

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,

v.

CM HK LIMITED,
Patent Owner.

IPR2025-01071
Patent 11,698,687

**PATENT OWNER'S SUR-REPLY TO PETITION
FOR *INTER PARTES* REVIEW OF U.S. PATENT 11,698,687**

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EXHIBIT LIST

Ex. No.	Description
2002	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd. et al.</i> , Case No. 4:24-cv-06567 at Docket 1 (N.D. Cal. Sep. 18, 2024), Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc.’s Complaint for Declaratory Judgment
2003	<i>CM HK, Limited, v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:24-cv-00880 at Docket 46 (E.D. Tex. June 26, 2025), Defendants Samsung Electronics Co, Ltd. And Samsung Electronics America, Inc.’s Renewed Motion to Stay Pending Resolution of Any Motion to Dismiss the NDCA Action
2004	<i>CM HK, Limited, v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:24-cv-00880 at Docket 47 (E.D. Tex. July 9, 2025), Plaintiff CM HK Ltd.’s Opposition to Defendants’ Motion to Dismiss, Transfer, or Stay
2005	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 at Docket 73 (N.D. Cal May 15, 2025), Order Granting Defendant CM HK, Ltd.’s Motion to Dismiss
2006	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 at Docket 80 (N.D. Cal June 10, 2025), Joint Stipulation and Order to Stay All Deadlines in the Scheduling Order
2007	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 at Docket 72 (N.D. Cal May 13, 2025), Joint Claim Construction and Prehearing Statement
2008	<i>CM HK, Limited, v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:24-cv-00880 at Docket 2 (E.D. Tex. November 1, 2024), Plaintiff’s Original Complaint for Patent Infringement
2009	<i>CM HK, Limited, v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:24-cv-00880 at Docket 17 (E.D. Tex. Jan 28, 2025), Plaintiff’s Amended Complaint for Patent infringement
2010	<i>CM HK, Limited, v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:24-cv-00880 at Docket 36 (E.D. Tex. Mar. 3, 2025), Docket Control Order

2011	<i>CM HK, Limited, v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:24-cv-00880, (E.D. Tex. Jan. 7, 2025), Plaintiff’s P.R. 3-1 & 3-2 Disclosures
2012	<i>CM HK, Limited, v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:24-cv-00880, (E.D. Tex. Mar. 4, 2025), Defendants Samsung Electronics Co., Ltd and Samsung Electronics America, Inc’s Local Patent Rule 3-3 Disclosures
2013	Docket Navigator, “Time to Trial for Judge Rodney Gilstrap” (August 7, 2025)
2014	Docket Navigator, “Time to Trial for Eastern District of Texas,” (August 7, 2025)
2015	U.S. Patent Publication No. 2011/0199298, Bassompierre et al.
2016	Email from Bratton, Ariell, RE: <i>Samsung v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 (N.D. Cal.), IPR Threats to Evans, Christopher (May 2, 2025)
2017	March 24, 2025, Director’s Memo, <i>Guidance on USPTO’s rescission of “Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation,”</i> Boalick, Scott R. (August 7, 2025)
2018	Patent Trial and Appeal Board, FAQs for Interim Processes for PTAB Workload Management (accessed August 15, 2025)
2019	<i>Reserved</i>
2020	U.S. Patent Publication No. 2011/0163950, Ye et al
2021	U.S. Patent Publication No. 2011/0175806, Ye et al
2022	Declaration of Christopher L. Evans
2023	<i>CyWee Group Ltd. v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:17-cv-00140-RWS-RSP (E.D. Tex. Mar. 21, 2018), Declaration of Dr. Joseph J. LaViola, Jr. Ph.D. in support of CyWee Group Ltd.’s Reply Claim Construction Brief
2024	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 at Docket 110 (N.D. Cal. Aug. 27, 2025), Samsung’s Opposition to CM HK’s Rule 11 Motion for Sanctions

2025	<i>CyWee Group Ltd. v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:17-cv-00140-RWS-RSP at Docket 67 (E.D. Tex. Mar. 9, 2018), Samsung's Responsive Claim Construction Brief
2026	<i>CyWee Group Ltd. v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:17-cv-00140-RWS-RSP at Docket 67-1 (E.D. Tex. Mar. 9, 2018), Responsive Declaration of M. Ray Mercer, Ph.D.
2027	Andre Cornman & Darren Mei, <i>Extended Kalman Filtering</i> (Stanford EE 267, Virtual Reality Course Report, Gordon Wetzstein & Robert Konrad instructors, 2019)
2028	U.S. Patent & Trademark Office, Memorandum from Coke Morgan Stewart, Acting Under Sec'y of Commerce for Intellectual Prop. & Acting Dir. of the U.S. Patent & Trademark Office, to Members of the Patent Trial & Appeal Bd. (July 31, 2025), Enforcement and Non-Waiver of 37 C.F.R. § 42.104(b)(4) and Permissible Uses of General Knowledge in Inter Partes Reviews
2029	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 at Docket 93 (N.D. Cal Aug. 13, 2025), CM HK's Rule 11 Motion for Sanctions
2030	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 at Docket 116 (N.D. Cal Sep. 03, 2025), CM HK's Reply in support of its Rule 11 Motion for Sanctions
2031	<i>Google LLC v. CyWee Group Ltd.</i> , IPR2018-01257 (P.T.A.B. Jun. 14, 2018), Declaration of Prof. Majid Sarrafzadeh
2032	Declaration of Prof. Majid Sarrafzadeh from IPR2018-01257 and IPR2018-01258 dated June 17, 2019
2033	Rebuttal Declaration of Prof. Majid Sarrafzadeh from IPR2018-01257 dated June 13, 2018
2034	U.S. Patent 10,201,746 B1
2035	Deposition Transcript of Majid Sarrafzadeh on Feb. 27, 2026
2036	Excerpts from Expert Report of Dr. M. Ray Mercer Regarding Noninfringement dated Dec. 3, 2018 in <i>CyWee Group Ltd. v. Samsung Elects. Co., Ltd. et al</i> , No. 2:17-cv-00140-WCB-RSP (E.D. Tex.)

2037	Expert Report of Dr. M. Ray Mercer Regarding Invalidity dated Oct. 8, 2018 in <i>CyWee Group Ltd. v. Samsung Elects. Co., Ltd. et al</i> , No. 2:17-cv-00140-WCB-RSP (E.D. Tex.)
2038	D. M. Henderson, <i>Euler Angles, Quaternions, and Transformation Matrices—Working Relationships</i> , McDonnell Douglas Tech. Servs. Co. (1977)
2039	Exhibits 2020 through 2030 from IPR2018-01257 and IPR2018-01258
2040	Declaration of Dr. Joseph LaViola in Support of Patent Owner’s Response
2041	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 at Docket 51-1 (N.D. Cal Jan. 28, 2025), Declaration of Dr. Shun-Nan Liou in Support of CM HK’s Motion to Dismiss
2042	<i>Samsung Electronics Co., Ltd., et al., v. CM HK, Ltd.</i> , Case No. 4:24-cv-06567 at Docket 61-2 (N.D. Cal Feb. 18, 2025), Declaration of Dr. Shun-Nan Liou in Support of CM HK’s Reply in Support of its Motion to Dismiss
2043	Curriculum Vitae of Dr. Joseph LaViola
2044	National Pension Service - National Pension Fund Report 2024
2045	BigGo Finance – South Korea’s National Pension Fund Sees Stock Holdings Surge by ~\$48 Billion in Q4, Driven by Samsung and SK Hynix Rally, January 10, 2026
2046	Maeil Business News Korea – Printed from https://www.mk.co.kr/en/stock/12007600 on April 5, 2026
2047	<i>Samsung Electronics Co., Ltd., et al. v. CM HK, Limited</i> , Case No. 4:24cv-06567-JST, (N.D. Cal. Mar. 14, 2025), Samsung Electronics Co., Ltd and Samsung Electronics America, Inc’s Local Patent Rule 3-3 Disclosures
2048	<i>Samsung Electronics Co., Ltd., et al. v. CM HK, Limited</i> , Case No. 4:24cv-06567-JST, (N.D. Cal. Mar. 28, 2025), Samsung Electronics Co., Ltd and Samsung Electronics America, Inc’s Local Patent Rule 4-1 Disclosures
2049	<i>Samsung Electronics Co., Ltd., et al. v. CM HK, Limited</i> , Case No. 4:24cv-06567-JST, (N.D. Cal. Apr. 18, 2025), Samsung Electronics Co., Ltd and Samsung Electronics America, Inc’s Local Patent Rule 4-2 Disclosures

2050	Email correspondence between parties and the Board dated May 15, 2026 through May 18, 2026
2051	<i>Samsung Electronics Co., Ltd., et al. v. CM HK, Limited</i> , Case No. 4:24-cv-06567-JST, ECF No. 207 (N.D. Cal. Apr. 18, 2025), Samsung's Motion to Retain Confidentiality with Exhibits 1-6
2052	Robert A. Matthews, Jr., <i>Annotated Patent Digest</i> § 23:25.120 (May 2026 update)

I. INTRODUCTION

Petitioner bears the burden to prove, by a preponderance of the evidence that claims 1-7, 12, and 14 of U.S. Patent No. 11,698,687 are unpatentable.

Petitioner alleges that a POSITA would derive the '687 Patent's quaternion-based equations from Bassompierre's Euler angle EKF and modify Bassompierre's process to calculate resultant angles from a quaternion. But derivability is not disclosure. Bassompierre does not disclose a quaternion EKF, and does not compute any absolute orientations because Bassompierre decouples reference frames so that yaw is fixed at zero by design. Petitioner's theory relies entirely on its expert's rewrite of Bassompierre using the '687 Patent as both his hindsight guide and target.

Petitioner's Reply also fails on claim construction. It argues "plain and ordinary meaning" for terms it simultaneously contends are indefinite in co-pending district court litigation, imports a "3D pointing device" into claims that recite only an "electronic device," and invokes an unsupported grammatical rule to strip the spatial reference frame limitation from the operative claim step.

II. ARGUMENT

A. CLAIM CONSTRUCTIONS.

1. Spatial Reference Frame – Claims 1, 2, 7, 14

Patent Owner's Proposed Construction	Petitioner's Proposed Construction
Claims 1, 2, 7: frame of reference associated with the electronic device,	no construction needed

which always has its origin at the same point in the device and in which the axes are always fixed with respect to the device Claim 14: frame of reference associated with a device, which always has its origin at the same point in the device and in which the axes are always fixed with respect to the device	
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The parties agree that this term requires a frame of reference “which always has its origin at the same point in the device and in which the axes are always fixed with respect to the device.” The parties diverge on whether the reference frame is tied to the “electronic device,” as the claims recite, or to a “3D pointing device,” which appears nowhere. Patent Owner also proposed separate constructions for claims 1 and 14 because, unlike claim 1, claim 14 is a method claim not tied to a particular device.

The claim language ties the “spatial reference frame” to the “electronic device” twice: “An electronic device subject to movements and rotations in a spatial reference frame, comprising” ... “a computing processor having processor circuitry configured to calculate a resulting deviation associated with the *movements and the rotations of the electronic device in the spatial reference frame.*” (Ex. 1001, claim 1 (emphasis added).) No claim recites a “3D pointing device.” (*Id.*)

The prior IPR confirms this. In IPR2018-01257, involving a related patent, the

parties agreed that “spatial reference frame” meant “a reference frame associated with the 3D pointing device, which always has its origin at the same point in the device and in which the axes are always fixed with respect to the device.” (Ex. 1013 at 46.) But the claim there specifically recited “a 3D pointing device, comprising: ... an accelerometer, generating a first signal set comprising axial accelerations associated with movements and rotations of the 3D pointing device in the spatial reference frame.” (Ex. 1010 at 35:40-58.) That is nearly identical to the ’687 Patent’s counterpart claim language, except the ’687 Patent’s claims recite “electronic device” where the earlier claim recited a “3D pointing device” (Ex. 1001 at 31:15-24.) The agreed construction tracked the device the claim itself named. It should do the same here with “electronic device” substituted for “3D pointing device.”

The specification agrees, describing embodiments in which the spatial reference frame is that of an electronic device. (Ex. 1001 at 23:32-40 (“a resultant deviation including deviation angles in a spatial reference frame of an electronic device, including ... a smartphone or other portable electronic apparatus”); *see also id.* at 5:39-45, 8:12-18, 9:15-21, 10:1-9, 10:63-11:1, 13:60-14:5, 14:6-18, 17:37-46, 19:21-35, Figs. 6, 7, 8, 10, 11, 12.)

Finally, Petitioner’s position cannot be reconciled with its argument in district court that the term “spatial reference frame” is indefinite under 35 U.S.C. § 112(2) because it “fail[s] to inform, with reasonable certainty, those skilled in the art about

the scope of the invention.” (Ex. 2012 at 69-71; Ex. 2047 at 69-71; Paper 31 at 7-11.) That inconsistency further undermines Petitioner’s construction.

Accordingly, the Board should reject Petitioner’s invitation to import a “3D pointing device limitation” into claims 1 and 14 and instead adopt Patent Owner’s constructions:

Claims 1, 2, 7: “frame of reference associated with the electronic device, which always has its origin at the same point in the device and in which the axes are always fixed with respect to the device

Claim 14: “frame of reference associated with a device, which always has its origin at the same point in the device and in which the axes are always fixed with respect to the device.”

2. Predicted axial accelerations – Claims 1, 4, 14

Patent Owner’s Proposed Construction	Petitioner’s Proposed Construction
Claim 1: Gravitational acceleration along the electronic device’s axes derived from the current quaternion	Plain and ordinary meaning: prediction of an axial acceleration

This term raises three questions: (i) whether it must be construed at all; (ii) whether it means gravitational acceleration along the device’s axes derived from the current quaternion; and (iii) whether Petitioner has advanced inconsistent constructions without explanation.

First, the Board must construe the term because the parties dispute its scope. *O2 Micro Int’l Ltd. v. Beyond Innovation Tech. Co.*, 521 F.3d 1351, 1360 (Fed. Cir. 2008) (“When the parties raise an actual dispute regarding the proper scope of these

claims, the court, not the jury, must resolve that dispute.”). The construction “must ... be explicit, at least as to any construction disputed by [the] parties.” *CSR, PLC v. Skullcandy, Inc.*, 594 F. App’x 672, 678 (Fed. Cir. 2014) citing *Gechter v Davidson*, 116 F.3d 1454, 1457 (Fed. Cir. 1997). Petitioner contends there is no dispute because Patent Owner’s construction “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.” (Paper 35, “Reply” at 2-3.) In other words, Petitioner concedes that the “predicted axial accelerations” must be derived from a quaternion.

Second, Patent Owner’s construction comes directly from the claims and the specification. Claim 1 explicitly requires “converting variables of the current quaternion into predicted axial accelerations corresponding to time T.” (Ex. 1001, claim 1.) The predicted axial accelerations are thus computed from the device’s orientation, expressed as the current quaternion. “This is a direct mathematical transformation because the current quaternion encodes an orientation, and from that orientation, the direction of gravity relative to the device’s body axes can be computed precisely.” (Ex. 2040, ¶ 68.) A quaternion carries “no information about the device’s linear motion or rotational velocity,” so converting it into predicted axial accelerations “yields the components of gravitational acceleration along each device axis and nothing more.” (Ex. 2040, ¶¶ 96, 122.) Equations 2 through 4 in the specification convert the current quaternion into “the gravitational acceleration

components that the accelerometer should be measuring if the device were oriented exactly as the current quaternion describes.” (*Id.*, ¶ 68.) Gravity is the only axial acceleration that can be predicted from a quaternion or the device’s orientation.

This was confirmed by Samsung’s prior expert, Dr. Mercer, who testified: “A POSA would have understood that it is only mathematically possible to generate an orientation output based on “axial accelerations” and magnetism readings if the axial accelerations are interpreted to be based exclusively on the gravitational accelerations.” (Ex. 2026, ¶ 199.)

The specification confirms that “predicted axial accelerations” are “calculated based on the abovementioned current state or second quaternion,” and that “the computing processor may use a data conversion utility to convert quaternion into the predicted axial accelerations Ax' , Ay' and Az' ” through equations (2), (3), and (4). (Ex. 1001, 17:18-38, Figs. 7, 8, 10, 11.)

Petitioner, by contrast, supports its construction, “prediction of an axial acceleration” only with the testimony of Dr. Sarrafzadeh. (Reply at 4 (citing Ex. 2036).) But the Board “should discount any expert testimony ‘that is clearly at odds with the claim construction mandated by the claims themselves, the written description, and the prosecution history, in other words, with the written record of the patent.’” *Phillips*, 415 F.3d at 1318. Petitioner’s proposed construction merely rephrases “predicted axial accelerations” without clarifying its meaning or scope.

Third, Petitioner offers no explanation for its inconsistent positions. Petitioner relies exclusively on the Institution Decision, arguing that 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.” (Reply at 4 (citing Paper 17 at 21-22).) But the Institution Decision did not address Dr. Mercer’s reports or Petitioner’s indefiniteness defenses asserted in district court. (See *generally* Paper 17.) Moreover, the Institution Decision was procured because of Petitioner’s misconduct that is currently pending before the Board in Patent Owner’s Authorized Motion for Sanctions. (Paper 31.)

Finally, Petitioner’s complaint that Patent Owner submitted only a redacted excerpt of Dr. Mercer’s report is irrelevant. Petitioner has the complete report and could have filed any missing portion it believed supplied missing context. Petitioner did not. The cited excerpts accurately reflect Dr. Mercer’s claim interpretations and Petitioner offers no explanation for abandoning those positions here.

Accordingly, the Board should adopt Patent Owner’s construction for this term.

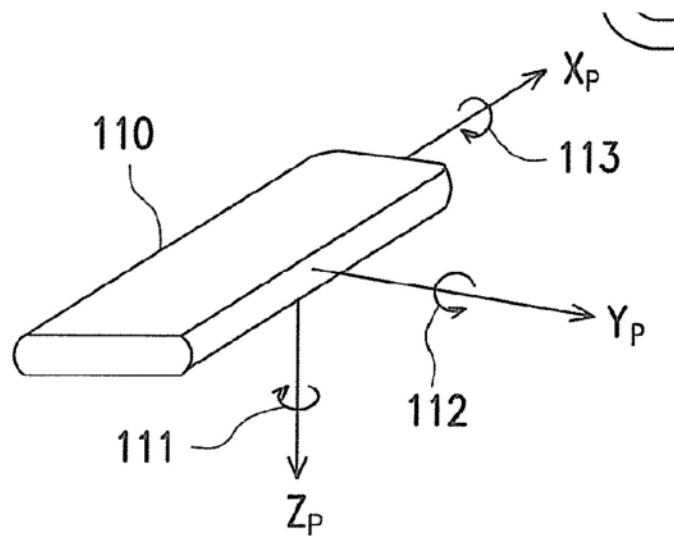
3. Resulting Deviation – Claims 1, 7, 12, 14, 25

Patent Owner’s Proposed Construction	Petitioner’s Proposed Construction
orientation of the electronic device expressed as yaw, pitch, and roll angles	plain and ordinary meaning

The issue for this term is whether Patent Owner’s construction is unnecessarily

limiting because it includes yaw. It is not. Petitioner relies on Bassompierre’s pitch angle and roll angle as disclosing the “resulting deviation.” (Reply at 12.)

Patent Owner’s construction comes directly from the specification. (Patent Owner’s Response at 30-45.) The specification consistently describes calculating “the resulting deviation of the electronic device 300 including three resultant angles preferably about each of the three axes of the spatial reference frame.” (Ex. 1001, 10:65-11:1.) Figure 1 depicts those “resultant angles” as the rotational angles about the three orthogonal axes: the yaw angle (111) about Z_p , the pitch angle (112) about Y_p , and the roll angle (113) about X_p :



(Ex. 1001, Fig. 1.) The specification describes it the same way: “the second updated state ... may be further calculated and converted to the *resulting deviation* including resultant angles ... wherein the resultant angles includes the yaw angle, pitch angle

and roll angle ... associated with the spatial reference frame, preferably about each of *three orthogonal coordinate axes* of the spatial reference frame.” (*Id.*, 26:9-18 (emphasis added).) The same “three orthogonal coordinate axes” language is cited by Petitioner as “confirming lack of the lexicography mandating PO’s proposed construction.” (Reply at 6 (citing Ex. 1001, 13:5-14; 13:60-14:5).) So, they are not inconsistent with Patent Owner’s construction because “Euler angles represent orientation as three sequential angles (yaw, pitch, and roll) about three orthogonal axes.” (Ex. 2040, ¶ 54.)

Petitioner’s attack on the inclusion of yaw in Patent Owner’s construction fails because it improperly imports an accuracy limitation into the claims and misapplies claim differentiation. Patent Owner’s expert testified that a three-axis gyroscope “provides angular velocities for roll, pitch, and yaw,” and “if you integrate angular velocity, it will give you the orientation for roll, pitch, and yaw.” (Ex. 1022, 22:5-20; *see* Ex. 2040, ¶ 71.) And that “absolute orientation” can be calculated using only a gyroscope and accelerometer. (Ex. 1022, 37:19-38:6.) This testimony is un rebutted. Petitioner relies on Dr. LaViola’s testimony that yaw angle predictions drift and are less accurate in the absence of magnetometer readings. (Reply at 7-8 (citing Ex. 1022, 24:12-15, 26:14-27:6, 37:19-38:6, 107:21-109:3).) But that testimony is irrelevant because the claims at issue have no drift or accuracy related limitations.

Petitioner’s claim-differentiation argument fails because the yaw angles referenced in dependent claims 9, 10, 22 and 23 are not part of the “resulting deviation.” Claims 2 and 8 recite a “measured yaw angle” and a “predicted yaw angle” as intermediate values in the EKF correction. (Ex. 1001, claims 9, 10, 22, 23.) Those intermediate yaw angles are not the final “resultant angles” that represent the device’s orientation (or updated quaternion); they are intermediate steps used to compute that orientation. Thus, claim differentiation does not apply because Patent Owner’s construction is consistent with those dependent claims; it does not render them “void, meaningless, or superfluous.” *See Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 810 (Fed. Cir. 2021).

Finally, Petitioner’s construction cannot be reconciled with its argument in district court that the term “resulting deviations comprising resultant angles” is indefinite. (Ex. 2012 at 69-71; Ex. 2047 at 69-71; Paper 31 at 2-3.)

Accordingly, the Board should adopt Patent Owner’s construction.

4. Quaternion – Claims 1, 3, 12, 14, 25

Patent Owner’s Proposed Construction	Petitioner’s Proposed Construction
Plain and ordinary meaning, which is: a four-component mathematical representation used to represent three-dimensional orientation as a single rotation.	Plain and ordinary meaning

Petitioner argues that no construction is needed because it ‘does not resolve any

dispute between the parties.’ (Reply at 1-2.) That is incorrect. The construction resolves the threshold question of what Bassompière must disclose. Patent Owner’s construction confirms that Petitioner can prevail only by proving that a POSITA “would ... have been motivated to use quaternions instead of Euler angles in Bassompière's EKF.” (Reply at 2.) Accordingly, the Board should adopt Patent Owner’s proposed construction.

5. Provide/Providing Content Based on the Resulting Deviation in the Spatial Reference Frame – Claims 1, 14

Patent Owner’s Proposed Construction	Petitioner’s Proposed Construction
Plain and ordinary meaning, which requires the content to be provided in the spatial reference frame	Plain and ordinary meaning

Samsung makes three arguments against Patent Owner’s proposed construction: (i) there is no dispute to resolve, (ii) Patent Owner’s proposed construction violates the rule of last antecedent, and (iii) Patent Owner’s construction improperly excludes the embodiment of figure 5. (Reply at 8-11.) All fail.

First, the scope of this term bears directly on patentability because under Patent Owner’s proposed construction Bassompière fails to disclose this limitation. Bassompière provides content in the screen reference frame, not the device reference frame. (Ex. 1006, Figs. 2, 3; Ex. 2040, ¶ 73; Ex. 1002, ¶ 44.) Petitioner itself identifies the device reference frame as the "spatial reference frame." (Paper 1,

“Petition” at 26 (“The pointer is subject to 'movements and the rotations in a spatial reference frame,' i.e., the reference frame XYZ of the pointer 10.”).) Under Patent Owner's construction, Bassompierre does not “provide content ... in the spatial reference frame.” When the construction of a term determines whether the prior art discloses a claim limitation, there is a dispute the Board must resolve. *O2 Micro Int'l Ltd. v. Beyond Innovation Tech. Co.*, 521 F.3d 1351, 1360 (Fed. Cir. 2008).

Second, Petitioner’s “no commas separate the words,” rule of last antecedent argument is made without citation. (Reply at 9.) And the Supreme Court has stated, in the context of statutory interpretation, that the rule of last antecedent “is not an absolute and can assuredly be overcome by other indicia of meaning.” *Barnhart v. Thomas*, 540 U.S. 20, 26 (2003). English prepositional phrases of location and context frequently function as adverbials with wide scope, modifying the entire predicate rather than the nearest noun. Consider: “The analyst reported the findings *based on the data* in the quarterly meeting.” No one reads “in the quarterly meeting” as modifying “the data.” It modifies “reported,” the operative verb. Here are a few more examples of sentences employing the same structure:

The navigator will plot the course *based on the star positions* in nautical coordinates.

The surgeon will make the incision *based on the imaging results* in the operating room.

The processor will output the signal *based on the detected frequency* in the radio frequency domain.

Each example follows the identical syntactic structure: [verb] [based on X] [in Y] with no commas, yet in each case “in Y” naturally modifies the verb rather than X. The same logic applies here: “wherein the processor circuitry is further configured to provide content *based on the resulting deviation* in the spatial reference frame.”

Third, Samsung’s argument that Patent Owner’s proposed construction excludes the embodiment of Figure 5 from the claim scope seeks to impermissibly confine the claims to specific embodiments. As the Federal Circuit held in *Phillips*, “although the specification often describes very specific embodiments of the invention, we have repeatedly warned against confining the claims to those embodiments.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1323 (Fed. Cir. 2005) (en banc). And has repeatedly held that when “the patent describes multiple embodiments, every claim does not need to cover every embodiment.” *Apple Inc. v. Andrea Elecs. Corp.*, 949 F.3d 697, 708 (Fed. Cir. 2020). Because it “is the claims, not the preferred embodiments, that define the metes and bounds of the patentee’s invention.” *IQRIS Techs. LLC v. Point Blank Enters., Inc.*, 130 F.4th 998, 1004 (Fed. Cir. 2025). That is the case here. Patent Owner’s proposed construction “simply leaves out some alternative embodiments ... while capturing one embodiment expressly described” as permitted. *SIMO Holdings Inc. v. Hong Kong uCloudlink*

Network Tech. Ltd., 983 F.3d 1367, 1379–80 (Fed. Cir. 2021).

Accordingly, the Board should adopt Patent Owner’s proposed construction.

B. BASSOMPIÈRE DOES NOT DISCLOSE THE FOLLOWING CLAIM LIMITATIONS.

As Patent Owner’s Response showed, Bassompierre does not teach multiple claim elements, including “quaternions,” “predicted axial accelerations,” “resulting deviation,” and “data association model.” Petitioner’s answer takes two forms: it disputes Patent Owner’s claim constructions, or it concedes that Bassompierre is written in Euler angles and argues that a POSITA “would know how to derive” the limitation “in quaternion form.” The first is answered by the claim construction section above; the second is a modification argument, not a disclosure. Neither shows that Bassompierre teaches the claimed limitations.

1. Quaternion.

Petitioner’s argument that Bassompierre discloses “quaternions” is based entirely on “*modifying* Bassompierre’s Euler-based EKF equations to use quaternions...” (Reply at 11 (emphasis added).) Bassompierre does not inherently teach this limitation. And, as explained below, a POSITA would not have modified Bassompierre to create that quaternion version. (Paper 24, “Patent Owner Response” at 45-51; *infra* § II.C.)

2. Predicted axial accelerations.

Patent Owner does not agree that Equation 22 of Bassompierre teaches “predicted

axial accelerations” because it does not derive them from the current quaternion as required by the claims. Once again, Petitioner argues that POSITA “would know to *derive* [equation 22] in quaternion form...” (Reply at 11-12 (emphasis added).) So, Bassompierre does not inherently teach this limitation. And, as explained below, a POSITA would not have modified Bassompierre to create that quaternion version. (Patent Owner Response at 45-51; *infra* § II.C.)

3. Resulting deviation.

Petitioner’s assertion that the pitch and roll angles in Bassompierre are “resulting deviation” is incorrect. (Reply at 12.) The “resulting deviation” limitation is missing entirely from Bassompierre. As explained above, the “resulting deviation” is the “orientation of the electronic device expressed as yaw, pitch, and roll angles,” which reflect the device’s absolute orientation. (*Supra* § II.A.3.) Bassompierre never calculates orientation; it focuses exclusively on pitch and roll. (Patent Owner Response at 42-44; Ex. 1006, 11:9-30 (“These two values give direct information on the horizontal displacements ... and vertical displacements ... regardless of the angle of yaw...”)).) [Y]aw plays no role in cursor control” in Bassompierre. (Ex. 2040, ¶¶ 74, 76.)

So, the “absolute orientation of the device relative to the screen is therefore immaterial to pointer control” in Bassompierre. (*Id.*, ¶ 74.)

Further, Petitioner’s entire case rests on the Euler angle state vector being

replaced by a quaternion state vector. As a result, Petitioner's equations for $\hat{x}_k^-$ and $\hat{y}_k^-$ are in quaternion form. Therefore, Petitioner's attempt to replace Euler angles with quaternions effectively removes the pitch and roll angles (Petitioner's alleged "resultant angles") from all of Bassompierre's quaternion-converted EKF equations.

Petitioner's answer is that a POSITA would decompose a quaternion output "into the more intuitive representation of roll, pitch, and yaw," citing Kim. (Reply at 14 (citing Ex. 1007, 271).) That is another modification argument, not an inherent disclosure in Bassompierre. And it depends entirely on Kim, which is not part of this ground. And, as explained below, a POSITA would not have modified Bassompierre in this way. (Patent Owner Response at 45-51; *infra* § II.C.)

4. Data association model.

Petitioner concedes Equation 23 is in Euler form and again argues that a POSITA "would readily know to implement" it "with a four-dimensional current quaternion." (Reply at 15.) Again, this is a modification argument, not proof that Bassompierre inherently discloses this element. And, as explained below, a POSITA would not have modified Bassompierre's Equation 23 in quaternion form. (Patent Owner Response at 45-51; *infra* § II.C.)

5. Configured to provide content based on the resulting deviation in the spatial reference frame.

As discussed above, this term requires the content to be provided in the spatial

reference frame. (*Supra* § II.A.5.) Bassompierre provides content in the screen reference frame, not the device reference frame. (Ex. 1006, Figs. 2, 3; Ex. 2040, ¶ 73; Ex. 1002, ¶ 44.) Petitioner identifies the device reference frame as the “spatial reference frame.” (Petition at 26 (“The pointer is subject to ‘movements and the rotations in a spatial reference frame,’ i.e., the reference frame XYZ of the pointer 10.”)) Accordingly, Bassompierre does not “provide content ... in the spatial reference frame.”

C. PETITIONER HAS NOT SHOWN THAT A POSITA WOULD HAVE BEEN CAPABLE OR MOTIVATED TO MODIFY BASSOMPIÈRE.

Petitioner has not shown that a POSITA would have been capable or motivated to make the same modifications to Bassompierre that Dr. Sarrafzadeh did.

Petitioner relies on a single reference, Bassompierre. A single reference renders a claim obvious only if it would have been obvious to modify it to reach the claimed invention, *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1361 (Fed. Cir. 2016), which requires proof of some “suggestion or motivation to modify the teachings of that reference,” *SIBIA Neurosciences, Inc. v. Cadus Pharm. Corp.*, 225 F.3d 1349, 1356 (Fed. Cir. 2000). It is not enough, therefore, for the Petitioner to show that a POSITA would have been capable of modifying Bassompierre, they must also show that a POSITA would have been motivated.

1. No Capability.

Petitioner’s Reply repeatedly mischaracterizes the record, stating that PO does not dispute Petitioner’s modified quaternion equations. (See, e.g., Reply at 2, 11, 15, 17, and 19 “PO does not dispute ...”) In fact, Patent Owner has repeatedly disputed the mathematical validity and origination of Petitioner’s proposed modifications. (See, e.g., Paper 8 at 28-30 and Paper 25 at 56-61.) Petitioner includes a table in their reply which highlights key equations that the Patent Owner disputes. A copy of the table of equations from Petitioner’s Reply is pasted for reference:

Euler Angle Form	Quaternion Form
“previous quaternion” and “current quaternion”	
$\hat{x}_k^- = \begin{pmatrix} \hat{\theta}_k^- \\ \hat{\psi}_k^- \end{pmatrix} = \begin{pmatrix} \hat{\theta}_{k-1} \\ \hat{\psi}_{k-1} \end{pmatrix} + T_e \begin{pmatrix} \alpha \sqrt{\omega_y^2 + \omega_z^2} \\ \omega_x \end{pmatrix}$ (Ex. 1006, equation 21.)	$\dot{q} = \frac{1}{2} \begin{bmatrix} q_0 \\ q_1 \\ q_2 \\ q_3 \end{bmatrix} \otimes \begin{bmatrix} 0 \\ \omega_x \\ \omega_y \\ \omega_z \end{bmatrix};$ (Solution to Ex. 1006, Equation 26.)
“predicted acceleration”	
$\hat{y}_k^- = \begin{bmatrix} -\sin \hat{\theta}_k^- \\ \cos \hat{\theta}_k^- \cdot \sin \hat{\psi}_k^- \\ \cos \hat{\theta}_k^- \cdot \cos \hat{\psi}_k^- \end{bmatrix}$ (Ex. 1006, equation 22.)	$\begin{bmatrix} 2(q_1 q_3 + q_0 q_2) \\ 2(q_2 q_3 - q_0 q_1) \\ q_0^2 - q_1^2 - q_2^2 + q_3^2 \end{bmatrix}$ (Petition, 38-41.)
“updated quaternion”	
$\hat{x}_k = \hat{x}_k^- + K_k \left(\begin{bmatrix} a_{x,k} \\ a_{y,k} \\ a_{z,k} \end{bmatrix} - \hat{y}_k^- \right)$ (Ex. 1006, equation 23.)	$\hat{q}_k = \hat{q}_k^- \otimes (K_k(z_k - h(\hat{q}_k^-)))$ (Petition, 46-47.)

Reply at 19.

“Previous quaternion” and “current quaternion” equation: Petitioner asserts that $\dot{q}$ is equivalent to $\hat{x}_k^-$ to allege that Bassompierre discloses a “previous

quaternion” and a “current quaternion.” (Reply at 19.) PO has repeatedly explained that terms $\dot{q}$ and $\hat{x}_k^-$ are not equivalent. (Paper 8 at 27-29 and Paper 24 at 50-51.) The term $\dot{q}$ is a time derivative, the dot denoting d/dt, while $\hat{x}_k^-$ is Bassompierre’s unitless, normalized state estimation vector. Further, Petitioner provides no explanation as to how the same equation is used for both the “previous quaternion” and the “current quaternion.”

“Predicted axial acceleration” equation: Petitioner’s expert relies on a modified form of an equation from an outside reference, Kim, to arrive at his quaternion form of “predicted axial accelerations.” (Ex. 1002 at 42-46.) PO has explained that $\hat{y}_k^-$ is derived from a rotation matrix that is only presented in Euler angle form in Bassompierre. (Paper 24 at 53.) Dr. Sarrafzadeh’s own work shows that the rotation matrix of Kim, as applied to the rotation matrix Euler angle equation of Bassompierre, does not result in the predicted axial acceleration equation that he ultimately used. (Ex. 1002 at 43-44.) Further, given that “predicted axial accelerations” are derived from the “current quaternion,” the flaws of the Petitioner’s equation for the “current quaternion” propagate to their “predicted axial acceleration” equation.

“Updated quaternion” equation: Petitioner relies on a matrix multiplication supplied by their expert to allege that Bassompierre discloses an “updated quaternion,” stating that it is equivalent to Bassompierre Eq. 23. (Reply at 19.) PO has repeatedly highlighted the Petitioner’s failure to show how a POSITA would

obtain and use this equation, and PO has never conceded that the two equations are equivalent. (Paper 8 at 29-30, Paper 24 at 41.) They are objectively not equivalent. Petitioner also relies on the matrix multiplication equation for disclosing the “data association model.”

Dr. LaViola testified that Dr. Sarrafzadeh is “a person of extraordinary skill in the art” whose knowledge “goes beyond a POSITA.” (Ex. 2040, ¶ 37; Ex. 1022, 15:21-16:11, 18:19-20:13.)

Dr. Sarrafzadeh’s inability to provide coherent, workable quaternion counterpart equations despite his high level of expertise is strong evidence that a POSITA is also not capable of constructing a quaternion EKF from Bassompierre.

2. *Motivation.*

Petitioner argues that a POSITA would have been motivated to modify Bassompierre because of the “computational efficiency of quaternions over Euler angles” and because “Bassompierre and the asserted claims pursue the same objectives.” (Reply at 16-21.) Both fail.

First, there is no evidence that Petitioner’s proposed modifications to Bassompierre would result in any gains in “computational efficiency.” Petitioner’s only proof is Bassompierre’s statement that quaternions avoid “computations of the sines and cosines of the pitch and roll angles that are greedy in terms of computation power.” (Reply at 17 (citing Ex. 1006, 20:10-13.) But Dr. LaViola testified that “a

POSITA would have recognized that the additional overhead of a quaternion implementation provides no performance advantage for a two-degree-of-freedom system like Bassompierre's." (Ex. 2040, ¶ 137.) And Petitioner's expert admitted that whether or not quaternions are more computationally efficient "depends on the application" and that sometimes "quaternions performed easier type of math" and sometimes "Euler will be easier to use." (Ex. 2035, 245:16-246:4, 254:15-25.) "You can use one or the other. It makes no difference." (*Id.*, 263:16-25.) "[I]t's not always advantageous to use quaternions over Euler angles." (*Id.*, 255:17-21.) "Sometimes you may prefer Euler." (*Id.*) Thus, there is no evidence that Dr. Sarrafzadeh's conversion of Bassompierre from Euler angles to quaternions is more computationally efficient, or that a POSITA would have believed it was or been motivated to do it.

To arrive at the "resulting deviation," Petitioner introduces further complexity by alleging that a POSITA would: (1) use quaternion form equations for calculations corresponding to Bassompierre Equations 21-23 to obtain an alleged "updated quaternion"; (2) calculate roll, pitch, and yaw angles from the updated quaternion then discard the yaw; and (3) compute the axial velocities in the carrier frame from the roll and pitch. (Reply at 13.) Petitioner falsely characterizes this as a two-step algorithm, again attempting to characterize their laborious Bassompierre modifications as equivalent to Bassompierre's simplistic Euler angle model. (Reply

at 14 citing Ex. 1006 FIG. 6.) Further, Bassompierre teaches away from such modification and teaches that angular velocity can be calculated directly from a quaternion. (Ex. 1006 Eq. 27.)

Second, Bassompierre does not pursue the same objective. The experts agree that the '687 Patent claims “describe an electronic device” and method that “track[s] an electronic device’s orientation in a spatial reference frame, output as resultant angles comprising yaw, pitch and roll angles.” (Ex. 2040, ¶ 65; Ex. 1002, ¶ 46 (“The '687 patent’s field of endeavor is ... to provide orientation of a device in three-dimensional space.”).) The specification states the goal is “outputting ... deviation including 3D angles in a spatial reference frame in an ‘absolute’ manner.” (Ex. 1001, 30:33-47.) “Absolute orientation is the exact orientation of an object.” (Ex. 1022, 35:15-22.) The claims require that “content” is provided based on the “resulting deviations.”

By contrast, Bassompierre “describes a system for moving a pointer on a screen” using “angular velocities,” and seeks to correct the “tilt or torsion” problem that arises when a user holds the pointer at 45 degrees rather than horizontal. (Ex. 2040, ¶ 73; Ex. 1002, ¶ 44; Ex. 1006, 2:16-22.) To do so, Bassompierre decouples the pointer’s absolute spatial orientation from cursor movement through its carrier reference frame. (Response at 49.) Because of that decoupling, Bassompierre never computes absolute orientation or yaw, so even a motivated POSITA following

Bassompierre would not arrive at the claimed yaw, pitch, and roll output. Further, a motivated POSITA would never determine cursor movements based on pitch or roll, but rather angular velocity. Bassompierre and the '846 patent do not have the same objectives.

Accordingly, Petitioner has shown neither a motivation to modify Bassompierre nor that a POSITA could have done so, and its theory rests on hindsight.

III. CONCLUSION

For the foregoing reasons, the Board should adopt Patent Owner's constructions of "spatial reference frame," "predicted axial accelerations," "resulting deviation," "quaternion," and "configured to provide content based on the resulting deviation in the spatial reference frame." Under those constructions, Bassompierre does not disclose the challenged limitations. And Petitioner has not shown a motivation to modify Bassompierre's EKF to use quaternions or that a POSITA would have been able to do so. Patent Owner respectfully requests that the Board confirm the patentability of claims 1-7, 12, and 14 of the '687 Patent.

Respectfully Submitted,

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CERTIFICATE OF WORD COUNT (37 C.F.R. § 42.24(d))

Pursuant to 37 CFR § 42.24(d), the undersigned certifies that this brief complies with the type-volume limitations of 37 CFR § 42.24(c)(4). This brief contains **4,878** words as calculated by the “Word Count” feature of Microsoft Word, the word processing program used to create it, which is less than the 5,600 word count limit.

This brief also complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft Word in 14-point Times New Roman font.

Respectfully submitted,

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August 12, 2026
Date

CERTIFICATE OF SERVICE 37 C.F.R. § 42.6(e)

The undersigned hereby certifies that the above document was served
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