

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.
PETITIONER

V.

CM HK LIMITED
PATENT OWNER

Case No.: IPR2025-01023
Patent No. 10,852,846

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

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Ex. No.	Description	Previously Submitted
Ex. 1001	U.S. Patent No. 10,852,846 to Liou et al. (“the ’846 patent”)	X
Ex. 1002	Declaration of Majid Sarrafzadeh, Ph.D.	X
Ex. 1003	Curriculum Vitae of Majid Sarrafzadeh, Ph.D.	X
Ex. 1004	Prosecution History of U.S. Patent No. 10,852,846	X
Ex. 1005	WO 2009/156499 to Bassompierre et al.	X
Ex. 1006	Certified Translation of WO 2009/156499 to Bassompierre et al. (“Bassompierre”)	X
Ex. 1007	A. Kim and M. Golnaraghi, “A quaternion-based orientation estimation algorithm using an inertial measurement unit,” PLANS 2004. Position Location and Navigation Symposium (IEEE Cat. No. 04CH37556), 268-272, 2004 (“Kim”)	X
Ex. 1008	U.S. Patent No. 8,462,109 to Nasiri (“Nasiri”)	X
Ex. 1009	U.S. Patent No. 8,441,438	X
Ex. 1010	U.S. Patent No. 8,552,978	X
Ex. 1011	IPR2018-01258, Paper 86 (Final Written Decision)	X
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Ex. 1013	IPR2018-01257, Paper 87 (Final Written Decision)	X
Ex. 1014	Provisional Application No. 61/292,558	X
Ex. 1015	3/7/2018 Deposition Trans. of Dr. LaViola in <i>CyWee Group Ltd. v. Samsung Elecs. Co., Ltd.</i> , 17-cv-00140 (E.D. Tx.)	X
Ex. 1016	5/22/2019 Deposition Trans. Of Dr. Joseph LaViola in IPR-2018-01257 and IPR-2018-01258	X

Ex. 1017	1/7/2025 Plaintiff's P.R. 3-1 & 3-2 Disclosures for <i>Samsung Electronics Co, Ltd. et al v. CM HK, Ltd.</i> (2:24-cv-00880 E.D. Tx.)	X
Ex. 1018	<i>Sotera</i> Stipulation Email From E. Brann to M. Shore on July 19, 2025	X
Ex. 1019	<i>CM HK, Ltd., v. Samsung Electronics Co. Ltd. and Samsung Electronics America, Inc.</i> , No. 2:24-cv-00880, Dkt. 28	X
Ex. 1020	<i>CM HK, Ltd., v. Samsung Electronics Co. Ltd. and Samsung Electronics America, Inc.</i> , No. 2:24-cv-00880 ("the Texas Litigation"), Dkt. 55	X
Ex. 1021	7/9/2018 Claim Construction Opinion and Order in <i>CyWee Group Ltd. v. Samsung Elecs. Co., Ltd.</i> , 17-cv-00140 (E.D. Tx.)	X
Ex. 1022	5/20/26 Deposition Trans. Of Dr. LaViola in IPR2025-01023	
Ex. 1023	RealNav: Exploring Natural User Interfaces for Locomotion in Video Games", Williamson et al.	
Ex. 1024	Responsible Investment & Governance Report 2024, https://fund.nps.or.kr/eng/main.do	
Ex. 1025	Declaration of Keunwoo Choi	

I. INTRODUCTION

Samsung Electronics Co., Ltd. (“Petitioner”) submits this Reply concerning claims 1, 3, 7, and 9 of U.S. Patent No. 10,852,846 (“the ’846 Patent”) (Ex. 1001). Patent Owner’s arguments should be rejected and the claims found unpatentable for at least the reasons set forth in the Petition and accompanying exhibits, the Board’s decision to institute *inter partes* review (Paper 17, “Decision”), cross-examination testimony, and the additional reasons below.

II. CLAIM CONSTRUCTION AND BASSOMPIÈRE’S APPLICABILITY TO THE CHALLENGED CLAIMS

A. “quaternion” – Claims 1, 3, 7, 9

PO fails to show that there is any confusion as to the plain meaning of “quaternion” as understood by a POSITA or by the experts in this matter. As explained below, the Board need not construe that term because it does not resolve any dispute between the parties. *EmeraChem Holdings, LLC v. Volkswagen Grp. of Am., Inc.*, 714 F. App’x 995, 997 (Fed. Cir. 2017) (“Claim terms are construed to resolve a ‘controversy, and only to the extent necessary to resolve the controversy.’”).¹

¹ PO faults Petitioner for not construing any terms other than “spatial reference frame.” (Response, 40.) But, as explained in Section II of this Reply, PO has not

PO argues that its proposed construction is dispositive because “Petitioner does not contend that Bassompierre discloses quaternions.” (Response, 24.) Wrong. As the Board recognized, Petitioner relied on, *inter alia*, Bassompierre’s teachings of “[a] first variant embodiment,” which involves “replacing the angles of torsion θ and ψ by a quaternion formulation of the same torsion.” (Decision, 30; *see also id.*, 32 (discussing the Petition’s analysis of Bassompierre’s quaternion disclosures); Petition, 36-39 (discussing Bassompierre’s equation 26).) PO does not dispute that Bassompierre’s “first variant” embodiment discloses a quaternion under PO’s construction. PO’s argument is that a POSITA would not have been motivated to use quaternions instead of Euler angles in Bassompierre’s EKF (Response, 45-46) but that does not turn on, and would not be resolved by, PO’s proposed construction of “quaternion.”

B. “predicted axial accelerations” – Claims 1 and 7

Here too, PO proposes a construction that does not resolve any dispute between the parties and should therefore be rejected. PO contends that Bassompierre cannot satisfy PO’s proposed construction (“gravitational acceleration along the electronic device’s axes derived from the current quaternion”) because “Equation 22

shown that the terms not construed in the Petition warrant anything other than their plain and ordinary meaning.

[of Bassompierre] is written entirely in Euler angles and includes no quaternions.” (Response, 47.) But, as the Board recognized at institution, this argument does not address Petitioner’s analysis that a POSITA would have been motivated to use the Euler angle-based Equation 22 of Bassompierre in quaternion form. (Decision, 17, 32-35; Petition, 37-42.) For this reason alone, the Board should decline to adopt Petitioner’s proposed construction. *EmeraChem Holdings*, 714 F. App'x at 997.

PO’s construction is also not supported by the intrinsic evidence. Contrary to PO’s assertion, the cited portions of the claims and the specification do not “define” predicted axial accelerations as gravitational acceleration. (Response, 25-26 (*citing* Ex. 1001, claim 1, 17:37-52).) The other portion of the specification cited by PO in support of this narrowing merely states that “undesirable” axial accelerations are caused by forces other than gravity and that the described sensor fusion algorithm can serve to exclude such undesirable interferences. (Response, 26-27 (*citing* Ex. 1001, 18:43-57).) Nothing in that portion of the specification excludes accelerations like linear or centrifugal accelerations from being part of the claimed predicted axial acceleration. Critically, the cited portion relates to “preferred embodiment[s]” and “example[s]” that are “provided for illustrative purposes only.” (Ex. 1001, 18:43-57.) PO does not demonstrate that the statements herein limit claim scope. *IQRIS Techs. LLC v. Point Blank Enters.*, 130 F.4th 998, 1004 (Fed. Cir. 2025) (*citing Playtex Prods., Inc. v. Procter & Gamble Co.*, 400 F.3d 901, 907-08 (Fed. Cir. 2005)

(“It is the claims, not the preferred embodiments, that define the metes and bounds of the patentee's invention.”).

PO alleges that Petitioner and its expert have taken inconsistent positions regarding the meaning of “predicted axial acceleration.” (Response, 27-31.) The Board has already noted that Petitioner has sufficient reason to contend here that “predicted axial accelerations” should be accorded its plain and ordinary meaning. (Decision, 22-23.) Dr. Sarrafzadeh’s testimony that “predicted axial acceleration” is “a prediction of the axial acceleration, based on a prediction method” is wholly consistent with the plain and ordinary meaning, which is prediction of an axial acceleration. (Ex. 2035, 84:15-21, 90:12-17, 124:12-19, 125:19-21, 154:7-10.)

PO’s twisting and turning of *isolated* sentences from Dr. Mercer’s report in the *CyWee* litigation does not establish any inconsistency in Samsung’s positions. (Response, 27-31.) As an initial matter, PO did not submit a complete unredacted copy of Dr. Mercer’s report, thereby depriving the Board of the full context of Dr. Mercer’s statements.

Regardless, PO has not demonstrated that Samsung or Dr. Sarrafzadeh analyzed predicted axial acceleration as a “gravitational acceleration component *isolated from* [the] composite value” of acceleration output by the accelerometer. (*Contra* Ex. 2036, ¶203 (emphasis added).) Samsung relied on Bassompierre’s equation 22, which is derived by multiplying a rotation matrix by the gravity vector

(Ex. 2035, 99:7-100:7), not by isolating gravitational acceleration from a composite acceleration value. Significantly, PO ignores Dr. Mercer’s statement that the composite acceleration value can be just “gravitational” acceleration. (Ex. 2036, ¶203 (“composite acceleration value (linear, centrifugal, *and/or* gravitational”) (emphasis added).) Similarly, PO relies on two isolated sentences from Dr. Mercer’s report differentiating between the words “predicted” and “estimated” to suggest that his testimony conflicts with Samsung’s reliance on equation 22’s “a priori estimation.” (Response, 29; Ex. 2040, ¶¶ 101-102.) But there is *zero* context for Dr. Mercer’s statements as PO redacts significant portions of the surrounding statements. (See Ex. 2036, ¶¶204-206.) Moreover, those statements were made in the context of non-infringement (*see id.*, ¶207) and PO does not demonstrate that the algorithm in the accused products in that litigation is identical to Bassompierre’s EKF algorithm such that Samsung’s IPR positions conflict with its prior positions in the *CyWee* litigation.

C. “electronic device” – Claims 1, 3

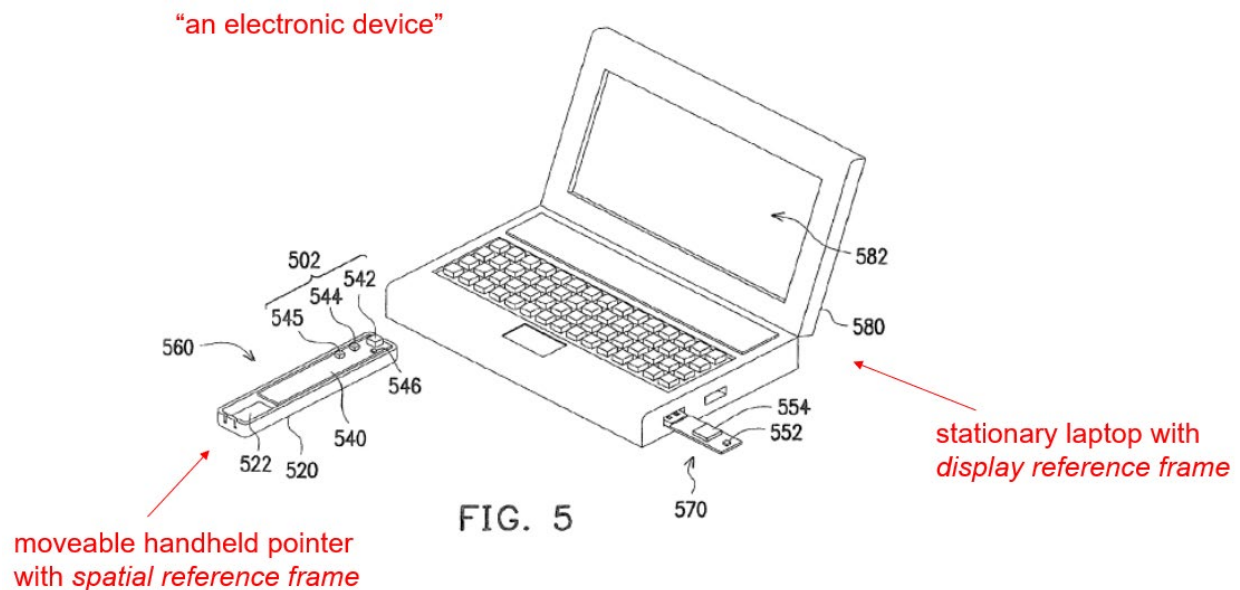
PO’s construction of “electronic device” seeks to exclude from the claim scope a “split configuration” (such as that of Figure 5 of the ’846 patent and in Bassompierre Figure 2) in which the handheld pointer moves while a separate display remains stationary. (Response, 32-35.) PO’s construction limits the claim to an integrated device in which the claimed “display device” and “motion sensor module”

are all part of the same housing and rotate together. (*Id.*) PO's construction is not supported by the intrinsic evidence and would require excluding the Figure 5 embodiment of the specification from the scope of "electronic device."

The claims do not require that *all* of the components of the electronic device move together in the same reference frame. (*Contra id.*, 32-33.²) Nor does the claim require them to be in a single housing. Claim 1 recites an "electronic device" (Ex. 1001, 31:9) that has a "display device" associated with a "display reference frame" (*id.*, 31:12-13), and a "motion sensor module comprising a rotation sensor and an accelerometer," (*id.*, 31:14-15) which are "associated with the movements and rotations of the electronic device in a spatial reference frame" (*id.*, 31:20-21). Unlike the motion sensor module, whose components are associated with the movements and rotation of the electronic device *in a spatial reference frame*, the claim specifies that the display device is subject to rotation in a different reference frame ("display reference frame"). (Ex. 1001, 31:11-12.) This undercuts PO's construction, which requires the display device to also be subject to movement and rotations in the spatial reference frame. (Response, 32.)

² PO appears to be presuming such movement because the claim recites "movements and rotations of the electronic device within a spatial reference frame."

The specification *expressly* supports Samsung’s understanding by describing in Figure 5 (reproduced below) “an electronic device,” which includes a moveable handheld pointer (560) and a stationary laptop computer (580). (Ex. 1001, 11:41-46 (“*an electronic device 500 . . . As shown in FIG. 5, the electronic device 500 may comprise two parts 560 and 570 in data communication with each other.*”) (emphasis added); *see also id.*, 12:17-23.)



(*Id.*, FIG. 5 (annotated).)

The specification explains that the “electronic device” of Figure 5 moves in the “spatial reference frame” even though a part of the electronic device (the laptop 580) is stationary. (*Id.*, 12:60-13:3; *see also id.*, 11:41-60.) The specification states that the “electronic device” can move “in the spatial *pointer* reference frame” (*id.*, 12:60-13:2, emphasis added) confirming that the spatial reference frame can be the reference frame of the 3D pointer device 560 as opposed to a solitary reference frame

of the entire electronic device.³ Adopting PO’s construction would require excluding the embodiment of Figure 5 from the claim scope and therefore cannot be correct. *CUPP Computing AS v. Trend Micro Inc.*, 53 F.4th 1376, 1381 (Fed. Cir. 2022) (internal citation omitted) (“claim interpretation that excludes a preferred embodiment from the scope of the claim is rarely, if ever, correct”).

PO’s expert (Dr. La Viola) confirmed Samsung’s understanding that claim 1 covers the embodiment of Figure 5. (Ex. 1022, 112:13-113:1, 116:4-7.) He testified that because claim 1 requires that the processor of the electronic device “translate[s] the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame,” the claim scope must cover an embodiment where the reference frames are different, as in the embodiment of Figure 5. (*Id.*, 121:17-123:13 (*citing* Ex. 1001, 31:10-26, 31:58-61 (claim 1)).)⁴

³ Figure 5 of the ’846 patent is reproduced above and annotated to show the relationship between the between the spatial reference frame and display reference in “an electronic device.”

⁴ PO examined its own witness three times, attempting to elicit a change to Dr. LaViola’s multiple admissions that claim 1 covers the split configuration embodiment of Figure 5 of the ’846 patent. (Ex. 1022, 112:13-114:13, 117:15-

While Figure 6 of the specification includes an embodiment of an electronic device, such as a smartphone, where the display (and its display reference frame) is in the same housing as the motion sensor (and its spatial reference frame), that embodiment is not dispositive. (*Id.*, 13:4-12.) Nowhere does the specification define or require that “an electronic device” be understood as limited to the device of Figure 6. The electronic device of Figure 6 is merely an exemplary embodiment where the display reference frame and spatial reference frame happen to be fixed in relation to each other.

PO’s proposed construction should be rejected and the term given its ordinary meaning.

D. “spatial reference frame” – Claims 1, 7

The parties dispute whether the spatial reference frame is associated with “a 3D pointing device,” as Petitioner contends, or “the electronic device” as PO posits. But *the crux of this dispute* is whether the claimed “spatial reference frame” be associated with a component of the electronic device (like in Bassompierre) or whether there must be a singular reference frame for the entire electronic device such

119:13, 123:17-126:9.) Only after PO directed Dr. LaViola in a series of leading questions to his declaration (*id.*, 123:17-126:9) did Dr. LaViola change his opinion that the embodiment of Figure 5 is covered by claim 1. (*Id.*, 128:3-12.)

that the entire electronic device rotates about that singular reference frame. Petitioner proposes the former understanding whereas PO proposes the latter. Petitioner's construction and understanding should be adopted as it most naturally aligns with the claims and the specification.

As an initial matter, PO asserts that Petitioner's construction should be rejected because the claims do not recite the term "3D pointing device." (Response, 35-36.) Were it correct, PO's construction should also be rejected because claim 7 of the '846 patent does not recite "electronic device." In fact, claim 1 does not specify the spatial reference frame with respect to any device.

The preamble of claim 1 recites an "electronic device." (Ex. 1001, 31:9-10.) Claim 1 further states that the electronic device includes a display device in display reference frame (*id.*, 31:12-13) and a "motion sensor module. . . associated with movements and the rotations of the electronic device in a spatial reference frame." (*Id.*, 31:14-21.) While both the display device and motion sensor module are defined as part of the same electronic device, ***only the motion sensor module*** is expressly recited as being associated with movements and rotations in the spatial reference frame. (*Id.*, 31:12-21.) Claim 7 does not even specify what element rotates in the spatial reference frame.

Petitioner's construction resolves this uncertainty by defining the spatial reference frame as "a reference frame associated with the 3D pointing device," as

was done in IPR2018-01257. (Petition, 23-25.) This construction makes clear that the spatial reference frame is a reference frame associated with a moving component of the electronic device, which is a pointing device moving in the three dimensions of the spatial reference frame.⁵ And this pointing device may or may not move in tandem with the display device or its display reference frame. Samsung’s construction clarifies that the claimed movement and rotations are that of the pointing device and not necessarily that of the display device. This construction is supported by the specification, which explains that the “spatial reference frame” of a split configuration pointer (110) and stationary display (120) embodiment refers to the 3-axis reference frame of the 3D pointing device, not that of the display. (*Id.*, 24-25, Ex. 1001, 4:44-54 (describing the split configuration of pointing device and display screen in Figure 1); *id.*, 9:5-17 (“The spatial reference frame is analogous to the reference frame $X_P Y_P Z_P$ also shown in FIG. 1 and FIG. 2.”).)

The specification further supports Samsung’s understanding because it discloses an “electronic device” in the embodiment of Figure 5, which can move “in the spatial *pointer* reference frame” (Ex. 1001, 12:60-13:2, emphasis added) confirming that the spatial reference frame can be the reference frame of a

⁵ In claim 1, the moving component is the “motion sensor module.”

component (the 3D pointer device 560) *within that* electronic device.

E. “resultant angles” – Claims 1, 7

PO’s proposed construction should be rejected because it limits the claims based on examples in the specification. PO incorrectly states that “throughout the ’846 Patent, the term ‘resultant angles’ is used *exclusively* to refer to the yaw, pitch, and roll angles of the electronic device.” (Response, 38 (emphasis in original).) The specification makes numerous references to the resultant angles with no mention of yaw, pitch, and roll angles, confirming lack of the lexicography mandating PO’s proposed construction. (Ex. 1001, 11:36-40, 12:61-13:1, 13:49-57.)

The proposed construction’s inclusion of yaw as a resultant angle is particularly suspect and not supported by the claim language in view of the specification. In advocating for its proposed construction, PO contends that “the specification further explains that the resulting deviation is obtained and output in an ‘absolute’ manner, meaning it reflects the actual movements and rotations of the electronic device in the spatial reference frame rather than a relative or partial measurement.” (Response, 39 (*citing* Ex. 1001, 19:58-65, 22:50-57, 30:33-47).) These portions of the specification concern the use of a nine-axis motion sensor, which includes use of a rotation sensor (gyrometer) for detecting angular velocities, an accelerometer capable of detecting axial accelerations, *and a magnetometer capable of detecting magnetism*. (Ex. 1001, 5:36-46.) The ’846 patent specification

explains that readings from the magnetometer are used to provide more precise yaw angle readings. (*Id.*, 24:38-25:10 (equation 21).) Claims 1 and 7 recite a rotation sensor and an accelerometer, but not a magnetometer, and do not therefore seek “absolute” orientation readings. (*Id.*, 31:14-17.) PO’s expert confirmed that yaw-angle predictions drift and are generally inaccurate in the absence of magnetometer readings. (Ex. 1022, 24:12-15, 26:14-27:6, 37:19-38:6, 107:21-109:3.)

If PO intended that the recited resultant angles include pitch, roll and yaw angles, it could have said so in the claims. Indeed, non-challenged claims 2 and 8 recite use of a magnetometer and claims 2, 5, 8 and 11 explicitly recite yaw. These claims make clear that the magnetometer provides accurate yaw determinations that the mere use of only the rotation sensor and accelerometer of claims 1 and 7 cannot. Adoption of PO’s construction of “resultant angles” would render those dependent claims meaningless under the presumption of claim differentiation. *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 810 (Fed. Cir. 2021) (“[i]t is highly disfavored to construe terms in a way that renders them void, meaningless, or superfluous”); *Phillips v. AWH Corp.*, 415 F.3d 1303, 1315 (Fed. Cir. 2005).

III. BASSOMPIÈRE DISCLOSES OR SUGGESTS ALL OF THE CLAIM LIMITATIONS

A. Bassompierre discloses all limitations of claims 1 and 3

1. “electronic device”

Relying on its faulty construction, PO argues that Bassompierre does not

disclose an “electronic device” because Bassompierre’s pointer and display are separate physical components (pointer/display in “split configuration”) and, relatedly, because the Bassompierre’s display is stationary and does not undergo movements and rotations in the spatial reference frame. (Response, 44-45.) This argument fails because the “electronic device” of claim 1 does not require the pointer and the display to be in the same housing. (*Supra* Section II.C.) Nor does claim 1 require the display to move and rotate in the spatial reference frame; the display is associated with its own reference frame (the “display reference frame”). (*Id.*) In fact, consistent with the ’846 patent specification, the display of the “electronic device” can be stationary while the “electronic device” moves in a “spatial reference.” (Ex. 1001, Fig. 5, 11:41-46, 12:60-13:2.) Bassompierre therefore discloses an “electronic device” (as recited in claims 1 and 3) under the term’s plain and ordinary meaning. (Petition, 25-27.)⁶

2. “quaternions”

PO acknowledges that Petitioner relies on Bassompierre’s Euler-based EKF

⁶ Even if PO was correct that the “electronic device” must be an integrated device where all components move and rotate in the spatial reference frame, claims 1 and 3 would be unpatentable based on the Bassompierre-Nasiri combination. (Petition, 63-71; *supra* Section V.)

equations in quaternion form. (Response, 45-46.) PO does not dispute that modifying Bassompierre’s Euler-based EKF equations to use quaternions discloses the claimed “‘previous quaternion corresponding to time T-1,’ a ‘current quaternion corresponding to time T,’ and an ‘updated quaternion associated with time T.’” (*Id.*) Instead, PO contends that there would not have an “apparent reason to make those modifications.” (*Id.*) Petitioner addresses PO’s arguments against motivation in Section IV below.

3. “predicted axial accelerations”

PO argues that Bassompierre’s Equation 22 cannot provide “predicted axial acceleration” because it is “written entirely in Euler angles and includes no quaternions.” (Response, 47.) Yet, PO does not contest that Equation 22 of Bassompierre predicts acceleration along axes. (*Id.*) Further, the Board found that PO “acknowledges that Bassompierre predicts axial accelerations.” (Decision, 17.) As the Petition explains, Equation 22 of Bassompierre teaches determination of “predicted axial accelerations” in Euler angle form and a POSITA would know to derive that equation in quaternion form to arrive at the exact same known Equations 2 through 4 of the ’846 patent, taking the values of [q1 q2 q3 q4] from the current quaternion:

$$\begin{bmatrix} 2(q_1q_3 + q_0q_2) \\ 2(q_2q_3 - q_0q_1) \\ q_0^2 - q_1^2 - q_2^2 + q_3^2 \end{bmatrix}$$

(Petition, 37-42; Ex. 1002, ¶¶50, 52-53, 72-75, App. [1.e].) Bassompierre thus teaches predicted axial accelerations, as claimed.

4. “spatial reference frame”

Predicated on its faulty construction, PO argues that Bassompierre does not teach a spatial reference frame “associated with the electronic device” because Bassompierre does not have a “single unified frame associated with a single integrated device.” (Response 47-48.) As already explained in Sections II.C and II.D above, PO’s unduly narrow construction of “electronic device” and “spatial reference frame” erroneously excludes the ’846 patent’s pointer/display “split configuration” embodiment of Figure 5 and should be rejected. Bassompierre teaches an electronic device in a split configuration (*id.*, 48) just like that of figure 5 of the ’846 patent. And just like the Figure 5 embodiment of the ’846 patent, the “electronic device” in Bassompierre can move/rotate in the reference frame (X Y Z) of the pointer device, which is part of the “electronic device.” (Petition, 30-31). Bassompierre’s (X, Y, Z) reference frame is a “spatial reference frame” as claimed in claims 1 and 7.

5. “resultant angles”

PO does not dispute that the pitch and roll angles in Bassompierre equation 23 constitute “resultant angles.” (Response, 49-50; Petition, 56-57.) Nor does PO dispute that the pitch and roll angles are used as input to equation 24 in Bassompierre

to calculate ω_w and ω_v . (Response, 49-50; Petition, 56-57.) Instead, PO assumes, incorrectly, that a POSITA motivated to use quaternions in Bassompierre's EKF would necessarily use Equation 27. (Response, 49-50; Ex. 2040, ¶¶129-131, 141, 146.) PO provides no basis in Bassompierre for that assertion.

A POSITA reading Bassompierre would not read it as requiring use of Equation 27 if quaternions were used. Instead, Bassompierre states that “[s]everal variants are possible” and that “it is advantageous to retain a *two-step algorithm*.” (Ex. 1006, 20:7-9 (emphasis added).) The two-step algorithm is the one described in figure 6 and which Samsung relies on in its petition. (Petition, 51-53; Ex. 1006, 15:3-7, FIG. 6.) Neither PO nor Dr. La Viola dispute this reading of Bassompierre. It is black-letter law that “a prior-art reference ‘must be considered for everything it *teaches* by way of technology and is not limited to the particular *invention* it is describing and attempting to protect.’” *Netflix, Inc. v. DivX, LLC*, No. 2022-1083, 2023 WL 2298768, at *4 (Fed. Cir. Mar. 1, 2023).

In fact, the prior art (such as Kim (Ex. 1007)) expressly recognizes that a POSITA would execute an EKF using quaternions and then decompose the output quaternion “into the more intuitive representation of roll, pitch, and yaw.” (Petition, 54 (citing Ex. 1007, 271); see also Ex. 1002, ¶82.) Dr. La Viola does not address Petitioner's showing regarding Kim, and his conclusory and narrow reading of Bassompierre should be rejected as it does not consider the prior art's teachings as a

whole. Moreover, the '846 patent itself converts the updated quaternion back into pitch, roll, and yaw angles in Euler angle format. (*See* Ex. 1001, 19:40-50.) To the extent PO is suggesting that conversion back from quaternion to Euler angle format would have been inefficient, PO cannot claim a patentable distinction over Bassompierre merely because it claimed an inefficient computational method. As Samsung explained in the Petition, converting the quaternion output of equation 23 into Euler angles would have been one of two available choices for a POSA, and thus obvious. (Ppetition, 51-54.) *Uber Techs., Inc. v. X One, Inc.*, 957 F.3d 1334, 1339 (Fed. Cir. 2020) (holding that when there are “only two possible methods,” the use of each method is obvious).

6. “data association model”

Without invoking any claim construction dispute, PO argues that Bassompierre fails to disclose a “data association model” because Equation 23 is in Euler angle form, not quaternion form. (Response, 50-51). PO apparently concedes that Equation 23 includes a model for comparing measured acceleration and predicted acceleration $\hat{y}_{\bar{k}}$ data by subtracting one from the other, but lacks only the utilization of a quaternion-based state vector to perform such comparison in the overall context of the EKF equation. (*Id.*) Based on Bassompierre’s teaching, a POSITA would readily know to implement Equation 23 with a four-dimensional current quaternion $\hat{q}_{\bar{k}}$ in view of Bassompierre’s teaching that the Kalman gain G is multidimensional.

(Petition, 48-49; Ex. 1002, ¶79.) PO does not dispute the correctness of Petitioner’s derivation of the Kalman gain equivalent requiring a 4x3 matrix to project Euler to quaternion space, only the motivation of a POSITA to implement the EKF in quaternion form (Ex. 2040, ¶138), which is addressed in the next section. Bassompierre teaches the data association model.⁷

B. Bassompierre discloses all limitations of claims 7 and 9

PO’s arguments with respect to claims 7 and 9 fail for the reasons discussed above in Sections III.A.2-6. Critically, PO acknowledges that its arguments with respect “electronic device” do not apply to claims 7 and 9. (Response, 45.) PO’s arguments for “spatial reference frame” (*supra* Section III.A.4) do not apply to claims 7 and 9 because they do not limit the “spatial reference frame” to any device.

⁷ The petition once mistakenly refers to the current quaternion as $\hat{x}_k$ instead of $\hat{x}_k^-$ in the discussion of the data comparison model. (Petition, 58). This is a clear typographical and notational error where the petition should have used $\hat{x}_k^-$ for the current quaternion as it does in every other location in the Petition. PO’s Response articulates no clear reason why this typographical error supports the notion that Bassompierre does not include a data association model. (Response, 51).

IV. A POSITA WOULD HAVE BEEN MOTIVATED TO MODIFY BASSOMPIÈRE

PO's six arguments for why a POSITA would not have been motivated to modify Bassomprière's Equation 21 to substitute quaternions for Euler angles fail for the following reasons.

First, PO's admission that quaternions are more computationally efficient than Euler angles is support for, not against, the notion of a POSITA implementing the EKF equation of Bassomprière, including Equation 21, in quaternion form. (Response, 52.) Bassomprière indisputably recognized the computational efficiency of quaternions over Euler angles.

Second, Petitioner's reliance on the "first variant embodiment" does not require such embodiment to be the preferred one. (*Contra* Response, 53.) *Bayer Pharma AG v. Watson Labs., Inc.*, 874 F.3d 1316, 1328 (Fed. Cir. 2017) ("[O]bviousness does not require that the motivation be the *best* option, only that it be a *suitable* option from which the prior art did not teach away." (original emphasis) (cleaned up)).

Third, PO does not dispute that Bassomprière teaches an EKF filter or the accuracy of Petitioner's quaternion calculations and derivations. (Ex. 1022, 18:19-20:6.) PO argues only that such calculations would be complex and require application of mathematical techniques like kinematic differential equations, normalization, and large matrix calculations. (Response, 53-55, 61.) But PO does

not dispute the benefits of using quaternions instead of Euler angles. PO's argument that a POSITA would see no benefit in using quaternions instead of Euler angles in a system with only two degrees of freedom (i.e., pitch and roll) is addressed by Bassompierre's own teaching that use of quaternions "exhibits the advantage of avoiding computations of the sines and cosines of the *pitch and roll angles* that are greedy in terms of computation power." (Ex. 1006, 20:10-13 (emphasis added).) Moreover, Dr. La Viola's testimony in support of PO's argument is conclusory as he never explains why a quaternion implementation would not provide a computational advantage for a two-degree-of-free system. (See Ex. 2040, ¶139.)

PO relatedly argues that Dr. Sarrafzadeh's use of complex math to show the equivalency of EKF calculations in Euler and quaternion form means that Petitioner engaged in gap-filling. (Response, 51-55.) PO acknowledges that Bassompierre presents related Euler angle and quaternion equations, such as Equation 21 and 26, both of which concern the orientation determination. (Response, 58-59.) That one equation is discrete and one in derivative form requiring discretization is immaterial. The application of complex, but well-known, mathematical concepts to convert from one space to another is not gap-filling, but mere application of a POSITA's knowledge and skill.

Fourth, there is no hindsight bias in Petitioner's analysis of the EKF equations of Bassompierre. As explained in Section III.A.5, PO's argument fails to consider

Bassompierre’s teachings as a whole. Bassompierre discloses an embodiment with $\hat{x}_{\bar{k}}$ as a *quaternion* state vector, i.e., using $[q_0 \ q_1 \ q_2 \ q_3]$ rather than Euler angle pitch/roll $[\theta \ \psi]$. (Ex. 1006, 20:18-20.) From this substitution (and equation 26, which is a quaternion form of equation 21 for finding the “current quaternion” (Petition, 36-37)) a POSITA would work *forward* (not backward (Response, 55)), as explained in Samsung’s petition and Dr. Sarrafzadeh’s declaration. (Petition, 33-49, Ex. 1002, ¶¶64-79.) For example, a POSITA would use the “current quaternion” at time T, to calculate the “predicted acceleration” at time T, and “updated quaternion” at time T in Bassompierre’s EKF equations. (Ex. 1002, ¶¶64-79.) Again, PO does not dispute the correctness of the quaternion equations set forth in Dr. Sarrafzadeh’s declaration.

Fifth, contrary to PO’s contentions (Response, 55-56), Bassompierre and the asserted claims pursue the same objectives, namely, render movement on a display. PO’s discussion of Bassompierre’s carrier reference frame and the supposed decoupling of the pointer’s absolute spatial orientation from cursor movement is a distraction. (Response, 12-16, 55-56.) Equation 24 in Bassompierre (Petition, 56; Ex. 1006, 11:25–12:9) provides the necessary teaching for the claimed translation of pointer movement (spatial reference frame) to the display.

Sixth, PO’s argument that by starting “from the Euler angle embodiment, rather than Bassompierre’s first variant embodiment, Dr. Sarrafzadeh demonstrates that Bassompierre does not provide enough information for a POSA to develop a

quaternion EKF” (Response, 56) ignores the knowledge of a POSITA. Bassompierre provides only Equations 25 through 27 in quaternion form because it assumes that a POSITA knows how to implement the EKF equations in quaternion form. *Kim* confirms this, showing the determination of the predicted acceleration from quaternions as part of the measurement model of the EKF, but leaving to the POSITA the remaining details of the full EKF implementation. (Ex. 1007, 270, Section III.B). Similarly, PO’s expert published papers describing the use of EKFs in quaternion form without detailing the relevant equations and operations in quaternion form. (Ex. 1023.)

V. BASSOMPIÈRE AND NASIRI RENDER CLAIM 1 OBVIOUS

PO does not contest that the Bassompierre-Nasiri combination discloses an integrated “electronic device” that rotates with respect to a solitary “spatial reference frame,” which satisfies all limitations of claims 1, 3, 7, and 9. PO merely argues that the Petition “does not proffer any motivation to import the EKF algorithm of Bassompierre to [Nasiri’s] device.” (Response, 41.) That argument ignores and leaving wholly unrebutted Petitioner’s explanation that Bassompierre and Nasiri have overlapping teachings regarding the use of gyroscopes, accelerometers, sensor fusion algorithms (e.g., EKF), gravity vectors, gaming applications on a two-dimensional display, and single body devices. (Petition, 65-69.)

PO suggests that there would have been no likelihood of success because

“Bassompierre requires a stationary device reference frame separate from a pointer reference frame in order to function.” (Response, 41.) PO bases this argument on its expert’s testimony that if the device and display frames were “unified” Bassompierre’s tilt/torsion problem would return. (Ex. 2040, ¶85.) But Dr. LaViola never explains what he means by “unified,” i.e., whether the tilt/torsion problem returns if the device reference frame and display reference frame are the same, or if they are merely fixed relative to each other. Regardless, Petitioner does not argue that a POSITA would collapse Bassompierre’s display reference frame and device reference frame; instead, a POSITA would fix one with respect to the other using a transformation matrix in view of Bassompierre’s own Figure 5 where both parts of the device are related by fixed angle θ in the same housing. (Petition, 68-69). Thus, a POSITA could reasonably expected to implement Bassompierre’s sensor fusion algorithm in a device like Nasiri where both the sensors and the display screen are fixed in the same housing. (Ex. 1002, ¶¶91-92.)

VI. NPS IS NOT AN RPI

NPS did not control, fund, or influence this IPR in any way. (See Ex. 1025, ¶¶1-4.) NPS cannot be an RPI for this reason alone. NPS’s alleged 7.8% ownership stake does not warrant a different conclusion. *Tianma* itself notes that a percentage ownership is “not necessarily dispositive.” *Tianma Microelectronics Co. v. LG Display Co.*, IPR2025-01579, Paper 12, 8 n.6 (March 18, 2026) (precedential).

Here, NPS is merely a passive pension fund no different from other passive owners (e.g., Vanguard) of U.S. publicly traded companies. PO has not shown otherwise. In fact, PO's allegation that "NPS possesses the ability to influence Samsung's...litigation" (Paper 28, 3–4) is baseless because NPS's responsible-investment materials treat "litigation" as NPS's own shareholder derivative suits or damages claims and state that, in that context, NPS "does not exercise any influence on investee companies or directors." (Ex. 1024, 16; *see also* Paper 33, 5–6 (Board finding it "at least as likely, if not more so," that "litigation" refers to NPS initiating litigation on its own behalf); Ex. 2044, 53, 60.)

VII. PO'S OTHER ARGUMENTS ARE MERITLESS

Contrary to PO's arguments, the absence of quaternions from the provisional application does not conflict with Petitioner's obviousness position that Bassompière teaches the use of quaternions. (Response, 64-65.) Unlike Bassompière, the provisional application indisputably does not once mention quaternions, let alone suggest to a POSITA that quaternions ought to be utilized. (Petition, 71-74.) PO again argues for §325(d) discretionary denial by alleging that Petitioner failed to carry its burden under *Ecto World*. (Response, 42.) That argument was raised as part of discretionary denial briefing and rejected. PO's argument that Dr. Sarrafzadeh's testimony is not credible is meritless. (*Id.*, 62-64.) In a seven-hour deposition and in a rebuttal expert declaration, PO could not identify

any substantive errors in Dr. Sarrafzadeh’s declaration. That Dr. Sarrafzadeh could not remember on the spot the exact number of hours spent preparing the declaration or the source of the references raised in his declaration do not go to the credibility of his technical opinions, which remain undisturbed. PO’s incorrect construction of “predicted axial accelerations” and mischaracterizing of the record relating to that term cannot be the basis for Dr. Sarrafzadeh’s supposed failure to articulate or consistently apply claim construction. (*Supra*, Section II.B.)

VIII. CONCLUSION

The Board should find claims 1, 3, 7, and 9 of the ’846 patent unpatentable and cancel them.

Respectfully submitted,

Dated: July 17, 2026

By: /Naveen Modi/
Naveen Modi (Reg. No. 46,224)

Counsel for Petitioner

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Petitioner's Reply to Patent Owner's Response contains, as measured by the word-processing system used to prepare this paper, 5,569 words. This word count does not include the items excluded by 37 C.F.R. § 42.24 as not counting towards the word limit.

Respectfully submitted,

Dated: July 17, 2026

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CERTIFICATE OF SERVICE

I certify that I caused to be served on the counsel identified below a true and correct copy of the Petitioner's Reply to Patent Owner's Response and supporting exhibits by electronic means on July 17, 2026:

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