17, 2020, we granted a motion for joinder in IPR2020-00055, joining Ford Motor Company as a Petitioner in this proceeding. Paper 17.

An oral hearing was held on July 21, 2020, and a transcript of the hearing is included in the record. Paper 22 ("Tr.").

B. Real Parties in Interest

Petitioner identifies BMW of North America, LLC, BMW Manufacturing Co., LLC, Bayerische Motoren Werke, AG, and Ford Motor Company as real parties in interest. Pet. 48; IPR2020-00055, Paper 1, 48.

Patent Owner identifies Carrum Technologies, LLC and Pratima Instruments, LLC as real parties in interest. Paper 5, 1.

C. Related Matters

The parties identify *Carrum Technologies, LLC v. BMW of North America, LLC*, No. 1:18-cv-01645 (D. Del. Oct. 23, 2018); *Carrum Technologies, LLC v. FCA US LLC*, No. 1:18-cv-01646 (D. Del. Oct. 23, 2018); and *Carrum Technologies, LLC v. Ford Motor Company*, No. 1:18-cv-01647 (D. Del. Oct. 23, 2018) as related matters. Paper 5, 1; Pet. 48. The parties also identify as related matters IPR2019-00902 (institution denied) and IPR2019-00927 (institution denied), which were likewise directed to the ’475 patent. Pet. 48; Paper 5, 1.

D. The ’475 Patent

The ’475 patent discloses “a method and system for controlling a vehicle having” an adaptive cruise control (ACC) system. Ex. 1001, 1:7–10. The disclosed ACC system may include a vehicle speed sensor for measuring a vehicle’s speed, a lateral acceleration sensor for measuring the acceleration of the vehicle in the direction of the vehicle’s lateral axis in a turn, and a yaw rate sensor for measuring the rate that a vehicle is rotating about its vertical axis. *Id.* at 4:18–23.

A controller may determine the vehicle’s position within a turn from the lateral acceleration data provided by the sensors. *Id.* at 4:27–29, 5:41–47 (explaining how the disclosed system determines whether the vehicle is “in the entry of a turn, in the middle of a turn, or in the exit of a turn” using lateral acceleration data). In addition to lateral acceleration, the ’475 patent instructs that the controller may also use other data to predict whether the vehicle is in a turn, including yaw rate, yaw rate of change, and the vehicle’s speed. *Id.* at 6:1–6.

When the controller determines that the vehicle has entered a turn, it preemptively instructs the vehicle’s braking system to reduce the speed of the vehicle such that the lateral acceleration is reduced to a predetermined maximum limit according to the vehicle’s position within the turn. *Id.* at 6:20–29. Upon reducing the vehicle’s speed, the controller may use the vehicle's lateral acceleration, yaw rate, yaw rate of change, and speed data to estimate the path of the vehicle in the turn. *Id.* at 6:44–47.

In one embodiment of the '475 patent, a method of controlling a vehicle includes

> the steps of operating the vehicle in an adaptive cruise control mode such that the vehicle is travelling at a set speed; determining whether the vehicle is in a turn in the vehicle's path by detecting a change in the vehicle's lateral acceleration; and when the vehicle is determined to be in the turn, reducing the vehicle's speed according to the vehicle's position in the turn, monitoring for objects and maintaining the vehicle's speed if an object is positioned out of the path of the vehicle.

Id. at 2:58–67.

E. Illustrative Claim

Of the challenged claims, claims 1 and 6 are independent, with claims 2–5 depending, directly or indirectly, from claim 1 and claims 7–12 depending, directly or indirectly, from claim 6. Claim 1 is illustrative of the challenged claims and is reproduced below:

> 1. A method of controlling a vehicle having an adaptive cruise control system capable of controlling a vehicle speed and obtaining a vehicle lateral acceleration, said method comprising the steps of:
>
> measuring a lateral acceleration from a lateral acceleration sensor;
>
> detecting a change in a vehicle lateral acceleration based on a change in the measured lateral acceleration;
>
> determining when the vehicle is in a turn based on the detected change in the vehicle lateral acceleration; and
>
> if a vehicle is in a turn, reducing the vehicle speed according to the determination that the vehicle is in the turn and the detected change in the vehicle lateral acceleration.

Ex. 1001, 8:7–19.

F. Prior Art and Asserted Grounds

Petitioner asserts that claims 1–12 would have been unpatentable on the following grounds (Pet. 9–10):

Claims Challenged	35 U.S.C. §	References/Basis
1, 4, 5	103[1]	Brochure,[2] Schmitt[3], AAPA[4]
2, 3	103	Brochure, Schmitt, AAPA, Ishizu[5]
6, 8, 9	103	Brochure, Schmitt
7	103	Brochure, Schmitt, Ishizu
10–12	103	Brochure, Schmitt, Khodabhai[6]

Petitioner submits the Declaration of Dr. Azim Eskandarian (Ex. 1003) in support of its unpatentability arguments in the Petition and a second Declaration of Dr. Eskandarian in support of its arguments in the Reply (Ex. 1009). Patent Owner supports its arguments with the declaration of Dr. Gregory M. Shaver. Ex. 2003.

II. ANALYSIS

A. Legal Standards

To prevail in its challenge to claims 1–12 of the ’475 patent, Petitioner has the burden to establish by a preponderance of the evidence that the challenged claims are unpatentable. 35 U.S.C. § 316(e) (2018);

[1] The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the application from which the ’475 patent issued was filed before this date, the pre-AIA version of § 103 applies.
[2] BMW Brochure, Bayerische Motoren Werke, 2002 (“Brochure”) (Ex. 1007).
[3] Schmitt, US 6,456,924 B1, issued Sept. 24, 2002 (Ex. 1004).
[4] Petitioner contends statements contained in the ’475 patent constitute Applicant Admitted Prior Art (“AAPA”) (Ex. 1001).
[5] Ishizu, US 2001/0044691 A1, published Nov. 22, 2001 (Ex. 1005).
[6] Khodabhai, US 5,959,569, issued Sept. 28, 1999 (Ex. 1006).

37 C.F.R. § 42.1(d) (2019). This burden never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A patent claim is unpatentable under 35 U.S.C. § 103 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 having ordinary skill in the art to which said subject matter pertains. *See KSR Int'l Co. v. Teleflex Inc*., 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) if in the record, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

Petitioner contends one of ordinary skill in the art would have had "knowledge or familiarity with in-vehicle computing" and "a bachelor's degree in electrical engineering, computer engineering, or a related engineering discipline and two to three years of industry experience in the field of automotive control systems or automotive engineering, or equivalent experience, education, or both." Pet. 9 (citing Ex. 1003 ¶ 23).

Patent Owner does not dispute Petitioner's definition of one of ordinary skill in the art. PO Resp. 3.

Because it is consistent with the disclosures of the '475 patent and the prior art of record, we adopt Petitioner's uncontested definition of one of ordinary skill in the art. We note, however, that neither party contends that the proper determination of the level of ordinary skill in the art would impact the result in this proceeding.

C. Claim Construction

In this proceeding, the claims of the ’475 patent are construed “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b).” *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340, 51,340, 51,358 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018) (now codified at 37 C.F.R. § 42.100(b) (2019)). Under that standard, the words of a claim are generally given their “ordinary and customary meaning,” which is the meaning the term would have had to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

Both parties contend that the claim terms of the ’475 patent should be given their plain and ordinary meaning. Pet. 9; PO Resp. 13. Upon review of the prior art of record and the parties’ arguments, we agree that no claim terms of the ’475 patent require express construction for purposes of this decision and that the ordinary and customary meaning should be applied to all claim terms. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”)).

D. Claims 1, 4, and 5 over the Brochure, Schmitt, and AAPA

Petitioner contends that claims 1, 4, and 5 would have been obvious over the combined disclosures of the Brochure, Schmitt, and AAPA. Pet. 10–23.

1. The Brochure

The Brochure describes the technological features and refinements included with certain 2002 model year BMW vehicles. Ex. 1007, 4; Ex. 1008 ¶¶ 11–12. One technological feature disclosed in the Brochure is an Active Cruise Control (ACC) system that utilizes a radar sensor mounted beneath the front bumper of a vehicle to "determine the position and speed of the preceding vehicle." Ex. 1007, 21. The Brochure explains that "[o]n straight highway sections Active Cruise Control can use the radar sensor to determine whether another vehicle is proceeding in your own lane or an adjoining one." *Id.* The Brochure notes, however, that "[t]his concept alone is not enough in curves," where the ACC system must rely on additional data from the vehicle's Dynamic Stability Control (DSC) system to project the vehicle's trajectory and "determine whether a detected vehicle will have any effect on" the host vehicle's path. *Id.*

In addition to assisting in monitoring preceding vehicles, the Brochure explains that the DSC utilizes sensors to monitor "the current rate of lateral acceleration," the speed of the host vehicle, the steering wheel angle, "the vehicle's tendency to rotate around its vertical axis" (or yaw), "lateral acceleration," and braking pressure. *Id.* at 24–25. The DSC uses this sensory data to determine the vehicle's current dynamic status, which is then "compared with reference data stored in the DSC computer." *Id.* at 25. If the "DSC detects a deviation between the vehicle's current operational status and the reference data," it enters its active mode and may intervene both "through the brake system and the engine management." *Id.*

2. Schmitt

Schmitt discloses a method and device for improving vehicle traction, especially in curves. Ex. 1004, 1:7–8, 1:38–49. In one embodiment, curve entry and curve exit are ascertained "by differentiating the transverse acceleration or similar quantities that vary during cornering, such as wheel speed difference of the wheels of the non-drive axel, yaw rate quantities, or steering angle quantities." *Id.* at 3:28–34. In at least one embodiment, curve entry is recognized when the change of transverse acceleration exceeds "a predefined limiting value." *Id.* at 3:34–37, 3:48–50 (noting the use of transverse acceleration to determine whether a limiting value has been exceeded). Curve vertex is identified when, subsequent to curve entry, the transverse acceleration fails to meet the limiting value but at the same time exceeds a different limiting value. *Id.* at 3:37–41. Finally, "[i]f the change of [lateral acceleration] fails to meet a predefined limiting value, a curve exit is inferred." *Id.* at 3:41–42.

Schmitt explains that information on the respective cornering phase is used to influence the drive control. *Id.* at 3:51–54. In particular, when curve entry is recognized, slip thresholds for activating the traction controller are reduced as compared to thresholds for "straight-ahead driving," and at curve exit "the slip thresholds are raised as compared to the slip thresholds selected during cornering." *Id.* at 3:55–4:3. Using these modified slip thresholds, if Schmitt determines that slippage is imminent, the traction controller may reduce at least one output quantity of the drive unit of the vehicle, such as drive torque, to improve stability. *Id.* at 2:66–3:6. "Besides this drive intervention, in some exemplary embodiments, a brake intervention" may also be performed "at the spinning wheel." *Id.* at 3:6–8.

3. Alleged AAPA

The '475 patent discusses various features and problems with prior art ACC systems. Ex. 1001, 1:64–2:43; Pet. 13–14. Some of these problems are illustrated in Figure 1 of the '475 patent, which is reproduced below:

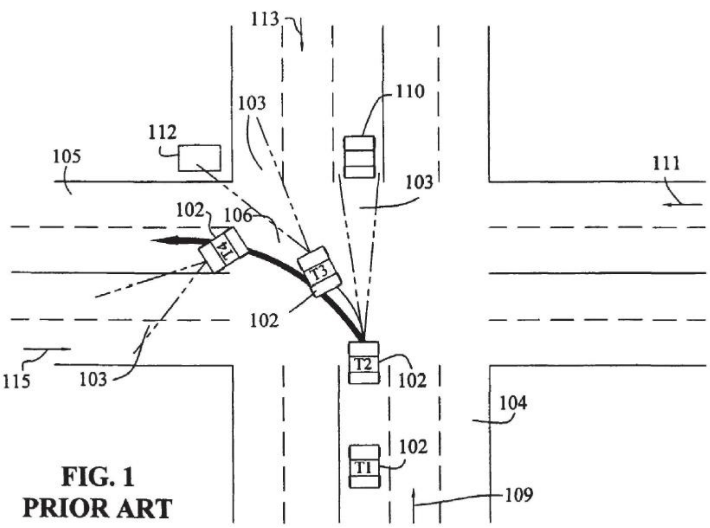

FIG. 1
PRIOR ART

Figure 1 is a diagrammatic view of a vehicle having a prior art ACC system in a turn situation and shows problems that may occur when a host vehicle is at time points T1–T4. Ex. 1001, 2:1–43, 3:50–51. According to the '475 patent, one problem present at time points T2 and T3 is that prior art ACC systems were "not capable of disregarding the stationary targets not within the vehicle's path (i.e., 'out-of-path' targets)," such as stationary objects 110 and 112. *Id.* at 2:1–31. A problem presented at time point T4 is that prior art systems would maintain their set cruising speed in turning situations, which the '475 patent explains could "cause excessive lateral acceleration and the possible loss of control of the host vehicle." *Id.* at 2:32–43.

The Petition contends that the '475 patent's discussion of existing problems in prior art systems constitutes applicant admitted prior art.

Pet. 13–16. As discussed in the Institution Decision, however, Petitioner does not direct us to any statement in the ’475 patent to suggest that the identified problems with prior art ACC systems were known to others in the art, nor any citation in the ’475 patent to prior art references that disclose these problems. Inst. Dec. 9–10. Thus, we reiterate our conclusion set forth in the Institution Decision that the ’475 patent’s disclosures do not constitute applicant admitted prior art. *Id.*

Petitioner does not contest our determination that the ’475 patent does not constitute applicant admitted prior art and does not further rely on the alleged admissions to support its obviousness challenges. Pet. Reply 6–7; Tr. 5:12–18. Accordingly, we do not include or further analyze the alleged AAPA in any of Petitioner’s proposed grounds of unpatentability.

4. Analysis: Claim 1

Petitioner contends the Brochure and Schmitt teach or suggest every limitation of claim 1 of the ’475 patent. In particular, Petitioner contends the Brochure discloses measuring a vehicle’s lateral acceleration using a lateral acceleration sensor, detecting “the lateral acceleration rate (i.e., a detected change in the lateral acceleration),” and determining whether the vehicle is in a turn based on the detected change in vehicle lateral acceleration. Pet. 17–18 (citing Ex. 1003 ¶¶ 46–48; Ex. 1007, 21, 24). Petitioner further contends that Schmitt discloses reducing a vehicle’s speed according to a determination that the vehicle is in a turn and based on the detected change in vehicle lateral acceleration. *Id.* at 19–20 (citing Ex. 1004, 2:59–62, 2:66–3:9, 3:28–37, 4:38–39, 4:41–5:11; Ex. 1003 ¶ 51).

With respect to the reason to implement Schmitt’s speed reducing method in the Brochure, Petitioner contends that because the problem of excess lateral acceleration in turning situations “was known in the art, and because *Schmitt* is in the same field of endeavor—vehicle safety systems," "a person of skill would readily combine the Brochure with *Schmitt*." *Id.* at 21 (citing Ex. 1003 ¶ 53).

Patent Owner contends independent claim 1 would not have been obvious over the Brochure and Schmitt because (1) Schmitt is not analogous art to the '475 patent, (2) the Brochure does not disclose "measuring a lateral acceleration from a lateral acceleration sensor," (3) the Brochure does not disclose "detecting a change in a vehicle lateral acceleration based on a change in the measured lateral acceleration," and (4) Petitioner has failed to show that one of ordinary skill in the art would have sought to combine the Brochure and Schmitt to arrive at the invention recited in claim 1. PO Resp. 16–36, 43–49. We address these arguments in turn.

a) The Brochure and Schmitt are Analogous to the '475 Patent

A reference may qualify as prior art for an obviousness determination "only when analogous to the claimed invention." *In re Bigio,* 381 F.3d 1320, 1325 (Fed. Cir. 2004). "Two separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved." *Id.* Petitioner contends that because Schmitt and the Brochure are in the same field of endeavor—vehicle safety systems—they may be combined in its obviousness grounds. Pet. 21 (citing Ex. 1003 ¶ 53).

Patent Owner argues Schmitt's "vehicle stability and traction control" system "is not directed to an ACC system and so is not in the same field of endeavor as the Brochure and '475 patent." Sur-reply 22–23; PO Resp. 26–27 (citing Ex. 2006, 144, 146, 148) (asserting that ACC systems are marketed as improving driver comfort and in some situations an ACC system "may not actually contribute to vehicle safety at all"). Patent Owner further contends that Petitioner has not asserted that Schmitt is reasonably pertinent to the particular problem addressed in the '475 patent. Sur-reply 23. Petitioner counters that ACC systems seek to improve both operator comfort and safety, which demonstrates that the Brochure, Schmitt, and the '475 patent are all in the same field of endeavor. Pet. Reply 7–10 (citing Ex. 1009 ¶¶ 25, 28, 30–36; Ex. 2006, 143–144, 146).

As noted by Patent Owner, the '475 patent and the Brochure disclose ACC systems, whereas Schmitt discloses a vehicle control system. PO Resp. 26–27. The '475 patent and the Brochure demonstrate, however, that ACC systems control the operation of a vehicle and, similar to the system of Schmitt, are concerned with both operator comfort and safety. Ex. 1001, 2:29–31 ("This excessive braking may annoy and provide discomfort to the driver of vehicle 102."), 2:32–36 (noting that "maintenance of a set cruise speed in turning situations may cause excessive lateral acceleration and the possible loss of control of the host vehicle"); Ex. 1007, 21, 24 (the Brochure disclosing the dual goals of vehicle safety and driver comfort); Ex. 1009 ¶¶ 23–36. Thus, we find that Schmitt and the Brochure are in the same field of endeavor as the '475 patent—vehicle control systems—and represent analogous art that may be applied in an obviousness challenge.[7] Ex. 1004, 1:44–49 (Schmitt noting that its system will both improve traction and driver comfort).

[7] Because the Brochure and Schmitt are in the same field of endeavor as the '475 patent, we need not address the second prong of the analogous art test. We note, however, that the '475 patent addresses two problems—excess lateral acceleration in a turn and avoiding braking for out-of-path targets.

b) Measuring a lateral acceleration from a lateral acceleration sensor

The Brochure's ACC system uses data supplied by the DSC's suite of sensors, which monitor, among other things, lateral acceleration. Ex. 1007, 21, 24. Petitioner contends the sensor that monitors lateral acceleration in the Brochure is a lateral acceleration sensor, as recited in claim 1. Pet. 17; Ex. 1003 ¶ 46 (Dr. Eskandarian asserting that in his opinion the Brochure teaches a lateral acceleration sensor).

Patent Owner contends the Brochure merely discloses a suite of unnamed sensors that "monitor[] the current rate of lateral acceleration[,] the speed[, and] the steering wheel angle" of the host vehicle and "keep track of the vehicle's tendency to rotate around its vertical axis[,] lateral acceleration[,] steering wheel angle[, and] braking pressure." PO Resp. 43–44 (citing Ex. 1007, 24; Ex. 2003 ¶ 102). And because there are multiple ways that lateral acceleration can be monitored or kept track of, including calculating this value based on yaw rate and steering angle, Patent Owner contends the identified disclosures of the Brochure are insufficient to show that lateral acceleration is measured by a lateral acceleration sensor. *Id.* at 44–45; Sur-reply 7–8.

In reply, Petitioner asserts that although there are different ways to determine lateral acceleration, directly measuring lateral acceleration using a sensor is the "most straightforward way" to do so and "is what one of skill would have understood by reading the Brochure." Pet. Reply 15 (citing Ex. 1009 ¶ 68; Ex. 1011, 100). In response to Patent Owner's argument that

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Ex. 1001, 2:47–50. The Brochure and Schmitt are each reasonably pertinent to one or both of these problems. Ex. 1004, 1:44–49 (reducing vehicle speed in a turn); Ex. 1007, 21 (the Brochure reducing vehicle speed for in-path targets), 24–25 (assessing vehicle stability in a turn).

the sensors are unnamed, Petitioner asserts that one of ordinary skill in the art would have understood that an unnamed sensor that keeps track of lateral acceleration "is most likely a lateral acceleration sensor." *Id.* at 16 (citing Ex. 1009 ¶¶ 69–70).

Patent Owner contends Petitioner's argument that the Brochure's unnamed sensor is "most likely a lateral acceleration sensor" is "too little, too late," as such evidence was necessary to support Petitioner's prima facie case in the Petition. Sur-reply 7.

The Brochure discloses that the vehicle's sensors monitor "the current rate of lateral acceleration" and "keep track" of "lateral acceleration." Ex. 1007, 24. We are directed to no disclosure in the Brochure of the *sensors* obtaining lateral acceleration in any manner other than directly measuring this value. *Id.* ("Ultra-sensitive sensors serve as the core components" and "keep track of . . . lateral acceleration"). Thus, we credit the testimony of Dr. Eskandarian that one of ordinary skill in the art would have understood that the sensor in the Brochure that keeps track of lateral acceleration and monitors the current rate of lateral acceleration is a lateral acceleration sensor. Ex. 1003 ¶ 46; Ex. 1009 ¶¶ 69–70. Moreover, to the extent it is possible that the disclosed sensors do not directly measure lateral acceleration, we agree with Dr. Eskandarian that the Brochure at a minimum suggests using a lateral acceleration sensor to measure lateral acceleration. Ex. 1009 ¶¶ 68–70.

With respect to Patent Owner's assertion that Petitioner's arguments come too late, we note that in his first declaration Dr. Eskandarian testifies that lateral acceleration sensors were known in the art and that one of ordinary skill in the art would have understood that the brochure teaches measuring vehicle lateral acceleration from a lateral acceleration sensor.

Ex. 1003 ¶ 46. Dr. Eskandarian's subsequent testimony that one of ordinary skill in the art reading the Brochure would have understood that the Brochure directly measures lateral acceleration using a lateral acceleration sensor is consistent with this position, and his testimony regarding unnamed sensors directly responds to arguments presented in Patent Owner's Response. Ex. 1009 ¶ 69. Thus, we find that Petitioner's arguments relating to the lateral acceleration sensor do not constitute improper new arguments. *See Apple Inc. v. Andrea Elecs. Corp.*, 949 F.3d 697, 706–707 (Fed. Cir. 2020) (explaining that a petitioner may introduce new evidence in reply as long as this evidence is responsive to arguments raised in patent owner's response and does not raise a new theory of unpatentability).

c) Detecting a change in a vehicle lateral acceleration based on a change in the measured lateral acceleration

Petitioner contends the Brochure includes a sensor that measures the vehicle's lateral acceleration and discloses using a vehicle's "lateral acceleration rate (i.e., a detected change in the lateral acceleration)" to calculate a curve radius. Pet. 17–18 (citing Ex. 1007, 24 (using lateral acceleration rate to "calculate a curve radius"); Ex. 1003 ¶ 47). Thus, Petitioner contends the Brochure discloses "detecting a change in a vehicle lateral acceleration based on a change in the measured lateral acceleration," as recited in claim 1. *Id.*

Patent Owner contends Petitioner's argument fails for at least three reasons. First, Patent Owner contends that, as discussed above, the Brochure does not disclose directly measuring lateral acceleration using a lateral acceleration sensor. PO Resp. 46. We do not find this argument persuasive because, for the reasons discussed above in Section II.D.4.b, we find that the Brochure teaches or suggests using a lateral acceleration sensor.

Second, Patent Owner asserts that although Petitioner alleges that a sensor in the DSC "measures the vehicle's lateral acceleration" and that "the lateral acceleration rate (i.e., a detected change in the vehicle lateral acceleration) of the vehicle is used to calculate a curve radius," it "never connects the two" to assert that the "lateral acceleration rate" is based on a change in the measured lateral acceleration. *Id.* at 46–47 (citing Pet. 17–18). We do not find this argument persuasive because, although the Petition could have been more explicit in its discussion of this claim limitation, we understand the thrust of the Petition to be that one of ordinary skill in the art would have understood that the data from the lateral acceleration sensor is used to determine the vehicle's lateral acceleration rate. Pet. 17–18 (citing Ex. 1003 ¶ 47); Pet. Reply 18 (citing Ex. 1009 ¶¶ 80–81).

Finally, Patent Owner contends a person of ordinary skill in the art would have understood that a "lateral acceleration rate" is not "a detected change in the lateral acceleration." PO Resp. 48. In support of this argument, Patent Owner looks to the language of claim 7, which requires "measuring a vehicle yaw rate" and "a change in the vehicle yaw rate." *Id.* (citing Ex. 1001, 8:55–56). Patent Owner contends this claim structure "makes . . . clear" that "yaw rate cannot be the same as a change in the yaw rate" and, by analogy, that a "lateral acceleration rate is not the same as using a change in the lateral acceleration rate." *Id.* (citing Ex. 2003 ¶ 112).

Dr. Eskandarian testifies that the term "rate" means a "change" in a certain parameter over time. Pet. Reply 17 (citing Ex. 1009 ¶ 74; Ex. 1011, 101). Accordingly, Petitioner asserts that yaw rate is the rate of change in yaw and the change in yaw rate is the change of the change in yaw. *Id.* at 17–18. Likewise, Petitioner contends the Brochure's lateral acceleration rate, or "rate of lateral acceleration," is the *change* in lateral acceleration. *Id.*

Upon review of the parties arguments, we credit the testimony of Dr. Eskandarian that the term "rate" means a "change" in a certain parameter over time and that one of ordinary skill in the art would have interpreted the term "lateral acceleration rate" in the Brochure to mean the rate of change in lateral acceleration over time. Ex. 1009 ¶¶ 73–81; Ex. 1007, 24–25. Dr. Shaver's counter testimony is not persuasive because he does not persuasively address the meaning of the term "rate" in the challenged claims or persuasively address the difference in meaning of the terms "lateral acceleration" and "lateral acceleration rate" in the Brochure. *See* Ex. 2003 ¶¶ 107–115; Ex. 1007, 24–25. Thus, we find that the Brochure teaches or suggests "detecting a change in a vehicle lateral acceleration based on a change in the measured lateral acceleration."

d) Reason to Combine

With respect to claim 1, the Petition asserts that one of ordinary skill in the art would have sought to implement Schmitt's method of reducing speed in a curve when a change in lateral acceleration exceeds a preset maximum because it was well known, as disclosed in Schmitt, that excessive lateral acceleration in a turn could cause a vehicle to lose control. Pet. 19–20; *see also id.* at 21 ("Because this problem was known in the art, and because *Schmitt* is in the same field of endeavor—vehicle safety systems, a person of skill would readily combine the Brochure with *Schmitt*.").

Patent Owner asserts that (1) Dr. Eskandarian's testimony is "unreliable" because he admitted during cross-examination that the Brochure already reduces lateral acceleration in a curve when necessary to stabilize the vehicle, (2) because the Brochure already solves the purported problem in the art, there is no persuasive explanation in the Petition as to why one of ordinary skill in the art would have combined the Brochure and

Schmitt in the manner proposed, and (3) Petitioner's argument that it was known in the art "that excessive lateral acceleration could cause a vehicle to lose control" is too generic to support an obviousness conclusion.[8] PO Resp. 17–19, 28–29 (citing Ex. 2005, 44:4–22).

In reply, Petitioner asserts that the need to reduce the speed of a vehicle when entering a turn is "not only well-known, but common-sensical." Pet. Reply 6. Petitioner further asserts that Dr. Eskandarian never testified that the system described in the Brochure already includes the functions the Board found that Schmitt discloses, and only confirmed that the Brochure's system constantly monitors multiple parameters and, "depending on what the road surface conditions are and the speed," can apply the brakes when needed. *Id.* at 3 (citing Ex. 2005, 44:4–22).

Upon review of the parties' evidence and arguments, we credit Dr. Eskandarian's testimony, which is supported by the express disclosures of Schmitt, that the problem of excess lateral acceleration in curves was well known in the art. Ex. 1003 ¶ 51 (citing Ex. 1004, 2:59–62, 3:28–37, 4:38-39, 4:41–5:11). Given that the problem of excess lateral acceleration due to entering a curve at too high a speed was well known in the art, we find Petitioner's argument persuasive that one of ordinary skill in the art would

[8] Patent Owner also asserts that because Schmitt is not analogous art and is not directed to the problem of "excessive lateral acceleration caused by the maintenance of a set cruise speed in turning situations," Petitioner's motivation to combine arguments fail. PO Resp. 26–28, 30–32. These arguments are not persuasive because, as discussed previously, the Brochure, Schmitt, and the '475 patent are analogous art and the law does not require that the prior art references be combined for the same reasons outlined by the inventor. *See In re Fulton*, 391 F.3d 1195, 1202 (Fed. Cir. 2004) ("the law does not require that the references be combined for the reasons contemplated by the inventor.").

have sought to implement in the Brochure Schmitt's method of improving vehicle safety by decreasing vehicle speed based on the vehicle being in a curve and the detected change in the vehicle's lateral acceleration. Pet. 20–21.

We do not find Patent Owner's counter arguments persuasive. Although the Brochure can detect whether a vehicle is in a turn (Ex. 1007, 21) and may reduce the speed of the vehicle if necessary to maintain vehicle stability (*id.* at 24–25), we agree with Petitioner that Dr. Eskandarian did not testify that the Brochure's DSC system is configured to reduce the vehicle speed according to a determination that the vehicle is in a turn and a detected change in vehicle lateral acceleration, as is expressly disclosed in Schmitt. Pet. 20 (citing Ex. 1004, 2:59–62, 3:28–37, 4:38–39, 4:41–5:11); Tr. 44:4–22.

Moreover, we find that Petitioner's reasoning as to why one of ordinary skill in the art would have sought to combine the identified portions of the Brochure and Schmitt is not too generic. The Petition identifies both a specific problem known in the prior art (excess vehicle speed and lateral acceleration in turns) and a specific solution to this problem (implementation of Schmitt's method of reducing vehicle speed based on the vehicle's location in a turn (curve entry, vertex, and exit) and a measured lateral acceleration). Pet. 19–20. This is sufficient to explain why one of ordinary skill in the art would have sought to combine the identified disclosures of the Brochure and Schmitt.

In view of the foregoing, we find that the combination of the Brochure and Schmitt teaches or suggests every limitation of claim 1 of the '475 patent. We further find that one of ordinary skill in the art would have sought to combine the two references to address the known problem of loss of vehicle control due to excess speed in a turn. Accordingly, Petitioner has demonstrated by a preponderance of the evidence that claim 1 of the ’475 patent would have been obvious over the Brochure and Schmitt.

5. Analysis: Claim 4

Claim 4 depends from claim 1 and further requires “a step of determining the vehicle’s position within the turn.” Ex. 1001, 8:30–31.

Petitioner and Dr. Eskandarian assert that one of ordinary skill in the art would have sought to implement Schmitt’s method of determining a vehicle’s position within a turn in order to make “more accurate the determination to reduce a vehicle’s speed” in the Brochure. Pet. 22 (asserting that the accuracy of the Brochure’s projected path is critical to the ACC system’s operation); Ex. 1003 ¶ 54.

Dr. Eskandarian’s testimony that one of ordinary skill in the art would have sought to determine a vehicle’s position in a turn is directly supported by Schmitt, which discloses improving user comfort and vehicle safety by identifying whether a vehicle is at curve entry, curve vertex, or curve exit. Ex. 1003 ¶ 55; Ex. 1004, 1:41–45 (preventing a “traction gap” on curve exit being “felt unpleasantly by the driver”), 3:28–37, 3:60–66 (noting that slip thresholds are reduced at curve entry to increase the stability of the vehicle). Thus, we credit the testimony of Dr. Eskandarian that one of ordinary skill in the art would have sought to determine the location of a vehicle in a curve when determining whether to reduce vehicle speed. Ex. 1003 ¶¶ 54–56.

As noted by Patent Owner, Dr. Eskandarian testified on cross-examination that there are no particular flaws in the Brochure’s system and that it works perfectly. PO Resp. 51 (citing Ex. 2005, 63:11–64:9, 62:3–9; Ex. 2003 ¶¶ 118–120). The Brochure does not explain, however, how it projects a vehicle’s path within a turn. Ex. 1007, 21, 25. Thus, we find persuasive Dr. Eskandarian's testimony that one of ordinary skill in the art seeking to implement the accurate and successful system of the Brochure would have looked to prior art systems to determine how to accurately project a vehicle's path and determine whether the vehicle's speed should be reduced. Ex. 1003 ¶¶ 54–56 (Dr. Eskandarian asserting that Schmitt's method "would make any determination that a vehicle had entered a curve more accurate thus making more accurate the determination to reduce a vehicle's speed"); Ex. 2005, 60:7–66:22; Pet. Reply 18–19.

Patent Owner's argument that Dr. Eskandarian changed his testimony during cross-examination, recanting any reliance on accuracy as a reason to implement Schmitt's method in the Brochure, presents a close question. Dr. Eskandarian's testimony that the Brochure can be made "more accurate" is somewhat ambiguous. Ex. 1003 ¶ 54. Was Dr. Eskandarian referring to using a known and accurate method as an implementation detail for the Brochure or referring to a method of improving the accuracy of the Brochure's existing system? Dr. Eskandarian made clear during his deposition, however, what he intended by his direct testimony, i.e., that one of ordinary skill in the art would have looked to Schmitt in order to understand how to accurately reproduce the system and functionality described in the Brochure. Ex. 2005, 62:11–66:22; Ex. 1003 ¶ 56. Patent Owner was aware of this testimony and had a full and fair opportunity to respond to it in its Response and Sur-reply. Thus, we do not agree that Petitioner and Dr. Eskandarian changed their argument in reply or that Patent Owner was not given a full and fair opportunity to respond to Petitioner's argument.

Addressing Dr. Eskandarian's "implementation detail" argument, Patent Owner asserts that one of ordinary skill in the art would not have had "any reason to believe that *Schmitt* discloses the implementation details of the Brochure" and Petitioner's argument that Schmitt's method would make the Brochure more accurate implies that Petitioner believes "that *Schmitt* discloses *different* implementation details than those utilized in the Brochure's system." PO Resp. 24 (citing Pet. 22; Ex. 1003 ¶ 56; Ex. 2003 ¶¶ 86–87). Patent Owner further argues that the Board's decision in *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-00582, Paper 34, (PTAB Aug. 5, 2019) (informative) precludes reliance on "implementation details" as a reason to combine two or more references. *Id.* at 23–24.

We are not persuaded by these arguments. First, as discussed above, Petitioner does not assert that Schmitt discloses the precise method used in the Brochure, but that one of ordinary skill in the art would have looked to Schmitt in order to successfully implement the Brochure's method of determining whether to slow a host vehicle in a curve. Pet. 22; Pet. Reply 18–19.

Second, we do not agree that *Hulu* precludes reliance on "implementation details" as a reason to combine one or more references. In *Hulu*, the petitioner relied on the combination of O'Neil, Kao, and DeWitt for one ground of unpatentability. *Hulu*, Paper 34 at 6. The *Hulu* petitioner asserted that the combination of O'Neil and Kao disclosed every limitation of the challenged claims, but "[t]o the extent Patent Owner contends Kao's teachings . . . are insufficiently specific, [an ordinarily skilled artisan] would have found it obvious to refer to DeWitt for further implementation details." *Id.* at 15. The *Hulu* patent owner, however, did not subsequently challenge the sufficiency of Kao's teachings and instead called into question the "stated motivation for combining Kao with O'Neil." *Id.* Thus, the question of petitioner's reliance on DeWitt for implementation details was not addressed in *Hulu*. Nor are we directed to any case law or reasoning that would preclude reliance on "implementation details" as a reason to combine two or more prior art references.

In view of the foregoing, we determine that Petitioner has demonstrated that the Brochure and Schmitt teach or suggest every limitation of claim 4 of the '475 patent and that Petitioner sufficiently explains why one of ordinary skill in the art would have sought to implement Schmitt's method of determining the vehicle's position in a curve in the combined system of the Brochure and Schmitt. Thus, Petitioner has demonstrated by a preponderance of the evidence that claim 4 would have been obvious over the combined disclosures of the Brochure and Schmitt.

6. Analysis: Claim 5

Claim 5 depends from claim 1 and further requires that the step of reducing vehicle speed includes "a step of reducing the speed if the vehicle lateral acceleration exceeds a predetermined limit." Ex. 1001, 8:32–34.

The Brochure's DSC system monitors a "stream of data" from the sensors, and when it "detects a deviation between the vehicle's current operational status and the reference data it enters its active mode, with intervention both through the brake system and engine management." Pet. 23 (citing Ex. 1007, 25; Ex. 1003 ¶ 57). Petitioner contends a person of skill in the art would understand that the Brochure's "reference data" "is the same as a predetermined limit" and that the Brochure therefore reduces speed when the vehicle's lateral acceleration exceeds a predetermined limit.[9] *Id.* (citing Ex. 1003 ¶ 57).

[9] Petitioner and Dr. Eskandarian do not contend that Schmitt discloses this claim limitation. Pet. 23; Ex. 1003 ¶ 57; Pet. Reply 19–20; Ex. 1009 ¶¶ 88–89.

Patent Owner contends the cruise control system of the Brochure reduces speed based on only one factor—detection of a slower vehicle in the same lane—and there is no disclosure in the Brochure of reducing vehicle speed when lateral acceleration exceeds a predetermined limit. PO Resp. 53 (citing Ex. 1007, 21; Ex. 2003 ¶ 126). Patent Owner further asserts that Petitioner's argument that "reference data" is the same as a predetermined limit is "both incorrect and completely without support." *Id.* at 54. According to Patent Owner, if reference data is the same as a predetermined limit, then the Brochure's disclosure could be read as implementing braking "[w]hen the DSC detects a deviation between the vehicle's current operational status and the [predetermined limit.]" *Id.* at 55. Thus, even when driving on a straight road with zero lateral acceleration, the vehicle would have a "lateral acceleration that deviates from the predetermined limit," and the DSC could unnecessarily apply the vehicle's brakes. *Id.* (citing Ex. 2003 ¶ 129).

In response, Petitioner contends one of ordinary skill in the art would have understood that the Brochure's "reference data" includes, or is, a predetermined limit and that when the current operational status—including the vehicle's lateral acceleration—exceeds this limit, the brake system will intervene and reduce the vehicle's speed. Pet. Reply 19 (citing Ex. 1009 ¶ 88; Ex. 1011, 69).

Patent Owner counters that the argument that reference data includes or is a predetermined limit that, if exceeded, would cause a reduction in speed was not made in the Petition. Sur-reply 9 (citing Pet. Reply 19).

The Brochure discloses monitoring a stream of data that includes yaw rate, curve radius (calculated using the lateral acceleration rate), the vehicle's speed, steering wheel angle, and pressure applied to the brake pedal, and uses this information to determine the vehicle's current dynamic status. Ex. 1007, 25. If that dynamic status deviates from reference data stored in the DSC computer, the brake system may be activated. *Id.* The Brochure does not indicate, however, what sensor data the reference data or limits are directed to. Nor does the Brochure disclose that the magnitude of lateral acceleration (as required by claim 5), as opposed to the vehicle's lateral acceleration rate, is used at all in the determination of a vehicle's dynamic status.

Dr. Eskandarian's testimony on this point is conclusory and does not explain adequately why one of ordinary skill in the art would have concluded that there is a predetermined limit on lateral acceleration from the fact that the Brochure uses lateral acceleration rate to calculate curve radius. Ex. 1009 ¶¶ 85–89. In contrast, Dr. Shaver persuasively testifies that the DSC takes into account road conditions as well as other variables that are being monitored, and will only stabilize the vehicle when all of these combined variables indicate that the DSC "needs to stabilize the vehicle." Ex. 2003 ¶ 132. And because all of the reference data collected, including yaw rate, vehicle speed, and steering angle, would be considered when deciding whether the dynamic status deviates from the DSC's reference data, Dr. Shaver testifies that there is no predetermined limit for lateral acceleration in the Brochure. *Id*. We credit this testimony and find that Petitioner has not demonstrated sufficiently that the Brochure teaches or suggests reducing the speed of a vehicle if the lateral acceleration exceeds a predetermined limit. *Id.* ¶ 133.

In view of the foregoing, Petitioner has not demonstrated by a preponderance of the evidence that claim 5 would have been obvious over the Brochure and Schmitt.

7. Conclusion with Respect to Claims 1, 4, and 5

For the reasons set forth above, Petitioner has demonstrated by a preponderance of the evidence that claims 1 and 4 of the '475 patent would have been obvious over the Brochure and Schmitt. Petitioner has not demonstrated by a preponderance of the evidence, however, that the subject matter of claim 5 would have been obvious over this set of prior art references.

E. Claims 2 and 3 over the Brochure, Schmitt, and Ishizu

Claim 2 depends from claim 1 and further requires that the step of determining whether a vehicle is in a turn includes the steps of "measuring the vehicle speed," "measuring a vehicle yaw rate," and "measuring a rate of change in the vehicle yaw rate." Ex. 1001, 8:20–24. Claim 3 depends from claim 2 and further requires that the step of "determining" includes "a step of utilizing speed data corresponding to the vehicle speed, yaw rate data corresponding to the vehicle yaw rate, and yaw rate of change data corresponding to the [rate] of change in the vehicle yaw rate." *Id.* at 8:25–29.

Petitioner contends the subject matter of claims 2 and 3 would have been obvious over the combined disclosures of the Brochure, Schmitt, and Ishizu.

1. Ishizu

Ishizu discloses a system that maintains the lateral acceleration of a vehicle below a preset value. Ex. 1005 ¶ 3. Ishizu's vehicle control system includes a lateral acceleration sensor, a vehicle speed sensor, a target vehicle speed setting device, a drive system, and a connected controller. *Id.* at Abstract.

In operation, Ishizu's system obtains the vehicle's lateral acceleration, or "lateral-G," in one of two ways. First, lateral-G may be calculated using, among other things, steer angle and vehicle speed. *Id.* ¶¶ 31–32 (disclosing the use of "wheelbase dimension of the vehicle," "steering gear ratio," and a "stability factor" in the calculation). Second, lateral-G may be obtained by "using a yaw-rate sensor and processing the yaw rate ψ(t) by means of a low-pass filter (LPF)" and vehicle speed. *Id.* ¶¶ 29, 33–34.

2. Analysis

Petitioner contends one of ordinary skill in the art would have understood that calculating lateral acceleration using vehicle speed and yaw rate "would lead to higher confidence" in the Brochure's ACC system "knowing the vehicle lateral acceleration." Pet. 26 (citing Ex. 1003 ¶ 63). Thus, Petitioner and Dr. Bohannon conclude that an ordinarily skilled artisan would have sought to use Ishuzu's method of calculating lateral acceleration using vehicle speed and yaw rate in the Brochure to "check the accuracy of the lateral acceleration" used by the Brochure's system. *Id.* at 26–28 (citing Ex. 1003 ¶ 63).

During prosecution, the applicants overcame a pending rejection in light of the fact that directly measuring lateral acceleration using a lateral acceleration sensor is more reliable than calculating lateral acceleration using yaw rate. Ex. 2003 ¶ 141 (citing Ex. 1002, 197–198). Petitioner does not persuasively address this argument or explain why using yaw rate in addition to a lateral acceleration sensor would lead to higher confidence in the measured lateral acceleration. *Id.* ¶ 140 (Dr. Shaver noting that Petitioner and Dr. Eskandarian do not explain why calculating lateral acceleration would lead to higher confidence in the lateral acceleration measured by the sensor).

Petitioner also does not explain sufficiently how a "higher confidence" in the measured vehicle lateral acceleration would impact the behavior of the system in any way. For example, Petitioner does not explain how the system of the Brochure and Ishuzu would react if the two measurements of lateral acceleration are the same or how the combined system would handle a discrepancy between the calculated lateral acceleration and that measured by the sensor. Ex. 1003 ¶ 63; Ex. 2003 ¶ 140; PO Resp. 42–43 (citing Ex. 1002, 197–198), 59; Sur-reply 3; Tr. 58:1–15. Accordingly, we find that Petitioner has not presented a persuasive explanation as to why one of ordinary skill in the art would seek, in the combined system of the Brochure, Schmitt, and Ishizu, to both measure lateral acceleration using a lateral acceleration sensor and also confirm this value by calculating lateral acceleration using vehicle speed and yaw rate.[10] Ex. 2003 ¶ 140.

Claim 2 also requires determining whether a vehicle is in a turn by measuring a rate of change in the vehicle yaw rate. Ex. 1001, 8:24. Although the Petition concedes that Ishizu only uses yaw rate to calculate the magnitude of lateral acceleration, it contends one of ordinary skill in the art would have been able to determine the rate of change in vehicle yaw rate from the measured yaw rate "with minimal difficulty" and "would have been motivated to do this to calculate a lateral acceleration rate, as opposed to the magnitude of lateral acceleration at a given time." Pet. 27, 38–39. As noted

[10] Embodiments of the '475 patent consider a combination of lateral acceleration from a sensor, the change in measured lateral acceleration, vehicle speed, yaw rate, and the rate of change of yaw rate. Ex. 1001, 8:15–16, 8:20–24. But this is to predict whether the vehicle is in a turn and to estimate the path of the vehicle, not to confirm that the lateral acceleration data from the sensor is accurate. *Id.* at 6:1–11, 6:44–56.

in the Institution Decision, however, the Petition provides no reason why one of ordinary skill in the art would have wanted to calculate the lateral acceleration rate from vehicle velocity and yaw rate. Inst. Dec. 21. That it is easy to do, is not a persuasive reason to do so. *See Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993–94 (Fed. Cir. 2017) (noting that it is not enough to show two references could be combined; a petitioner must explain why one of ordinary skill would have been motivated to make the combinations or modifications of prior art to arrive at the claimed invention) (citing *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015)).

In its reply, Petitioner contends one of ordinary skill in the art would have sought to calculate lateral acceleration rate using the change in yaw rate in order to increase confidence in the Brochure's detected rate of change of vehicle lateral acceleration. Pet. Reply 21 (citing Ex. 1003 ¶ 65; Ex. 1009 ¶ 95; Ex. 1011, 76, 96–97, 107). We are not persuaded by this argument for two reasons. First, it comes too late. The Petition and Dr. Eskandarian's first declaration provide no reasoned explanation as to why one of ordinary skill in the art would have wanted to calculate a lateral acceleration rate using a change in yaw rate when such data is already available from a lateral acceleration sensor. A reply brief is not the proper vehicle to provide such an explanation in the first instance. *See* Consolidated Trial Practice Guide 73 (noting that a Petitioner may not submit new evidence or argument in reply "to make out a prima facie case of unpatentability"); Sur-reply 2–3 (noting that the Petition's discussion of Ishizu with respect to claims 2, 3, and 7 "never mentions the Brochure's detected *change* in lateral acceleration, much less a motivation for additionally calculating the change" in lateral acceleration using the change in yaw rate).

Second, as noted above with respect to lateral acceleration, Petitioner does not explain persuasively why confirming the lateral acceleration rate using the rate of change in yaw rate would have been beneficial or desirable in the system of the Brochure, which already measures lateral acceleration using the more reliable lateral acceleration sensor.[11] Ex. 1002, 197–198.

In view of the foregoing, we determine that Petitioner has not demonstrated by a preponderance of the evidence that claim 2 would have been obvious over the Brochure, Schmitt, and Ishizu. As Petitioner's arguments for claim 3 are identical to its arguments with respect to claim 2, Petitioner has also not demonstrated by a preponderance of the evidence that claim 3 would have been obvious over the Brochure, Schmitt, and Ishizu.

F. Claims 6, 8, and 9 over the Brochure and Schmitt

Petitioner contends the subject matter of claims 6, 8, and 9 would have been obvious over the combined disclosures of the Brochure and Schmitt. Pet. 28–37.

1. Analysis: Claim 6

Petitioner's arguments with respect to independent claim 6 generally follow its arguments for independent claim 1. Pet. 28–35. In particular, Petitioner contends the Brochure expressly discloses operating a vehicle in an adaptive cruise control mode (Pet. 30 (citing Ex. 1007, 21; Ex. 1003 ¶ 72)), measuring a lateral acceleration from a lateral acceleration sensor (*id.*

[11] To the extent Petitioner is correct that one of ordinary skill in the art would have sought to confirm the accuracy of the Brochure's lateral acceleration sensor using vehicle yaw rate, it is not evident why such a skilled artisan would then also seek to confirm that the lateral acceleration rate derived from the sensor is accurate using a calculated rate of change in yaw rate. The accuracy of the sensor would have already been confirmed using the previous yaw rate calculation.

at 30–31 (citing Ex. 1007, 21; Ex. 1003 ¶ 73)), detecting a change in vehicle lateral acceleration based on a change in the measured lateral acceleration (*id.* at 31 (citing Ex. 1007, 21, 24; Ex. 1003 ¶¶ 74)), determining the vehicle path based on the detected change in the vehicle's lateral acceleration (*id.* at 31–32 (citing Ex. 1007, 21, 24; Ex. 1003 ¶ 75), and monitoring for objects, detecting a location of an object, determining whether the location of the object is within the vehicle's path, and reducing speed based on the location of the object (*id.* at 32–33 (citing Ex. 1007, 21; Ex. 1003 ¶¶ 76–77)).

Petitioner again concedes that the Brochure does not explicitly disclose "when the vehicle is determined to be in the turn, reducing the vehicle speed according to that determination" but contends that one of ordinary skill in the art would have been motivated to implement such a system based on Schmitt. Pet. 33–35 (citing Ex. 1007, 21; Ex. 1003 ¶¶ 78–80; Ex. 1004, 2:59-62, 3:28-37, 4:38-39, 4:41-5:11, Claim 3).

Patent Owner applies the same counterarguments it directed to claim 1 to claim 6, i.e., that the Brochure does not disclose a lateral acceleration sensor (PO Resp. 43–46), the Brochure does not disclose detecting a change in vehicle lateral acceleration based on a change in the measured lateral acceleration (*id.* at 46–49), and Petitioner has failed to show that one of ordinary skill in the art would have sought to combine the Brochure and Schmitt to arrive at the invention recited in claim 6 (*id.* at 16–36).

Upon review of Petitioner's and Patent Owner's arguments and supporting evidence, we find that Petitioner has demonstrated sufficiently that the Brochure and Schmitt disclose every limitation of claim 6. And for the reasons discussed above with respect to claim 1, we find persuasive Petitioner's argument that one of ordinary skill in the art would have sought to implement Schmitt's method of reducing vehicle speed based on a determination that a vehicle is in a turn in the combined system of the Brochure and Schmitt. Thus, Petitioner has demonstrated by a preponderance of the evidence that claim 6 would have been obvious over the Brochure and Schmitt.[12]

2. Analysis: Claim 8

Claim 8 depends from claim 6 and further requires "a step of determining the vehicle's position within the turn." Ex. 1001, 8:57–58. In support of their arguments regarding claim 8, the parties reassert their previous arguments set forth for claim 4. Pet. 21–22, 35–36; PO Resp. 49–53. Thus, for the reasons discussed above with respect to claim 4 (Section II.D.5), we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 8 would have been obvious over the Brochure and Schmitt.

3. Analysis: Claim 9

Claim 9 depends from claim 8 and further requires that "said step of reducing the vehicle speed includes a step of reducing the vehicle speed if the vehicle lateral acceleration exceeds a predetermined limit." Ex. 1001, 8:59–61.

The parties asserts the same arguments for claim 9 that they assert for claim 5. Pet. 23, 36–37; PO Resp. 49–53. Thus, for the reasons discussed above with respect to claim 5 (Section II.D.6), we determine that Petitioner

[12] Petitioner does not provide an express reason to combine the Brochure and Schmitt in its discussion of claim 6. We understand this to be because Petitioner already explained in its discussion of claim 1 why one of ordinary skill in the art would have sought to combine the same identified functionality of Schmitt (reducing speed based on a determination that the vehicle is in a turn) with the Brochure, i.e., to avoid a loss of control in a turn. Tr. 24:26–25:5.

has not demonstrated by a preponderance of the evidence that claim 9 would have been obvious over the Brochure and Schmitt.

G. Claim 7 over the Brochure, Schmitt, and Ishizu

Petitioner contends the subject matter of claim 7 would have been obvious over the combined disclosures of the Brochure, Schmitt, and Ishizu. Pet. 37–39.

The parties asserts the same arguments for claim 7 as they assert for claim 2. *Id.*; PO Resp. 40–43, 58–60. Thus, for the reasons discussed above with respect to claim 2 (Section II.E.2), we determine that Petitioner has not demonstrated by a preponderance of the evidence that claim 7 would have been obvious over the Brochure, Schmitt, and Ishizu.

H. Claims 10–12 over the Brochure, Schmitt, and Khodabhai

Petitioner contends the subject matter of claims 10–12 would have been obvious over the combined disclosures of the Brochure, Schmitt, and Khodabhai. Pet. 39–47.

1. Khodabhai

Khodabhai discloses a "vehicle collision avoidance system which determines whether an obstacle lies in the path of a host vehicle." Ex. 1006, 1:9–13. In one embodiment of Khodabhai, the determination as to whether an obstacle is in the host vehicle's path of travel is based on output data from one or more collection devices. *Id.* at 2:41–44. These devices may include "a radar system, a rate of turn indicator, and other instruments mounted to the host vehicle, such as a speedometer or tachometer." *Id.* at 2:43–47.

Figure 2 of Khodabhai is reproduced below:

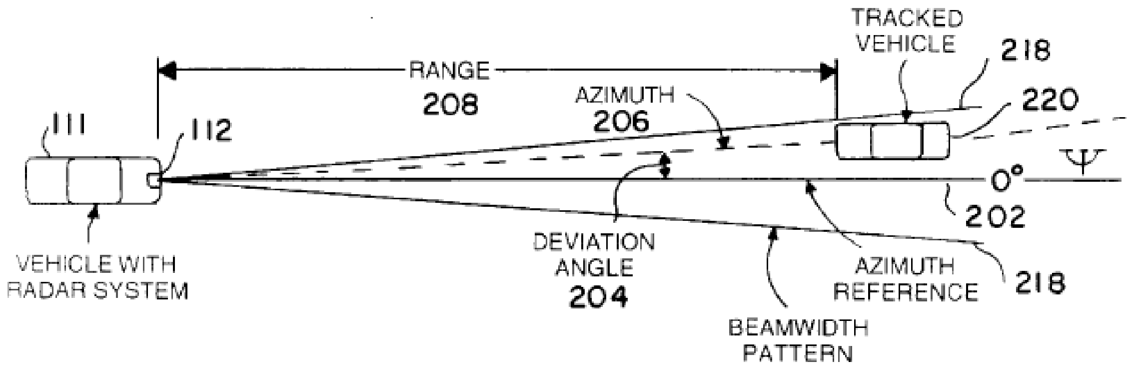

Figure 2 is a plan view illustrating the manner in which the radar system of Khodabhai determines off-boresight deviation and range of a target. *Id.* at 3:44–47. In Figure 2, host vehicle 111 uses radar beam 218 to track obstacles. *Id.* at 4:36–38. Radar beam 218 includes a zero-degree reference azimuth 202 extending along the center boresight and "provides a continuous indication of the azimuth of the vehicle 220 with respect to the reference azimuth 202, as well as indications as to the range 208 and the relative motion of the vehicle 220 with respect to the host vehicle 111." *Id.* at 4:34–45.

Khodabhai explains that in one embodiment,

> [i]nitially, the outputs from the collection devices are used to determine the host vehicle's velocity, average turn rate, the radius of curvature of the path being traveled, the relative velocity and range of any detected obstacles, and an obstacle azimuth angle, i.e., the deviation of an obstacle from a zero-degree (0º) reference azimuth co-incident with the longitudinal axis of the host, which is preferably the boresight of the radar systems. The obstacle azimuth angle is combined with the rate of turn information to determine whether or not the obstacle is in the path of the host vehicle.

Id. at 2:47–56.

2. Analysis: Claim 10

Claim 10 depends from claim 6 and further requires that the step of detecting includes the steps of measuring object range, measuring object range rate, measuring object angle, and determining the radius of curvature of the vehicle's path. Ex. 1001, 8:62–9:2; Pet. 40–46.

Petitioner contends Khodabhai discloses measuring an object range (Pet. 43–44 (citing Ex. 1006, 2:48–51; Ex. 1003 ¶ 98)), azimuth obstacle angle (*id.* at 45 (citing Ex. 1006, 4:48–53; Ex. 1003 ¶ 100)), and the radius of curvature of the vehicle's path (*id.* at 45–46 (citing Ex. 1006, Fig. 6)). Petitioner further contends that, because Khodabhai detects the range and relative velocity of any obstacle, it is "mere math to work out an *object range rate* at any given time." *Id.* at 44 (citing Ex. 1006, 2:48–51; Ex. 1003 ¶ 99). Accordingly, Petitioner concludes that Khodabhai teaches every limitation of claim 10.

Patent Owner asserts the Petition does not demonstrate that Khodabhai actually measures an object range rate or explain why a person of ordinary skill in the art would have sought to calculate and use object range rate in the Brochure or Khodabhai. PO Resp. 39, 60 (citing Pet. 44; Ex. 2003 ¶ 175).

In reply, Petitioner asserts that Patent Owner "fails to comprehend that no motivation is needed to obtain the object range rate" as "it is part of and already disclosed by 'the relative velocity' in *Khodabhai.*" Pet. Reply 21. Petitioner further asserts that one of ordinary skill in the art would have sought to use Khodabhai's method of "using the object's range, the object's range rate, the object angle in relation to the vehicle, and the radius of curvature of the vehicle's path" to determine the position and speed of the preceding vehicle or object. *Id.* at 10 (citing Pet. 43–44; Ex. 1003 ¶¶ 97–98).

Khodabhai determines a target vehicle's range and relative velocity. Ex. 1006, 2:50, 4:44–45. We are directed to no disclosure in Khodabhai, however, of measuring, calculating, or using *object range rate* in its calculations or algorithms. *See id.* at 2:43–56. Indeed, in both the Petition and the Reply, Petitioner concedes that object range rate must be calculated from the information obtained by Khodabhai's sensors. Pet. 44 ("If a person of skill knew the relative range and velocity of an object, it is mere math to work out an *object range rate* at any given time."); Pet. Reply 21–22; Ex. 1009 ¶ 101 (Dr. Eskandarian testifying in support of Petitioner's Reply that "only 'mere math' is needed" to obtain an object range rate in Khodabhai). Thus, Petitioner has not carried its burden to demonstrate by a preponderance of the evidence that Khodabhai teaches or suggests "measuring object range rate," as recited in claim 10.

Nor has Petitioner carried its burden to explain why one of ordinary skill in the art would have sought to measure or calculate object range rate in Khodabhai or the combined system of Kohdabhai and the Brochure, even if this quantity can easily be calculated from Khodabhai's existing data using "mere math." Sur-reply 9–10; Ex. 2003 ¶¶ 174–176. Instead, Petitioner merely assumes without explanation that Khodabhai uses "the object's range rate" in its method, a conclusion that is in direct conflict with Dr. Eskandarian's declaration testimony. *Compare* Pet. Reply 10 *with* Ex. 1009 ¶¶ 97–98 (Dr. Eskandarian testifying that object range rate must be derived from the relative velocity measured in Khodabhai); Sur-reply 9–10 (asserting that there is "no way to square" Petitioner's reply arguments with the Petition).

In view of the foregoing, we are not persuaded that Petitioner has demonstrated by a preponderance of the evidence that claim 10 would have been obvious over the Brochure, Schmitt, and Khodabhai. Claims 11 and 12 depend, directly or indirectly from claim 10, and Petitioner's arguments with respect to these claims do not resolve the deficiencies discussed above with respect to claim 10. Accordingly, Petitioner has not demonstrated by a preponderance of the evidence that claims 11 and 12[13] would have been obvious over the Brochure, Schmitt, and Khodabhai.

III. CONSTITUTIONAL CHALLENGES

Patent Owner asserts adjudication of the challenged patent violates the United States Constitution because (1) subjecting a pre-AIA patent to IPR proceedings is "an impermissibly retroactive, unconstitutional taking" that "unfairly interferes" with Patent Owner's "reasonable investment-backed expectations without just compensation"; and (2) "IPR violates the Appointments Clause." PO Resp. 62–63.

We decline to consider Patent Owner's arguments in view of the Federal Circuit's decisions in *Celgene Corp. v. Peter*, 931 F.3d 1342, 1358–63 (Fed. Cir. 2019) (addressing takings arguments) and *Arthrex v. Smith &*

[13] Although our resolution of the challenge to claim 10 also resolves the challenge to claims 11 and 12, we note that Petitioner's obviousness arguments with respect to claim 12 span only two sentences and merely direct our attention to Petitioner's arguments made with respect to claims 10 and 11. Pet. 47 (citing to "Section V.E.1" and "V.E.3"). This challenge to claim 12 is deficient under a preponderance of the evidence standard because (1) Petitioner does not explain in the Petition how its arguments with respect to claims 10 and 11 apply to claim 12 and (2) Petitioner's reply arguments come too late, as a prima facie case must be made out in the Petition, not for the first time in reply.

Nephew, 947 F.3d 1320, 1337–38 (Fed. Cir. 2019) (addressing an appointments clause challenge).

IV. CONCLUSION

After reviewing the arguments and evidence of record, we determine that Petitioner has shown by a preponderance of the evidence that claims 1, 4, 6, and 8 are unpatentable. Petitioner has not shown, however, that challenged claims 2, 3, 5, 7, and 9–12 are unpatentable.

In summary:

Claims	**35 U.S.C. §**	**Reference(s)/Basis**	**Claims Shown Unpatentable**	**Claims Not shown Unpatentable**
1, 4, 5	103	Brochure, Schmitt	1, 4	5
2, 3	103	Brochure, Schmitt, Ishizu		2, 3
6, 8, 9	103	Brochure, Schmitt	6, 8	9
7	103	Brochure, Schmitt, Ishizu		7
10–12	103	Brochure, Schmitt, Khodabhai		10–12
Outcome			1, 4, 6, 8	2, 3, 5, 7, 9–12

V. ORDER[14]

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 4, 6, and 8 of U.S. Patent No. 7,512,475 B2 are determined to be unpatentable;

[14] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent

FURTHER ORDERED that claims 2, 3, 5, 7, and 9–12 have not been shown to be unpatentable;

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.

Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

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