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Paper 31
Entered: March 7, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ALLSTATE INSURANCE COMPANY,
Petitioner,

v.

ATOS, LLC,
Patent Owner.

IPR2021-01449
Patent 9,846,174 B2

Before CHRISTOPHER L. CRUMBLEY, KRISTINA M. KALAN, and JULIA HEANEY, *Administrative Patent Judges*.

HEANEY, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Challenged Claims 1–4 Not Unpatentable
Determining Challenged Claim 5 Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Allstate Insurance Company ("Petitioner") filed a Petition for *inter partes* review of claims 1–5 of U.S. Patent No. 9,846,174 B2 (Ex. 1001, "the '174 patent"). Paper 1 ("Petition" or "Pet."). ATOS, LLC (d/b/a "RideMetric") ("Patent Owner") filed a Preliminary Response. Paper 5 ("Prelim. Resp."). We determined the information presented in the Petition established that there was a reasonable likelihood that Petitioner would prevail in challenging at least one of claims 1–5 of the '174 patent, and we instituted *inter partes* review as to all challenged claims. Paper 8 ("Dec. on Inst.").

During the course of trial, Patent Owner filed a Patent Owner Response (Paper 13, "PO Resp."); Petitioner filed a Reply to the Patent Owner Response (Paper 16, "Pet. Reply"); and Patent Owner filed a Sur-reply (Paper 20, "PO Sur-reply").

Petitioner filed the Declaration of William R. Michalson, Ph.D. (Ex. 1003) in support of the Petition. Patent Owner filed the Declaration of Ioannis Kanellakopoulos, Ph.D. (Ex. 2001) with its Response. The parties also filed transcripts of the depositions of Dr. Michalson (Ex. 2019) and Dr. Kanellakopoulos (Ex. 1020).

An oral hearing was held on December 8, 2022, and a transcript of the hearing is included in the record. Paper 29 ("Tr.").

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 1–5 of the '174 patent. For the reasons discussed below, we hold that Petitioner has demonstrated by a preponderance of the evidence that claim 5

is unpatentable, but that Petitioner has not demonstrated by a preponderance of the evidence that claims 1–4 are unpatentable.

A. Real Parties-in-Interest

Petitioner identifies Allstate Insurance Company, Esurance Insurance Services, Inc., and Arity, LLC as the real parties-in-interest. Pet. 3. Patent Owner identifies itself, ATOS, LLC, as the real party-in-interest. Paper 4.

B. Related Proceedings

The parties identify the following litigation involving the '174 patent: *ATOS, LLC v. Allstate Insurance Company*, No. 1:20-cv-06224 (N.D. Ill.). Pet. 3; Paper 4 § II. Patent Owner identifies two additional patents involved in this litigation: US Patent Nos. 8,527,140 ("the '140 patent") and 9,152,609 ("the '609 patent"). The '174 patent incorporates by reference the disclosure of the '140 patent. Ex. 1001, 1:18–28.

Patent Owner also identifies the following related IPR Petitions: IPR2021-01118 challenging the '140 patent; and IPR2021-01209 challenging the '609 patent. Paper 4 § II.

C. The '174 Patent

The '174 patent, titled "Computer-Implemented Methods and Computer Systems/Machines for Identifying Dependent and Vehicle Independent States," describes detecting and analyzing "states" relating to the environment outside a portable device, such as a smartphone or tablet. Ex. 1001, code (54), 1:8–12. The patent describes using sensors on the portable devices to detect motion and determine if it is "vehicle dependent movement (acceleration, deceleration, accidents and cornering operational states, etc) ... [or] vehicle independent movement of the phone (movement

caused by the user handling the phone, phone falling to the ground, etc)." *Id.* at 1:14–18. According to the patent, the methods of the invention can be used for a driver evaluation service, such as to score "driving riskiness, or fuel efficiency" and for detection "that a vehicle has started and stopped driving, automatically and transparently to the user." *Id.* at 4:20–43.

The '174 patent incorporates by reference the '140 patent's disclosures about vehicle dependent and independent states. *Id.* at 1:20–28. Figure 1 of the '140 patent is reproduced below.

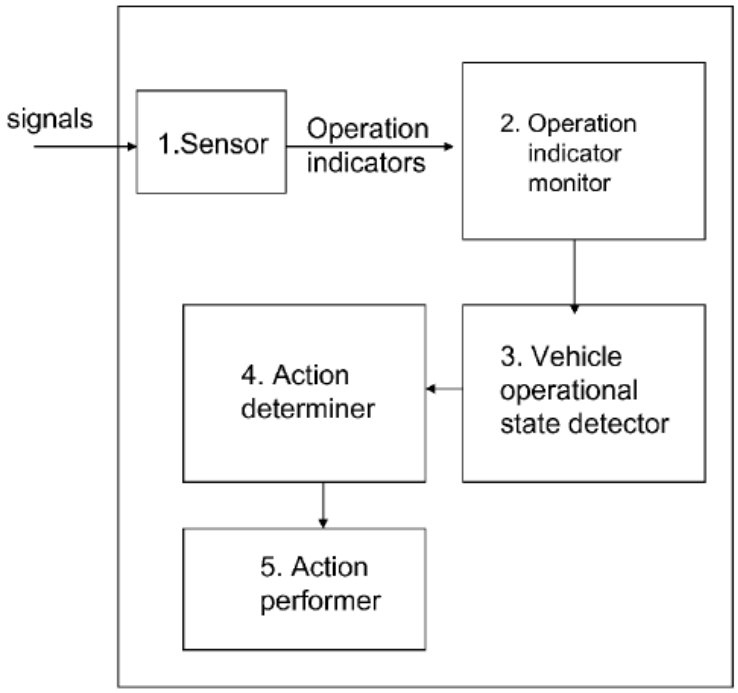


Figure 1 illustrates a portable device for taking action based on the state of the associated vehicle. Ex. 1014, 3:17–18. The top left corner of Figure 1 depicts a sensor receiving "signals" as an input and generating "[o]peration indicators" as an output. *Id.* at Fig. 1. The '140 patent describes basing a decision to perform an action on "determining the operational state of a vehicle surrounding the portable device," which in turn involves monitoring "an onboard sensor on the device." *Id.* at 3:49–51. According to the '140

patent, the sensor receives signals from the environment and converts them to "operation indicators." *Id.* at 3:50–52. The operation indicators from the sensor "are forwarded to the operation indicator monitor unit (unit 2) which continuously monitors and collects the operation indicators over time." *Id.* at 4:4–8. The monitor unit then forwards the operation indicators to an "operational state detector unit" that "uses pre-determined criteria which are a set of rules to help determine the operational state of the vehicle." *Id.* at 4:8–12.

The '174 patent describes that it has "identified a unique condition that is associated with turning in a vehicle . . . that at the time of the turn, the vector of rotation will be roughly parallel to the vector of gravity." Ex. 1001, 1:52–56. The patent describes using this condition to identify the probability of turning, but also to determine that, "[i]f the vectors of rotation and gravity are not roughly parallel, this is an indicator that the phone has been picked up, or fallen." *Id.* at 1:54–65. Figure 1 of the '174 patent is reproduced below.

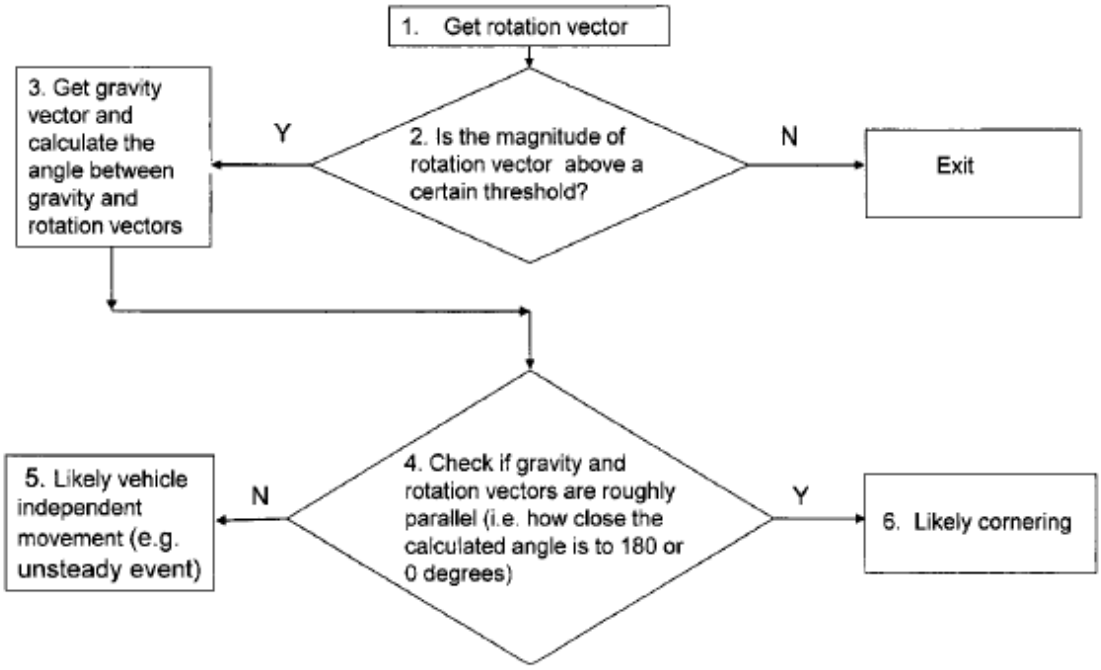


Figure 1 illustrates detection of vehicle cornering or independent movement. *Id.* at 1:66–67.

The '174 patent also describes detecting speed changes, and specifically "detecting whether a speed change vector is associated with acceleration or deceleration." *Id.* at 2:14–19. Figure 2 of the '174 patent is reproduced below.

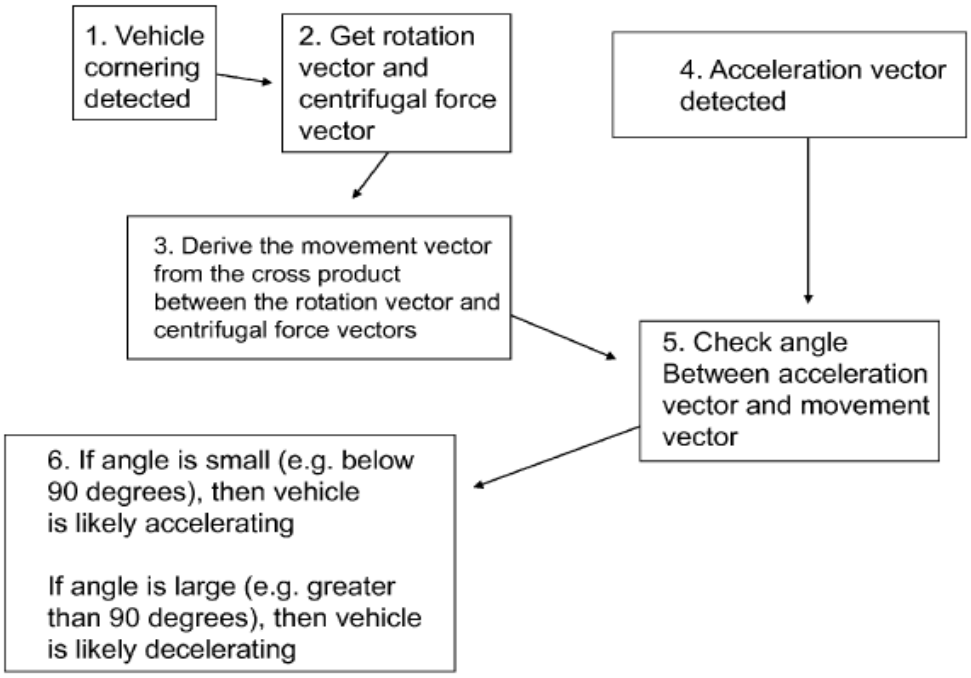


Figure 2: Detecting direction (accelerating or braking) of acceleration vector

Figure 2 illustrates detecting acceleration or braking of the acceleration vector. *Id.* at 4:1–2. In the initial steps of Figure 2, the rotation vector and centrifugal force vector of a turning vehicle are used to derive the movement vector, which is the cross product of those two vectors. *Id.* at 2:37–38. In step 5, the angle between the movement vector and acceleration vector is checked, and the result (step 6) determines if the vehicle is likely accelerating or decelerating. *Id*. at Fig. 2.

D. The Challenged Claims

Petitioner challenges claims 1–5 of the '174 patent. Pet. 1. Claim 2 depends from claim 1, and claim 4 depends from claim 3. Independent claims 1, 3, and 5, reproduced below, are illustrative of the subject matter of the challenged claims:

> 1. The method of detecting the condition of a vehicle turning, comprising estimating an angle of how closely a rotation vector is aligned with a gravity vector.
>
> 3. The method of detecting a direction of a speed change vector, comprising:
>
> a. detecting a condition of a vehicle turning;
>
> b. detecting a movement vector during the turn;
>
> c. estimating the angle between movement vector and speed change vector;
>
> d. determining that the speed change vector is acceleration vector if the estimated angle below certain threshold and determining that the speed change vector is deceleration vector if the estimated angle is above certain threshold.
>
> 5. The method of performing one or more actions on a portable device carried by an individual, comprising:
>
> a. monitoring at least one operation indicator transparently to the individual, wherein the at least one operation indicator is created by an on-board component of the device when the portable device is located inside a vehicle;
>
> b. detecting when the at least one operation indicator meets one or more predetermined criteria;
>
> c. determining entirely or in part the following states based on the one or more predetermined criteria:
>
> i. one or more vehicle independent states;
>
> ii. one or more vehicle dependent states.

Ex. 1001, 4:58–60; 4:64–5:7; 5:12–24.

E. Instituted Grounds of Unpatentability

We instituted *inter partes* review on the following grounds of unpatentability, which are all the grounds presented in the Petition. Pet. 4:

Ground	Challenged Claim(s)	35 U.S.C.[1]	Reference(s)/Basis
1	1–4	§ 103	Kleppner[2]
2	1, 2	§ 103	Johnson[3], Kleppner
3	3, 4	§ 103	Abramson[4], Kleppner
4	5	§ 102	Schwartz 2010[5]
5	5	§ 102	Kim[6]

[1] The Leahy-Smith America Invents Act ("AIA") included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. Because the '174 patent issued from an application filed after March 16, 2013, we apply the AIA versions of the statutory bases for unpatentability.

[2] Daniel Kleppner, et al., AN INTRODUCTION TO MECHANICS, McGraw Hill Book Company, 1973 (Ex. 1007).

[3] Derick A. Johnson, et al., "Driving Style Recognition Using a Smartphone as a Sensor Platform," 2011 14th International IEEE Conference on Intelligent Transportation Systems Washington, DC, USA. October 5–7, 2011 (Ex. 1010).

[4] US Patent No. 8,750,853 B2 to Abramson, et al., issued June 10, 2014 (Ex. 1009).

[5] US Patent Pub. No. 2010/0204877 A1 by Schwartz, published Aug. 12, 2010 (Ex. 1008).

[6] Korean Registered Patent Number 10-0775006 to Kim, S., et. al., issued Nov. 8, 2007 (Ex. 1005).

II. ANALYSIS

A. Level of Ordinary Skill in the Art

Factors pertinent to a determination of the level of ordinary skill in the art include: "(1) 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 workers active in the field." *Envtl. Designs, Ltd. v. Union Oil Co*., 713 F.2d 693, 696–697 (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.*

Petitioner argues a person of ordinary skill in the art at the time of the invention "would have been someone with a bachelor's or master's degree in the field of mechanical engineering, electrical engineering, or physics or with a bachelor's or master's degree in a related field and at least three years of experience in designing or developing portable device systems." Pet. 4 (citing Ex. 1003 ¶ 52). Petitioner further argues the "Skilled Artisan would have been aware of the types of portable devices discussed below and would have known how to utilize the portable devices and their accelerometers to detect motion while inside a vehicle," and "would have known how to model the forces on moving objects in line with Newtonian Mechanics." *Id.*

Patent Owner does not address Petitioner's proposal, or offer a competing proposal. *See generally* PO Resp.

Having considered the parties' arguments and evidence, we adopt the level of ordinary skill in the art proposed by Petitioner, because it is consistent with the disclosures of the '174 patent and the prior art of record.

We note, however, that neither party contends that any issue in this case turns on the differences between the parties' definitions of one of ordinary skill in the art.

B. Claim Construction

We apply the same claim construction standard that would be used to construe the claims in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). Under that standard, claim terms "are generally given their ordinary and customary meaning" as understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

Petitioner argued constructions of the terms "operation indicator" and "on-board component" in the Petition. Pet. 11–15. In our Decision on Institution, we determined that we did not need to explicitly construe any claim term at that stage of the proceeding. Dec. on Inst. 9; *see Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) ("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))). During trial, the parties argued the construction of several claim terms, including "rotation vector," "movement vector," "vehicle independent state," "operation indicator," and "transparently." *See* PO Resp. 7–19; Pet. Reply

1–6.[7] Additionally, Patent Owner argued that the term "on-board component" does not need to be construed. PO Resp. 17. We agree with Patent Owner and determine that we need not construe "on-board component." In the tables below, we set forth Petitioner's and Patent Owner's positions as to the terms "rotation vector," "movement vector," "operation indicator," "transparently," and "vehicle independent state," and in the right-hand column, our construction after considering the entire record. Apart from the five claims terms discussed below, we determine that no other terms require express construction. *See Vivid Techs.*, 200 F.3d at 803.

1. "rotation vector"

Petitioner	Patent Owner	PTAB
a vector that describes the motion of a body that is rotating around a point (i.e. ordinary meaning)	a vector with magnitude proportional to the angle traversed by a rotating body around a center point and with direction orthogonal to the plane of rotation	a vector that describes the motion of a body that is rotating around a point

Claim 1 recites "estimating an angle of how closely a rotation vector is aligned with a gravity vector." Patent Owner argues a rotation vector is a well-known concept used to represent the rotation of an object around an

[7] Throughout their papers, the parties have underlined reference names, italicized claim language, and bolded portions of text. *See, e.g.,* PO Resp. 2, 8; Pet. Reply 10. For consistency and readability, we remove all such emphasis in our quotation of the parties' papers.

axis, and that we should construe "rotation vector" based on its technical definition. PO Resp. 8 (citing Ex. 2001 ¶¶ 46, 48). Dr. Kanellakopoulos testifies "rotation vector" would be understood by a person of ordinary skill in the art to describe the motion of a body that is rotating around a point, and having magnitude proportional to the angle traversed by a rotating body around a center point and direction orthogonal to the plane of rotation. Ex. 2001 ¶ 46. Dr. Kanellakopoulos explains that this definition is consistent with the prevailing definition in the literature. Ex. 2001 ¶ 48 (citing Exs. 2003, 2007–2009).

Patent Owner argues its construction of rotation vector is consistent with the use of the term in the '174 patent. PO Resp. 9 (citing Ex. 1001, 1:59–60; Ex. 2001 ¶¶ 47, 68–74). According to Patent Owner, the '174 patent specification explains a vehicle's rotation vector is derived from gyroscope samples. *Id.* (citing Ex. 1001, 1:59–60). Patent Owner further argues a rotation vector is fundamentally different from an angular momentum vector, which is not inherent to an object and cannot be measured by gyroscope samples. *Id.* (citing Ex. 2001 ¶¶ 69, 70, 72). Patent Owner argues a person of ordinary skill in the art would know that a rotation vector can be used to detect whether a vehicle is turning because its magnitude and direction depend on whether a rotation is occurring, but an angular momentum vector exists even when a vehicle is travelling in a straight line, and cannot be used to detect if a vehicle is turning. *Id.* (citing Ex. 2001 ¶¶ 46, 69, 73).

Petitioner agrees with Dr. Kanellakopoulos that "rotation vector" would be understood by a person of ordinary skill in the art to describe the motion of a body that is rotating around a point. Pet. Reply 2 (citing

Ex. 2001 ¶ 46). Petitioner argues, however, that Patent Owner's proposed construction of "rotation vector" "either incorporate[s] unrecited claim elements or confirm[s] that a plain and ordinary meaning is appropriate." *Id.* Petitioner further argues that Dr. Kanellakopoulos's opinion regarding the characteristics of a rotation vector includes attributes identical to an angular momentum vector, except for magnitude, which is irrelevant to the challenged claims. *Id.* at 2–3.

Having reviewed the parties' arguments and evidence, we determine that Petitioner's proposed construction of "rotation vector" is consistent with the '174 patent's usage of the term "rotation vector" (or "vector of rotation"). *See* Ex. 1001, 1:54–2:11. Dr. Kanellakopoulos's opinion supports that "rotation vector" would be understood by a person of ordinary skill in the art to describe the motion of a body that is rotating around a point. As to the other aspects of Patent Owner's proposed construction, describing the characteristics of magnitude and direction, we determine that those attributes are not necessary to interpreting how a skilled artisan would understand "rotation vector" in light of the claim language and specification. *See* Tr. 47:26–48:7 (in Patent Owner's proposed construction of "rotation vector," "the magnitude requirement is not particularly important"). We address the parties' arguments as to differences between a rotation vector and angular momentum vector in Section II.D.2 below, because they underlie Petitioner's challenges involving Kleppner.

2. "movement vector"

Petitioner	Patent Owner	PTAB
a vector indicating the direction of movement of an object	a vector derived from the cross product of the centrifugal force vector and the rotation vector while a vehicle is turning	a vector derived from the cross product of the centrifugal force vector and the rotation vector

Claims 3 and 4 recite a movement vector. Neither party argues the term has an ordinary meaning to persons of ordinary skill in the art. *See* PO Resp. 10 ("movement vector is not a technical term of art", citing Ex. 2001 ¶ 53).

Patent Owner argues we should construe "movement vector" according to the following statement in the specification: "[t]he movement vector can be derived from the cross product between the centrifugal force and rotation vector, while the vehicle is turning." PO Resp. 10 (citing Ex. 1001, 2:29–31). Patent Owner argues patentee acted as its own lexicographer in providing this definition in the specification. *Id.* Patent Owner further argues the purpose of the movement vector in the context of the '174 patent is to determine the direction of motion of a vehicle using the accelerometers and gyroscopes on a portable device located within the vehicle. *Id.* at 11 (citing Ex. 2001 ¶ 53).

Petitioner argues we should construe "movement vector" as "a vector indicating the direction of movement of an object." Pet. Reply 5 (citing Ex. 1003 ¶ 202). Petitioner argues Patent Owner's proposed construction imports a limitation from the specification into the claims, and the words

"while a vehicle is turning" in the construction are superfluous, because the claim language itself recites "during the turn." *Id.* at 5.

Having considered the parties' positions as to construction of the term "movement vector" and applicability of the definition of "movement vector" set forth in the '174 patent specification (Ex. 1001, 2:29–31), we construe the term "movement vector" to mean "a vector derived from the cross product of the centrifugal force vector and the rotation vector." We adopt the definition set forth in the '174 specification because we determine patentee acted as its own lexicographer. *Cont'l Cirs. LLC v. Intel Corp.*, 915 F.3d 788, 796 (Fed. Cir. 2019) (citing *Phillips*, 415 F.3d at 1316) ("When the patentee acts as its own lexicographer, that definition governs."). We agree with Petitioner that the words "while a vehicle is turning" would be superfluous in the construction, because the step of "detecting a movement vector during the turn" already recites that the vehicle is turning. *Apple, Inc. v. Ameranth*, 842 F.3d 1229, 1237 (Fed. Cir. 2016) ("Construing a claim term to include features of that term already recited in the claims would make those expressly recited features redundant.")

3. "operation indicator"

Petitioner	Patent Owner	PTAB
a sensor measurement determined from signals from the environment	information derived by converting sensing device output determined from signals from the environment	a sensor measurement determined from signals from the environment

Claim 5 recites the step of "monitoring at least one operation indicator transparently to the individual." Petitioner argues we should construe

"operation indicator" to mean "a sensor measurement determined from signals from the environment." Pet. 11. Petitioner argues that although the '174 patent does not expressly define "operation indicator," it provides a description by incorporating by reference the '140 patent, which "provides context for that term" in describing vibration sensors that measure forces over time and "convert them into number of vibrations measured per second (operation indicators)." *Id.* at 12 (citing Ex. 1014, 3:52–55). Petitioner further relies on the following descriptions of an embodiment in the '140 patent: "an onboard sensor receives signals from the environment and converts them into operation indicators. Examples of signals from the environment include vibrations, acceleration, change in forces, noise, etc." and "we require that a sensor that converts sensory signals to operation indicators be part of the portable device." *Id.* (citing Ex. 1014, 3:58–61, 4:1–3).

Patent Owner argues we should construe "operation indicator" to mean "information derived by converting sensing device output determined from signals from the environment." PO Resp. 12. Patent Owner argues Petitioner's construction improperly "would equate the measurements taken by a sensing device with 'operation indicators,'" while under Patent Owner's construction, "sensing device measurements are not, standing alone, 'operation indicators.'" *Id.* According to Patent Owner, "the output from the sensing device must be converted into operation indicators." *Id*. Patent Owner argues the '140 patent specification (which the '174 patent incorporates by reference) supports its construction because it emphasizes that operation indicators result from a conversion. *Id*. at 13 (citing Ex. 1014, 3:49–52, 3:58–59, 4:1–3). Specifically, Patent Owner argues "signals from

the environment" as described in the '140 patent specification are signals measured by a sensing device, because a sensing device is necessary to determine what the signals from the environment are. *Id.* at 13–14 (citing Ex. 1014, 3:38–41). Patent Owner also relies on the '140 patent specification's description of a vibration sensor that measures forces over time, which are converted into an operation indicator, as supporting its argument that an operation indicator is derived from the output of a sensing device. *Id.* at 14 (citing Ex. 1014, Figs. 2–4; Ex. 2001 ¶¶ 21, 36 (explaining that an accelerometer is a sensing device that outputs units of m/s^2 which are further processed to create an operation indicator of vibrations per second)).

Petitioner responds that Patent Owner's construction improperly adds "an additional converting sensing device output" step into the claims. Pet. Reply 6. Petitioner argues claim 5 never mentions converting the output of a sensor, and the portion of the '140 patent specification Patent Owner relies upon does not support any additional conversion step as Patent Owner contends, because it merely describes sensors that "take in environmental signals" and output "'operation indicators,' without any additional process acting on the sensor's output." *Id.* (citing Ex. 1001; Ex. 1014, Fig. 1). Petitioner further argues Dr. Kanellakopoulos's testimony contradicts the intrinsic record by referring to a conversion step that the '140 patent specification never describes. *Id.*

Based on our review of the parties' arguments and evidence, we determine that the claim language and specification support Petitioner's proposed construction of "operation indicator." Claim 5 recites an "operation indicator is created by an on-board component" and the related portion of the '140 patent specification describes an on-board sensor that

converts signals from the environment into operation indicators. Ex. 1014, 3:49–52. As an "example," the specification describes a "vibration sensor" used to "measure forces over time (i.e. the signals) and convert them into the number of vibrations measured per second (operation indicators)." *Id.* at 3:52–55. The specification also states that "[a]n example of a vibrational sensing device is an accelerometer." *Id.* at 3:56–57. Thus, the '140 patent specification states that an accelerometer may be used to convert signals from the environment and output operation indicators in the form of vibrations measured per second, undermining Patent Owner's argument that accelerometers alone cannot produce operation parameters. *See* PO Resp. 14–15; PO Sur-reply 7–8.

Patent Owner's argument that an operation indicator requires a conversion step is not persuasive. The claim language does not require an accelerometer or vibration sensor; claim 5 recites that an on-board component creates an operation indicator. In the "monitoring …" step of claim 5 (Ex. 1001, 5:14–18), nothing in the claim language suggests anything more than monitoring an operation indicator created by an on-board component, such as converting the on-board component's output. The example in the '140 patent specification describing a multi-component sensor converting the output of an accelerometer does not limit the claim term "operation indicator" to require a conversion step. *See* Ex. 1014, 3:49–57. Converted output from the multi-component sensor described in the '140 patent specification would still be an "operation indicator" under our construction of the term, which is consistent with the specification. *See* Pet. Reply 8. Patent Owner's reliance on expert testimony is not persuasive because it lacks support in the intrinsic evidence. *See* PO Resp. 14–15

(citing Ex. 2001 ¶¶ 21, 36; Ex. 2018 ¶ 46); PO Sur-reply 8. *See Phillips*, 415 F.3d at 1317 (extrinsic evidence that contradicts the intrinsic record carries little weight).

Accordingly, we construe "operation indicator" to mean a sensor measurement determined from signals from the environment.

4. "transparently"

Petitioner	Patent Owner	PTAB
no construction necessary	without requiring user interaction	no construction necessary

The term "transparently" also appears in the monitoring step of claim 5. Petitioner argues construction of "transparently" is unnecessary to resolve its challenges to claim 5, and so it need not be construed. Pet. Reply 9 (citing *Vivid Techs,* 200 F.3d at 803).

Patent Owner argues we should construe "transparently" to mean "without requiring user interaction." PO Resp. 19. Patent Owner argues a method that acts automatically fails to meet this construction if it "requires the user to perform an explicit action to effect the process." *Id.* (citing Ex. 2001 ¶ 126). Patent Owner argues the "notion of transparency in computing is well understood" (*id.*) and

> a transparent process is one in which the user is not required to be aware of the circumstances required for the process to be performed and one in which no interaction between the user and the device is required to effect the process.

Id. at 20. Patent Owner also argues the '140 patent's specification supports this construction because it describes certain actions as being undertaken "automatically and transparently to the user," which implies that

"transparently" means something different from "automatically." *Id.* at 20 (citing Ex. 1014, 6:66–7:7). Patent Owner also argues that an example provided in the Specification, in which the device detects the speed of the vehicle and adjusts the volume of music based on that speed, supports its construction, because the user does not need to interact with the device to change the volume. *See id.* at 20–21 (citing Ex. 1014, 7:1–7).

Petitioner responds that Patent Owner's proposed construction of "transparently" does not distinguish between the monitoring step of claim 5 and the asserted prior art, Kim, and therefore construction of the term is unnecessary. Pet. Reply 9. Petitioner further argues that Patent Owner improperly relies on a portion of the '140 patent specification that does not relate to the monitoring step of claim 5, but rather to "performing" an action, which is not a step of claim 5. *Id.* at 9–10.

We agree with Petitioner that we need not construe "transparently," because even under Patent Owner's construction, Kim would disclose the limitation. We discuss this in detail in Section II.G.2, below. Accordingly, we determine that we need not expressly construe the term "transparently."

5. "vehicle independent state"

Petitioner	Patent Owner	PTAB
a state triggered when the portable device is moved independently of the movement of the vehicle	a state that is the result of movement of a portable device within the vehicle, independent of or unrelated to the movement of the vehicle	a state triggered when the portable device is moved independently of the movement of the vehicle

The term "vehicle independent state" appears in claim 5. Patent Owner argues it should be construed as "a state that is the result of movement of a portable device within the vehicle, independent of or unrelated to the movement of the vehicle." PO Resp. 11. Patent Owner relies on statements in the Background of the '174 patent specification that describe the methods of the invention as pertaining to

> detecting various kinds of vehicle dependent movement (acceleration, deceleration, accidents and cornering operational states) as well as vehicle independent movement of the phone (movement caused by the user handling the phone, phone falling to the ground, etc).

Id. (citing Ex. 1001, 1:12–18). *See also id.* (citing Ex. 1001, 1:24–26 ("vehicle independent states, triggered when the portable device is moved independently of movement of the vehicle")).

Petitioner agrees that the statements in the specification relied upon by Patent Owner make clear that vehicle independent states result from movement of the portable device independently of movement of the vehicle. Pet. Reply 5. Petitioner argues, however, that "[n]owhere does the specification demand this occur within a vehicle." *Id.* at 6. Petitioner further argues "Patent Owner has not pointed to a meaningful difference between the '174 patent and prior art based on [its construction of "vehicle independent state"] so it need not be construed." *Id.* at 5 (citing *Vivid Techs*., 200 F.3d at 803).

Patent Owner responds "a main premise of the '174 patent is to distinguish between different types of movement that occur while a portable device is inside a vehicle" and argues the purpose of the invention—to "eliminate or significantly reduce the chances of erroneous driving events

being registered"—only applies if the vehicle independent events occur while the device is in the vehicle. PO Sur-reply 6–7 (citing Ex. 1001, 1:38–45). Patent Owner also relies on the specification's statement that the method of the '174 patent distinguishes between "vehicle dependent states such as cornering, accelerating and braking, *while also recognizing vehicle independent event* (movement caused by the user handling the phone, phone falling to the ground, etc.)" (*id.* (emphasis in original) (citing Ex. 1001, 1:38–43)), and argues if the device is detecting vehicle dependent states *while also* detecting vehicle independent events, then the vehicle independent events must also occur while the device is in the vehicle. *Id.* at 7.

We decline to adopt Patent Owner's construction because it improperly reads into claim 5 a requirement that the specification and claim language do not support. The specification passages relied on by Patent Owner do not expressly state that a vehicle independent state must be determined while the device is inside a vehicle, and contrary to Patent Owner's argument, they also do not necessarily imply that. For example, the descriptions of "vehicle independent movement" and "vehicle independent event" in the specification (*see* Ex. 1001, 1:16, 42) refer to "phone falling to the ground." "Falling to the ground" implies that the phone may be outside a vehicle, not inside. Further, the specification's reference to detecting a vehicle dependent state "while also" recognizing a vehicle independent event does not necessarily imply that the vehicle dependent state and vehicle independent event are being detected simultaneously, as Patent Owner argues.

In the language of claim 5, a "vehicle independent state" is recited in the determining step (step c), and the requirement that the portable device is located "inside a vehicle" relates to creation of an operation indicator, as part of the detecting step (step b). Patent Owner does not dispute this, and agrees that a portable device "not in the vehicle" can satisfy the determining step (step c). Tr. 73:5–8. Patent Owner, however, argues step c's recitation that a "vehicle independent state" is based on step b's "predetermined criteria" creates a link between "vehicle independent state" and step b, and thus an "express requirement" in step c that the device is located inside the vehicle. *See* Tr. 73:8–26, 76:1–3. We decline to read this requirement into the claim language. Although the claim language states that determining a "vehicle independent state" is based on "predetermined criteria," and step b describes comparing "predetermined criteria" to an "operation indicator" that is created when the device is inside a vehicle, it does not limit the step of determining a vehicle independent state to a time when the portable device is inside a vehicle.

Accordingly, we construe "vehicle independent state" to mean a state triggered when the portable device is moved independently of the movement of the vehicle.

C. Principles of Law

"Anticipation requires that every limitation of the claim in issue be disclosed, either expressly or under principles of inherency, in a single prior art reference," *Corning Glass Works v. Sumitomo Elec. U.S.A., Inc.*, 868 F.2d 1251, 1255–56 (Fed. Cir. 1989), and that the claim limitations be "arranged or combined in the same way as recited in the claim[]," *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1371 (Fed. Cir. 2008).

However, "the reference need not satisfy an *ipsissimis verbis* test." *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009).

A claim is unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when available, evidence such as commercial success, long felt but unsolved needs, and failure of others. *Graham v. John Deere Co*., 383 U.S. 1, 17–18 (1966); *see KSR*, 550 U.S. at 407 ("While the sequence of these questions might be reordered in any particular case, the [Graham] factors continue to define the inquiry that controls.").

The Supreme Court made clear that we apply "an expansive and flexible approach" to the question of obviousness. *KSR*, 550 U.S. at 415. Whether a patent claiming the combination of prior art elements would have been obvious is determined by whether the improvement is more than the predictable use of prior art elements according to their established functions. *Id*. at 417. Reaching this conclusion, however, requires more than merely showing that the prior art includes separate references covering each separate limitation in a challenged claim. *Unigene Labs., Inc. v. Apotex, Inc*., 655 F.3d 1352, 1360 (Fed. Cir. 2011). Rather, obviousness additionally requires that a person of ordinary skill at the time of the

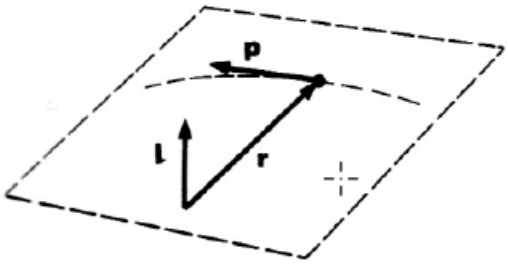
invention "would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention." *Id*.

D. Alleged Obviousness Based on Kleppner

Petitioner contends claims 1–4 are unpatentable as having been obvious over Kleppner. Pet. 27–48.

1. Kleppner (Ex. 1007)

Kleppner is a textbook titled "An Introduction to Mechanics." Ex. 1007. The text begins with an introduction to mathematical concepts to apply to physical problems, such as vector products, and the use of vectors to describe velocity and acceleration. *Id.* at xix, 6–14. Kleppner describes using the "right hand rule for vector multiplication," such that if two trajectory vectors are in the xy plane, their vector product is in the positive z direction if the "sense of rotation" of the point about the origin is counterclockwise, and in the negative z direction if the rotation is clockwise. *Id.* at 234. This is illustrated in the figure reproduced below.



Id. at 234. The figure reproduced above shows vectors r and p in a plane, with the vector L at a right angle to the motion of the particle at the intersection of the r and p vectors. *Id.*

2. Analysis

a) Claim 1

Petitioner contends it would have been obvious to perform the method of claim 1 based on Kleppner and the knowledge of a skilled artisan. Petitioner argues Kleppner discloses a gravity vector by representing a gravitational force on an object as "gravitational force *W*" with a vector pointing straight down, in addition to multiple examples applying the principles of mechanics. Pet. 28 (citing Ex. 1007, 49, 61, 72–73, 84, 107, 335; Ex. 1003 ¶ 154). Petitioner argues Kleppner discloses a rotation vector as "the vector used to describe the angular momentum of an object in circular motion" which is "the cross product between its momentum and position vectors." *Id.* at 29 (citing Ex. 1007, 6, 233). Petitioner relies on Kleppner's illustration of angular momentum vector L as having a direction perpendicular to the plane of an object's motion. *Id.* (citing Ex. 1007, 233–234; Ex. 1003 ¶ 155). Petitioner argues Kleppner discloses that the direction of vector L, i.e., positive or negative, depends on whether the object is turning clockwise or counterclockwise, which corresponds to "the condition of a vehicle turning" as recited in claim 1. *Id.* at 30 (citing Ex. 1007, 234; Ex. 1003 ¶ 156). Petitioner argues Kleppner thus, discloses a relationship between the gravity vector and rotation vector of an object, including how closely they are aligned, i.e., "when an object's rotation vector points upwards or downwards, it is aligned with the gravity vector (which for the purposes of a car or object traveling in a plane will point downwards), and the object is turning." *Id.* at 31 (citing Ex. 1007, 234; Ex. 1003 ¶¶ 157–158).

Petitioner further argues Kleppner discloses "estimating an angle" as recited in claim 1, because it discloses how to calculate the angle between

two vectors, and includes a section detailing "Mathematical Approximating Methods" "using simple approximate expressions instead of exact but complicated formulas." Pet. 31–32 (citing Ex. 1007, 6, 9, 39–47, 49; Ex. 1003 ¶ 159). Petitioner further argues to the extent Kleppner does not expressly disclose "estimating an angle," a person of ordinary skill in the art would have known how to estimate the angle between two vectors, with a reasonable expectation of success. *Id.* at 32–33 (citing Ex. 1003 ¶¶ 159–160).

Patent Owner argues Kleppner's angular momentum vector L is not a "rotation vector" under Patent Owner's proposed construction (PO Resp. 26–27), or even under the construction we have adopted. PO Sur-reply 12. Specifically, Patent Owner argues Kleppner's angular momentum vector describes an object's total angular momentum with respect to an origin point, and is the cross product of an object's linear momentum and its position vector from the chosen origin point. PO Resp. 27 (citing Ex. 1007, 233–234; Ex. 2001 ¶ 51). Patent Owner argues angular momentum is not inherent to an object, but is entirely dependent on the origin point chosen; it is fundamentally different from a "rotation vector" because it cannot be derived from a gyroscope. *Id.* at 27–28 (citing Ex. 2001 ¶¶ 69–72).

Patent Owner and Dr. Kanellakopoulos explain that Kleppner's angular momentum vector would not work in claim 1 because it does not have the characteristics of a rotation vector that can be used to determine whether a vehicle is turning: (1) an object has an angular momentum relative to an origin point even if the object is traveling in a straight line; (2) an object's angular momentum vector is entirely dependent on the choice of an arbitrary origin point, and therefore the alignment of an angular

momentum vector with an object's gravity vector gives no indication of whether a vehicle is turning, unlike a rotation vector that is aligned with a gravity vector only when the vehicle is turning on the plane of a road; (3) because angular momentum is entirely dependent on the choice of an origin point, if a person of ordinary skill in the art calculated angular momentum for a vehicle turning on an incline by choosing the origin point at the center of the vehicle's turning radius on the plane of the road, the method of claim 1 would not detect that a turn occurred. PO Resp. 28–31 (citing Ex. 1001, 1:54–65; Ex. 1007, 233–234; Ex. 2001 ¶¶ 69, 72–74).

Petitioner responds that even if Kleppner does not expressly disclose a rotation vector, it is undisputed that "rotation vector" is a term of art, and therefore a person of ordinary skill in the art would have read Kleppner with knowledge of a rotation vector, thus rendering claim 1 obvious. Pet. Reply 11 (citing Ex. 2001 ¶ 46). Petitioner argues claim 1 does not include the requirements on which Patent Owner's arguments are based, such as turning on an incline or discerning different sources of movement, and does not guarantee accuracy in all road conditions. *Id.* at 11–12. Petitioner argues it is irrelevant if Kleppner requires a person of ordinary skill to define an origin point before detecting a turn, because claim 1 is a "comprising" claim with a single-step method, and it does not matter if Kleppner's method requires an extra step of defining an origin point. *Id.* at 12. Petitioner further argues it is irrelevant that a rotation vector is only aligned with a gravity vector when rotational motion is occurring on the plane of the road, because claim 1's single-step method does not require "conclusively establish[ing] turning." *Id.* at 13–14.

In reply, Patent Owner argues Kleppner does not disclose a "rotation vector," even under Petitioner's proposed construction "a vector that describes the motion of a body that is rotating around a point." PO Sur-reply 12. Patent Owner reiterates Dr. Kanellakopoulos's explanation that an angular momentum vector "actually describes an aspect of an object's linear motion" *Id.* (citing Ex. 2001 ¶ 69). Patent Owner further argues Kleppner itself indicates the "sense of rotation" in the figure on Kleppner 234 "would be experienced even if the object is traveling in a straight line." *Id.*

After considering the full record, we find Petitioner has not established by a preponderance of the evidence that the method of claim 1 would have been obvious to a person of ordinary skill in the art, based on Kleppner's teaching. We agree with Patent Owner that Kleppner's angular momentum vector is not a "rotation vector" under our construction of that term, i.e., a vector that describes the motion of a body that is rotating around a point. Dr. Kanellakopoulos credibly explains the differences between Kleppner's angular momentum vector and a rotation vector. For example, Kleppner's angular momentum vector is defined with respect to its point of origin and does not describe an angle, but rather has units of $kg \cdot m^2/sec$ (Ex. 2001 ¶ 51 (citing Ex. 1007, 233)). Dr. Kanellakopoulos also explains angular momentum of a body rotating around a point is the same as angular momentum of the same body moving in a straight line with the same linear speed and at the same perpendicular distance to the same point, and therefore, angular momentum cannot be used to differentiate between an object turning and an object moving in a straight line. *Id.* ¶ 69. Dr. Kanellakopoulos's explanation that angular momentum is not inherent to an object, and its computation requires an arbitrary choice of a point of

origin that has no physical meaning in the context of vehicle motion, also supports Patent Owner's position. *Id.* ¶ 71 (citing Ex. 2004, 262). Accordingly, Patent Owner's argument, that angular momentum cannot be used to detect a vehicle turning, is persuasive. *Id.* We also find persuasive, as Dr. Kanellakopoulos explains, that Petitioner's argument regarding the figure on Kleppner 234 is based on misinterpretation of the vectors in that figure. *Id.* ¶ 67 (explaining that Kleppner 233–234 does not depict a gravity vector).

Petitioner does not argue that any of Dr. Kanellakopoulos's statements are incorrect (*see generally* Pet. Reply), but rather argues they are irrelevant. *See* Pet. Reply 12–13. For example, Petitioner argues claim 1 only requires estimating an angle between vectors, but not a vehicle turning. *See id.* at 13. We do not find Petitioner's argument persuasive because it is inconsistent with the Petition, which relies on Kleppner as teaching that principles of mechanics applying to an object also apply to a vehicle turning. *See* Pet. 28, 31 (citing Ex. 1003 ¶ 157). Therefore, we determine Petitioner has not shown that Kleppner (in the portions Petitioner relies upon) discloses a rotation vector.

We also do not find persuasive Petitioner's argument that even if Kleppner does not disclose a rotation vector, a person of ordinary skill would have used the knowledge of a rotation vector (because it is a term of art) alongside Kleppner's teaching, to arrive at claim 1. *See* Pet. Reply 11. This argument does not satisfy Petitioner's burden to provide articulated reasoning with some rational underpinning to support the conclusion of obviousness. *See KSR,* 550 U.S. at 418 (citing *In re Kahn,* 441 F.3d 977, 988 (Fed. Cir. 2006)). Petitioner does not explain which teaching of

Kleppner a person of ordinary skill would have selected and combined with their knowledge of a rotation vector to yield the method of claim 1, or explain why a person of ordinary skill would have recognized based on Kleppner that estimating the angle between a rotation vector and gravity vector could be used to detect a vehicle turning. Nor does Petitioner respond to Patent Owner's assertion that Kleppner provides no rationale for estimating an angle of alignment between a rotation vector and gravity vector as a way of detecting a vehicle turning. *See* Ex. 2001 ¶ 65.

We also do not find Petitioner's argument persuasive because it is inconsistent with the Petition, which in fact relied on Kleppner's angular momentum vector as disclosing the rotation vector of claim 1. Pet. 29–31. The only obviousness analysis of Kleppner in the Petition was based on applying Kleppner's angular momentum vector to the "rotation vector" of claim 1. *Id.* Petitioner's reply argument is also untimely; "Petitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g. to make out a prima facie case of unpatentability." Consolidated Trial Practice Guide ("TPG") 73 (Nov. 2019), *available at* https://www.uspto.gov/sites/default/files/documents/tpgnov.pdf. Petitioner had the burden to provide the rationale to support its obviousness challenge in the Petition; its attempt to present a rationale in the Reply was not in response to Patent Owner's Response. In view of the inconsistent argument Petitioner presented in the Petition, and Patent Owner and Dr. Kanellakopoulos's interpretation of Kleppner, which we find persuasive, we determine that Petitioner has not met its burden to show that a person of ordinary skill in the art would have applied knowledge of a rotation vector to Kleppner's teaching to arrive at the method of claim 1.

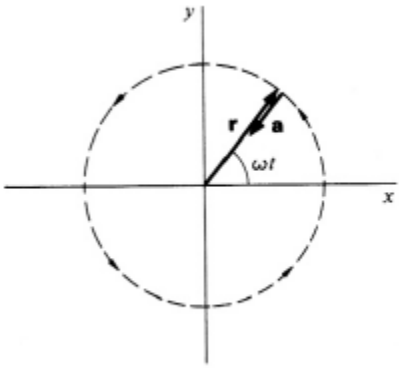
b) Claim 2

Claim 2 depends from claim 1 and includes the following additional step: "estimating the probability of the vehicle turning as a function of the angle between the rotation vector and the gravity vector." Petitioner's argument as to claim 2 does not remedy the deficiency discussed above with respect to independent claim 1. Accordingly, Petitioner has not demonstrated by a preponderance of the evidence that it would have been obvious to a person of ordinary skill in the art to arrive at the method of claim 2 based on Kleppner's teaching.

c) Claim 3

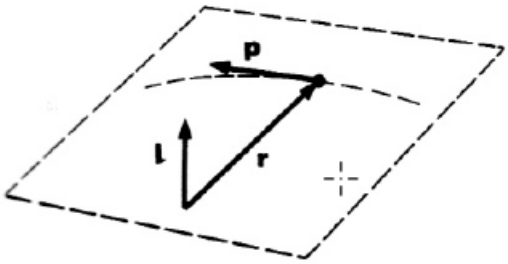
Petitioner contends claim 3 would have been obvious based on Kleppner and the knowledge of a skilled artisan. Pet. 38–46.

Petitioner argues Kleppner discloses detecting the condition of an object turning, based on its disclosure of the direction of angular momentum vector L on Kleppner 234, as discussed in II.D.2.a *supra*. *See* Pet. 38–39 (citing Ex. 1003 ¶¶ 154–157, 187). Petitioner argues acceleration vector **a**, depicted in a figure at Kleppner 18, corresponds to claim 3's "speed change vector" and that a person of ordinary skill in the art would have understood Kleppner as describing that the acceleration vector is the derivative of the velocity vector. Pet. 38–39, 41 (citing Ex. 1007, 14, 17–18; Ex. 1003 ¶ 184). This figure is reproduced below.



Id. at 18. The figure reproduced above shows vectors r and **a** in an x-y plane and depicting a dashed-line circle centered on the x-y intersection, with vector r directed radially outward from the x-y intersection and vector **a** directed radially inward. Ex. 1007, 18.

Step (b) of claim 3 recites "detecting a movement vector during the turn." Ex. 1001, 4:67. In the Petition, Petitioner contends Kleppner discloses the mechanics of an object turning, including the directions of the relevant vectors during a turn, because it "discloses for an object traveling in the x-y plane turning around a circle of radius r, its position vector p ('a movement vector during the turn') is illustrated in the following figure, along with angular momentum vector L (a rotation vector):"



Pet. 40 (citing Ex. 1007, 234; Ex. 1003 ¶ 191).[8]

[8] In our Decision on Institution, we noted that the Petition's description of this figure appeared to be inconsistent with the text on Kleppner 234, which refers to r as the position vector and p as the momentum vector. In its

Petitioner further contends Kleppner teaches that for the same object in circular motion, acceleration vector **a** is directed radially inward, and the centripetal force vector will point in the same direction as the acceleration vector, under Newton's Second Law of Mechanics, F = ma. Pet. 40–41 (citing Ex. 1007, 15, 18; Ex. 1003 ¶¶ 104, 191). Thus, Petitioner argues, the movement vector is the cross product of the rotation vector and centrifugal force vector for a turning object. *Id.* at 41 (citing Ex. 1003 ¶ 192).

Step (c) of claim 3 recites "estimating the angle between movement vector and speed change vector." Ex. 1001, 5:1–2. Petitioner contends Kleppner discloses the directions and relationships of the movement vector and acceleration vector, and contends that vector mathematics dictates that the component of the acceleration vector associated with the object's speed around the circle will be parallel to the object's movement vector or position vector. Pet. 42 (citing Ex. 1007, 18, 234; Ex. 1003 ¶ 195).

Patent Owner argues Kleppner does not disclose "any, let alone all, of the steps in claim 3," based on Patent Owner's construction of "movement vector" (which we have adopted except for the final words of Patent Owner's proposed construction, "while a vehicle is turning"). PO Resp. 38. Patent Owner argues Petitioner has not shown that Kleppner discloses a "movement vector" because Petitioner misinterprets the top left figure of Kleppner 234. PO Resp. 39–40. Patent Owner argues Kleppner's figure does not disclose radius r and "position vector p" as Petitioner asserts (*see* Pet. 40 (identifying radius r and position vector p)), but rather identifies r as the position vector and p as the momentum vector. *Id.* at 33 (citing Ex.

Reply, Petitioner stated that the Petition should have identified p as the momentum vector. Reply 16.

1007, 234). Patent Owner further argues Petitioner fails to explain how Kleppner discloses a movement vector, and that neither position vector r nor momentum vector p is a movement vector, because neither is derived from the cross product of a rotation vector and a centrifugal force vector. *Id.* at 40.

In reply, Petitioner relies on its argument that Kleppner discloses a rotation vector, as we discussed in Section II.D.2.a *supra*, and further argues a centrifugal force vector and the cross-product operation were well known. Pet. Reply 15. Petitioner further argues momentum vector p in the figure on Kleppner 234 discloses a movement vector because it is "the product of mass and velocity (a movement vector)." *Id.* at 16.

We agree with Patent Owner that Petitioner has not identified any disclosure of a rotation vector in Kleppner, for the reasons explained *supra* in Section II.D.2.a. Our construction of "movement vector," i.e., "a vector derived from the cross product of the centrifugal force vector and the rotation vector," depends on identification of a rotation vector. Therefore, because Petitioner has not identified disclosure of a rotation vector in Kleppner, it also has not identified a movement vector. To the extent Petitioner argues it would have been obvious to a person of ordinary skill in the art to arrive at a movement vector based on Kleppner's disclosure because a rotation vector, a centrifugal force vector, and the concept of a cross product were known, we find that Petitioner has not satisfied its burden to explain how a person of ordinary skill would have used Kleppner's disclosure, or been motivated to do so, as we discussed *supra* in Section II.D.2.a.

Accordingly, Petitioner has not demonstrated by a preponderance of the evidence that it would have been obvious to a person of ordinary skill in the art to arrive at the method of claim 3 based on Kleppner's teaching.

d) Claim 4

Claim 4 depends from claim 3. Petitioner's argument as to claim 4 does not remedy the deficiency discussed above with respect to independent claim 3. Accordingly, Petitioner has not demonstrated by a preponderance of the evidence that it would have been obvious to a person of ordinary skill in the art to arrive at the method of claim 4.

E. Alleged Obviousness Based on Johnson and Kleppner (Claims 1 and 2)

Petitioner contends claims 1 and 2 would have been obvious over the combination of Johnson and Kleppner. Pet. 48–53.

1. Johnson (Ex. 1010)

Johnson is titled "Driving Style Recognition Using a Smartphone as a Sensor Platform," and describes a method for monitoring driver behavior "that is inexpensive, accessible, and intelligently uses the sensors available on a mobile phone," using "Dynamic Time Warping (DTW) and smartphone based sensor-fusion (accelerometer, gyroscope, magnetometer, GPS, video) to detect, recognize and record [aggressive driving] actions without external processing." Ex. 1010, 1609.

Johnson's system, named MIROAD, utilizes the rear-facing camera, accelerometer, gyroscope and GPS (for event location and speed only) of a mobile phone. Figure 1, reproduced below, shows how the coordinate axes of the phone are assigned.

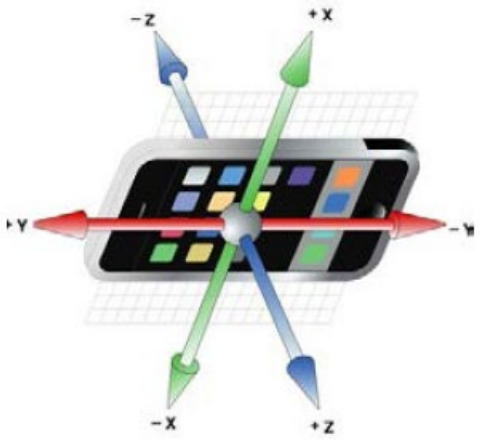


Figure 1 shows a mobile phone, rotated on its side for mounting on a vehicle dashboard, with x, y, and z axes identified. *Id.* at 1610–1611. The system uses accelerometer, gyroscope and magnetometer (compass) sensors to detect and classify vehicle movement, and to detect turning and lateral movement. *Id.* at 1611.

2. Analysis

Petitioner argues Johnson discloses methods for detecting driving actions using the accelerometer and gyroscope of a smartphone. Pet. 48–49 (citing Ex. 1010, Abstract, 1611; Ex. 1003 ¶ 163). Petitioner argues Johnson's gyroscope measures a rotation around the x axis, g_x, which corresponds to a "rotation vector," and its accelerometer outputs a gravity vector. *Id.* at 49. Petitioner argues Johnson also discloses Euler angle rotation with respect to the x axis, e_x, which Dr. Michalson explains a person of ordinary skill in the art would understand as describing orientation of the smartphone with respect to a fixed coordinate system. *Id.* at 19, 49 (citing Ex. 1010, 1611; Ex. 1003 ¶ 163).

Petitioner argues that to the extent Johnson does not expressly disclose estimating an angle of how closely a rotation vector is aligned with

a gravity vector, it would have been obvious to include "such functionality" in Johnson, in view of Kleppner's disclosure. Pet. 49. Petitioner relies on Kleppner as teaching the mathematical relationships of the rotation vector and gravity vector for an object traveling in a plane, and argues that a person of ordinary skill in the art would have been able to estimate the angle between two vectors with a reasonable expectation of success, because the steps for estimating an angle were well-understood mathematical concepts. *Id.* at 49–50. Petitioner argues Kleppner and Johnson are analogous art to the '174 patent because each involves estimation of rotation vectors as related to the gravity vector for a turning object, and are in the same field of "the physics of turning." *Id.* at 50 (citing Ex. 1007, 234; Ex. 1010, 1611, Ex. 1001, claim 1). Petitioner argues it would have been obvious to implement the disclosure of Kleppner in Johnson's smartphone because the combination would have implemented known teachings of physics and smartphones detecting vehicle rotation, to achieve a predictable result with a reasonable expectation of success. *Id.* at 51 (citing Ex. 1003 ¶ 170).

Patent Owner argues Johnson does not disclose a rotation vector, and that Johnson's gyroscope value g_x is a measure of angular velocity, not a rotation vector. PO Resp. 46 (citing Ex. 2001 ¶ 100). Patent Owner further argues Johnson does not estimate an angle of how closely a rotation vector is aligned with a gravity vector, and that Johnson uses the angular velocity from its gyroscope signals in a calculation that does not involve estimating how closely a rotation vector and gravity vector are aligned. *Id.* (citing Ex. 2001 ¶¶ 101–105). Dr. Kanellakopoulos notes that the device used in Johnson's method is mounted on the dashboard and cannot move independently from the vehicle. Ex. 2001 ¶ 98 (citing Ex. 1010, Fig. 2).

Dr. Kanellakopoulos explains that in Johnson's method, if a turning event is detected, Johnson then uses acceleration information to compare acceleration and jerk characteristics to pre-recorded templates of driving events according to the "DTW" algorithm, which is a "completely different approach than 'estimating an angle of how closely a rotation vector is aligned with a gravity vector.'" Ex. 2001 ¶¶ 103–104.

Patent Owner relies on its argument that Kleppner does not disclose a rotation vector, or estimating how closely a rotation vector is aligned with a gravity vector (*see* Section II.D.2.a supra). PO Resp. 47. Patent Owner further argues a person of ordinary skill in the art would not have been motivated, in view of Johnson's disclosure, to use an estimation of how closely a rotation vector is aligned with a gravity vector in order to detect if a vehicle is turning, because Johnson's device is mounted to the vehicle and thus, can easily determine if a turn is occurring without resorting to the method of claim 1. *Id.* at 47–48 (citing Ex. 2001 ¶ 106).

After considering the full record, we find Petitioner has not established by a preponderance of the evidence that the methods of claims 1 and 2 would have been obvious to a person of ordinary skill in the art, based on Johnson's and Kleppner's teachings. We agree with Patent Owner that Johnson does not disclose estimating an angle of how closely a rotation vector is aligned with a gravity vector, in order to detect the condition of a vehicle turning. Although Petitioner attempts to use Patent Owner's acknowledgement that a gyroscope (such as Johnson's) can be used to derive a vehicle's rotation vector (*see* Pet. Reply 16, citing Ex. 1010, 1611), and argues it did not concede Johnson fails to disclose "estimating an angle" (*id.*), Dr. Michalson agrees that Johnson "does not expressly disclose

'estimating an angle of how closely a rotation vector is aligned with a gravity vector.'" Ex. 1003 ¶ 165. Further, Petitioner and Dr. Michalson's explanation of how Johnson purportedly uses g_x and e_x signals to determine "turning movements" does not persuade us that a person of ordinary skill in the art would have understood that Johnson's method detects the condition of a vehicle turning by estimating an angle between the vehicle's rotation vector and gravity vector, in part because Petitioner and Dr. Michalson do not identify a specific aspect of Johnson's disclosure that performs the estimation. *See* Ex. 1010, 1613; Pet. 49 (citing Ex. 1010, 1611; Ex. 1003 ¶ 163). We find more persuasive Dr. Kanellakopoulos's explanation that Johnson's DTW algorithm uses a different method, not based on estimating vector alignment, than Kleppner's disclosure. *See* Ex. 2001 ¶ 104.

For the reasons discussed in Section II.D.2.a *supra*, we also find that Kleppner does not teach estimating an angle of how closely a rotation vector is aligned with a gravity vector. We also agree with Patent Owner that Petitioner fails to explain sufficiently how or why a person of ordinary skill would have combined Johnson's and Kleppner's teachings to arrive at the methods of claims 1 and 2, because Petitioner has not provided adequate reasoning or evidentiary support for its proposed combination. *See* II.D.2.a *supra* (citing *KSR*, 550 U.S. at 419).Therefore, we determine Petitioner has not established that a person of ordinary skill in the art would have been motivated to use Kleppner's disclosure with Johnson's teachings to arrive at the methods of claims 1 and 2.

F. Alleged Obviousness Based on Abramson and Kleppner (Claims 3 and 4)

Petitioner contends claims 3 and 4 would have been obvious over the combination of Abramson and Kleppner. Pet. 53–62.

1. Abramson (Ex. 1009)

Abramson is titled "Sensor-Based Determination of User Role, Location, and/or State of One or More In-Vehicle Mobile Devices and Enforcement of Usage Thereof," and describes determining roles and usages of a mobile device within a vehicle. Ex. 1009, code (54), 1:19–22.

Abramson discusses that "[d]rivers using a hand-held cellular phone or smartphone for talking, text messaging, and/or for executing other applications or 'apps' while driving has become a problem of near epidemic proportions." *Id.* at 1:33–36. Abramson attempts to

> identify the user of a particular mobile device (for instance, with respect to their role as a driver or passenger in the car), to identify various aspects of the usage of the device itself (for instance that the device is executing a text messaging application), and to identify instances when a mobile device deviates from its expected or regular operation.

Id. at 11:16–27. Abramson describes using sensors and GPS units of a mobile device to determine if the user is a passenger or driver in the car. *Id.* at 11:13–44.

2. Analysis

Petitioner argues that Abramson discloses using accelerometer measurements and a method for orienting a coordinate system of a mobile device to determine positive forward acceleration or deceleration, which corresponds to "detecting the direction of a speed change vector" as recited in claim 3. Pet. 54 (citing Ex. 1009, 45:21–23, 46:45–55, 53:5–32; Ex. 1003

¶ 211). As to step (a) of claim 3, Petitioner argues Abramson's measurement of lateral acceleration associated with a turning vehicle corresponds to detecting the condition of a vehicle turning. *Id.* at 55 (citing Ex. 1009, 52:5–32; Ex. 1003 ¶ 213).

As to step (b) of claim 3, Petitioner relies on its proposed construction of "movement vector" (which we have not adopted) and argues that a person of ordinary skill would understand from Abramson's disclosure of an acceleration vector, and Kleppner's teaching of the relationship between acceleration, velocity, and position vectors, that "doubly-integrating the acceleration vector will permit deriving first the velocity vector and then the position (or movement vector)." Pet. 56 (citing Ex. 1009, 50:11–20; Ex. 1002, 14–19). Petitioner further argues to the extent Abramson does not disclose a "movement vector," it would have been obvious to include a movement vector in Abramson's method, in view of Kleppner's teaching of a movement vector. *Id.* (citing Ex. 1003 ¶ 215). Petitioner relies on Kleppner for the same disclosures as discussed in Section II.D.2.c *supra*. *Id.* at 56–57. Petitioner argues it would have been obvious to implement the teachings of Kleppner in Abramson's smartphone because the combination would have implemented known teachings of physics and smartphone sensors detecting movement in a vehicle, to achieve a predictable result with a reasonable expectation of success. *Id.* at 58 (citing Ex. 1003 ¶ 218).

Patent Owner argues Abramson does not disclose "detecting a movement vector during the turn," or other steps of claim 3. PO Resp. 49–51. Specifically, Patent Owner argues, Abramson merely discloses that an object's position can be tracked by using double integration of values from its gyroscope and accelerometer. *Id.* at 51. Dr. Kanellakopoulos

disagrees with Dr. Michalson's assertions and states that double integrating the value from a gyroscope "results in a quantity that has no defined physical meaning." Ex. 2001 ¶ 112. With regard to the movement vector, Dr. Kanellakopoulos disagrees with Dr. Michalson that a position vector, obtained by double integrating acceleration values in Abramson's method, would be equivalent to a movement vector as we have construed that term (i.e., "the cross product between a rotation vector and centrifugal force vector"). *Id.* Patent Owner also reiterates its argument that Kleppner does not teach a movement vector. PO Resp. 50–51.

After considering the full record, we find Petitioner has not established by a preponderance of the evidence that the methods of claims 3 and 4 would have been obvious to a person of ordinary skill in the art, based on Abramson's and Kleppner's teachings. As explained in Section II.B.2 *supra*, we do not adopt Petitioner construction of a "movement vector" as recited in claims 3 and 4 and, thus, Petitioner's arguments based on this unadopted construction are unavailing. We agree with Patent Owner that Abramson does not disclose a movement vector, as we have construed that term, and we have also found that Kleppner does not disclose a movement vector (*see* Section II.D.2.a *supra*). Therefore, we determine Petitioner has not established that a person of ordinary skill in the art would have been motivated to use Kleppner's disclosure with Abramson's teachings to arrive at the methods of claims 3 and 4.

G. Alleged Anticipation Based on Kim

Petitioner contends Kim anticipates claim 5. Pet. 67–76.

1. Kim (Ex. 1005)

Kim "relates to a terminal device for providing a context aware-based mobile service." Ex. 1005, code (57). More specifically, Kim discloses a terminal device that includes sensors that output data to a "context awareness unit" that estimates the environment surrounding the user of the terminal device. *Id.* The terminal device then outputs context-appropriate content to the user. *Id.* According to Kim, using its disclosed system, "it is possible to seamlessly provide a mobile service suitable for the user's current location and context automatically without the user's intentional selection inside of a vehicle, outdoors or indoors." *Id.*

In one embodiment, Kim discloses terminal 100 having sensing unit 110 that includes a number of sensors, including camera 111, microphone 112, GPS 113, and acceleration sensor 114. Ex. 1005 ¶¶ 38–40. Acceleration sensor 114 detects "the motion state of an object by detecting dynamic forces such as acceleration, vibration, and impact" and can detect engine and vehicle vibrations. *Id.* ¶¶ 40–41. Kim discloses sending the data from sensing unit 110 to context recognition unit 120, which "estimates an external context or a user's behavior by comparing the sensor data sensed through the sensor unit 110 with a pattern of reference signals stored therein." *Id.* ¶ 42. According to Kim, "the context awareness unit 120 continuously detects a change in the user's context and detects a change in a service environment, for example, an area such as inside, outdoors, or indoors of the vehicle 200." *Id.* ¶ 43. After examining the user's context, user intention setting unit 130 examines the context and determines the

user's intention based on information previously input and stored by the user, and service creation unit 140 selects an appropriate service based on the context and user intention. *Id.* ¶¶ 44–45.

2. Analysis

Petitioner provides a limitation-by-limitation analysis with specific citations to Kim and Dr. Michalson's Declaration, as to every limitation of claim 5. Pet. 67–76 (citing various portions of Exs. 1003, 1005). Based on the evidence and arguments presented by Petitioner, we find that Kim discloses each limitation of claim 5. We focus our discussion below on the limitations that Patent Owner argues Kim does not disclose: "monitoring at least one operation indicator transparently to the individual" and "determining … one or more vehicle independent states." PO Resp. 58–65. *See In re NuVasive, Inc.*, 841 F.3d 966, 974 (Fed. Cir. 2016) (holding that the Board "was not required to address undisputed matters."). We organize our discussion by the disputed terms in claim 5 because Patent Owner's arguments are based on its proposed construction of those terms.

a) operation indicator

Petitioner relies on its proposed construction of "operation indicator" (which we have adopted) in arguing that Kim discloses "monitoring at least one operation indicator." Pet. 69. According to Petitioner, Kim discloses a terminal having sensor unit 110 that detects an external context or action using various sensors and outputs the corresponding sensor data (i.e., "monitoring at least one operation indicator"), GPS 113 that recognizes the location of the terminal, and acceleration sensor 114 for instantaneous detection of the motion state of an object by detecting dynamic forces such as acceleration, vibration, and impact (i.e., "wherein the at least one

operation indicator is created by an on-board component of the portable device").

Id. (citing Ex. 1003 ¶ 246; Ex. 1005 ¶¶ 39–40). Petitioner further argues Kim discloses a terminal providing a context awareness-based mobile service having context recognition unit 120 that acquires physical signals through sensor unit 110 (i.e., "detecting when the at least one operation indicator") and estimates context by comparing output of the sensor unit "with a pattern of reference signal stored therein" (i.e., "meets one or more predetermined criteria). *Id.* at 71–72 (citing Ex. 1003 ¶¶ 251–252; Ex. 1005, Figs. 1, 2, ¶ 42). Specifically, Petitioner argues the sensor unit of Kim's context recognition unit acquires physical signals relating to vehicle engine vibration and estimates context by comparing them with self-stored reference signals. *Id.* at 72–73 (citing Ex. 1003 ¶¶ 253; Ex. 1005, Fig. 1, ¶ 74).

Patent Owner argues Kim does not disclose an operation indicator, under Patent Owner's proposed construction of that term, because in Kim, sensor data is never converted. PO Resp. 58–59. Specifically, Patent Owner argues Kim's acceleration sensor does not produce an operation indicator because it does not perform a conversion. *Id.* at 59. Patent Owner further argues physical signals acquired by Kim's context recognition unit are not operation indicators because no conversion is performed before they are input to the context recognition unit. *Id.* at 60; *see also* PO Sur-reply 8 (citing Ex. 2001 ¶¶ 36–39).

Because Patent Owner's argument is based on a claim construction requiring converting of sensor data (which we have not adopted), we do not agree with Patent Owner that Kim does not disclose an operation indicator.

Rather, because we have adopted Petitioner's construction of the term "operation indicator" as "a sensor measurement determined from signals from the environment," we are persuaded by Petitioner's arguments that Kim discloses this limitation based on our adopted construction. Accordingly, we find that Petitioner establishes by a preponderance of the evidence that Kim discloses the "operation indicator" limitation.

b) transparently

Petitioner relies on Kim's disclosure of context recognition unit 120 comparing sensor data with previously stored pattern data and continuously detecting a change in the user's context, such as whether the user is in the driver's seat. Pet. 25–26 (citing Ex. 1005 ¶¶ 42–44);*see also* Ex. 1003 ¶¶ 88–89. Petitioner argues Kim's user interface unit 195 supports interaction with a user and includes a visual output device, an audible output device, a keypad, and a touch pad. *Id*. at 70–71 (citing Ex. 1005 ¶ 51; Ex. 1003 ¶ 248).

Patent Owner argues, based on its proposed construction of "transparently," that Kim does not disclose "monitoring at least one operation indicator transparently to the individual" because it does not monitor without requiring user interaction. PO Resp. 61–62. Patent Owner further argues Petitioner concedes that Kim's monitoring process requires user interaction, and instead relies on Kim's disclosure of determining whether a user is the passenger or driver of a vehicle, based on whether the device is mounted. *Id.* (citing Pet. 70–71; Ex. 1005 ¶¶ 73–74, 79; Ex. 2001 ¶ 126).

Petitioner responds that Kim discloses monitoring without user interaction, as Patent Owner's construction requires, and Kim does not

require that "a device is mounted to determine the user is a driver," as Patent Owner argues. Pet. Reply 26 (citing PO Resp. 61–62; Ex. 1005 ¶ 79). Petitioner asserts "Kim discloses that its device also monitors when 'the user is directly carrying the terminal 200 on their body or in a bag'" (*id.* (quoting Ex. 1005 ¶ 79)), and thus discloses "monitoring … transparently to the individual" even under Patent Owner's construction. *Id.* (citing PO Resp. 24). Petitioner further argues claim 5 does not require determining whether a user is a driver, or that the "determining" step be performed transparently to a user. *Id.*

We find that Petitioner establishes by a preponderance of the evidence that Kim discloses "monitoring … transparently to the individual." Petitioner shows, with supporting testimony from Dr. Michalson, that Kim detects changes in a user's context via its context recognition unit and sensor unit, and monitors that information without user input or observation. *See* Ex. 1003 ¶¶ 88–89.

To the extent Patent Owner's construction would require *performing* an action transparently, it is not supported by the language of claim 5, which only recites "transparently" in the monitoring step. Also, we note that Patent Owner's proposed construction of "transparently" as "without requiring user interaction" does not prohibit user interaction with a device, outside of the monitoring step. *See* PO Sur-reply 8 ("under the invention of the `174 patent, the monitoring process functions properly regardless of where the device is positioned and without interaction from the user."). For example, user interaction to position the device prior to the monitoring step would not preclude "transparently" (without user interaction) monitoring an operation indicator. Accordingly, we do not read the "without requiring user

interaction" construction as precluding user interaction with the device to prepare it for transparent monitoring (e.g., powering the device on and bringing it inside the vehicle in a proper position to monitor). Based on the foregoing, we determine that "transparently" is only a requirement of the monitoring step of claim 5, and thus claim 5 does not require that powering on the device or mounting it in the vehicle be transparent to the individual. Thus, we disagree with Patent Owner that Kim's method of determining if a user has mounted the device in the vehicle does not satisfy the "monitoring … transparently" limitation.

We also disagree with Patent Owner's assertion that Kim's method requires a user to interact with the device (by mounting it) in order for the device to sense vehicle vibrations and determine if the user is a passenger or a driver, and therefore Kim's method of monitoring is not transparent. *See* PO Resp. 61–62 (citing Ex. 1005 ¶ 73; Ex. 2001 ¶ 126). The claim limitation, however, merely requires "monitoring at least one operation indicator transparently to the individual" and does not specify the type of operation indicator monitored. Kim also discloses monitoring when the user is inside the car and carrying the device in a bag, which is a monitoring step that can be performed without user interaction.

Accordingly, we find that Petitioner establishes by a preponderance of the evidence that Kim discloses the "monitoring … transparently" limitation.

c) vehicle independent state

Petitioner relies on its proposed construction of "vehicle independent state" (which we have adopted) in arguing that Kim discloses "determining … based on the predetermined criteria … … one or more vehicle independent states." Pet. 73–76. Petitioner asserts Kim's Figures 1, 2, and 5

depict a context awareness-based mobile service that recognizes a user is in a vehicle by context recognition unit 120 comparing data from sensor unit 110 to previously stored pattern data to estimate current context of the user. *Id.* at 74–76 (citing Ex. 1005 Figs. 1, 2, 5, ¶¶ 33, 64; Ex.1003 ¶¶ 258–259). Petitioner relies on the following example from Kim as disclosing the use of specific vehicle-independent information:

> When the vehicle 200 stops, the user carries the terminal 100 and comes out of the vehicle 200 and is located outdoors, this context is recognized by the terminal 100 and it switches to an outdoor service mode to provide an outdoor service to the user.

Id. at 76 (citing Ex. 1005 ¶ 34).

Patent Owner argues Kim does not disclose "determining … based on the predetermined criteria … one or more vehicle independent states" because under Patent Owner's proposed claim construction, a vehicle independent state must be determined while the device is in the vehicle, and "[t]his never occurs in Kim." PO Resp. 63. Patent Owner argues Petitioner's reliance on Kim's disclosure of using a portable device outside a vehicle does not meet the requirement of determining a vehicle independent state while inside the vehicle. *Id.* (citing Ex. 1005 ¶ 34; Ex. 2001 ¶ 130).

As explained in II.B.5 *supra*, we do not adopt Patent Owner's construction of the "vehicle independent state" limitation that would require determining a vehicle independent state to occur while the device is inside a vehicle. Because Patent Owner's argument is based on a claim construction that we have not adopted, we instead agree with Petitioner that Kim discloses "determining … based on the predetermined criteria … one or more vehicle independent states." Accordingly, we find that Petitioner

establishes by a preponderance of the evidence that Kim discloses this limitation of claim 5.

H. Alleged Anticipation Based on Schwartz 2010

For the reasons discussed above, Petitioner has shown that claim 5 of the '174 patent is unpatentable, by a preponderance of the evidence, but has not shown that claims 1–4 are unpatentable. We have, thus, addressed all of the challenged claims. *See* 35 U.S.C. § 318(a) (requiring the Board to "issue a final written decision with respect to the patentability of any patent claim challenged by the petitioner and any new claim added under section 316(d)"); *see also SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding that a petitioner "is entitled to a final written decision addressing all of the claims it has challenged"). Accordingly, we need not and do not decide whether Petitioner has shown by a preponderance of the evidence that claim 5 is anticipated by Schwartz 2010. *Cf. In re Gleave*, 560 F.3d at 1338.

III. CONCLUSION

Petitioner has shown, by a preponderance of the evidence, that claim 5 is unpatentable,[9] but has not shown that claims 1–4 are unpatentable, as summarized below:

[9] 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. 16654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–4	103	Kleppner		1–4
1, 2	103	Johnson, Kleppner		1, 2
3, 4	103	Abramson, Kleppner		3, 4
5	102[10]	Schwartz 2010		
5	102	Kim	5	
Overall Outcome			5	1–4

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claim 5 of the '174 patent is held to be unpatentable, but that claims 1–4 of the '174 patent have not been proven 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.

[10] As explained in the previous section, we do not reach the § 102 ground based on Schwartz 2010, because Petitioner has shown that Kim anticipates challenged claim 5.

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