

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,

v.

CM HK LIMITED,
Patent Owner

IPR2025-01023
Patent 10,852,846

**PATENT OWNER'S RESPONSE TO PETITION
FOR *INTER PARTES* REVIEW OF U.S. PATENT 10,852,846**

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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: Samsung v. CM HK, Ltd., 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	U.S. Patent Publication No. 2009/0262074, Nasiri et al
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

I. INTRODUCTION

Petitioner bears the burden to prove, by a preponderance of the evidence, that claims 1, 3, 7, and 9 (the “challenged claims”) of U.S. Patent No. 10,852,846 (the “’846 Patent”) are unpatentable. Petitioner has not met that burden.

This case turns on a single prior art reference: Bassompierre. Petitioner asserts that Bassompierre discloses, or renders obvious, a quaternion-based sensor fusion system for determining the orientation of a single integrated electronic device. But Bassompierre does no such thing. It describes a fundamentally different system: a two-degree-of-freedom, Euler-angle-based remote pointer that maps angular velocity into cursor movement onto a separate, stationary display.

Petitioner’s inability to bridge that gap is dispositive. Its case suffers from three independent and fatal defects.

First, Petitioner never articulates or consistently applies a construction of the claim term, “predicted axial acceleration.” Instead, it advances multiple, mutually incompatible interpretations across this proceeding and prior litigation, while its expert declines to adopt any of them. Without a consistent claim construction, Petitioner cannot establish that the prior art invalidates the claims and therefore cannot carry its burden of proof.

Second, Bassompierre does not disclose the claimed invention. It does not disclose a quaternion-based Extended Kalman filter (“EKF”), does not generate predicted

axial accelerations from a quaternion, does not operate on a single integrated electronic device, does not determine orientation in a spatial reference frame as claimed, and does not translate that orientation to a movement pattern on a display as claimed. These are not minor differences—they reflect a fundamental mismatch between what Bassompierre teaches and what the claims require.

Third, Petitioner’s theory depends on creating a system that Bassompierre never discloses. To arrive at the claimed invention, Petitioner’s expert works backwards from the ’846 Patent and maps Bassompierre’s Euler-angle equations onto the quaternion-based equations of the ’846 Patent, while ignoring or mischaracterizing the few quaternion equations presented in Bassompierre. Because the Petitioner works backwards from the ’846 Patent rather than starting from the quaternion equations that Bassompierre actually provides, they fail to contend with Bassompierre’s segmented reference frames and velocity-based cursor movements, which are distinct from the claimed “spatial reference frame” and translated “resultant angles” as claimed. Petitioner’s constructed system is, therefore, not what the prior art teaches, it is what Petitioner’s expert can build with the benefit of hindsight and the disclosures of the ’846 Patent. But expert testimony cannot supply missing claim limitations or substitute for disclosure in a printed publication. 35 U.S.C. § 311(b).

In the end, Petitioner has shown only that a skilled artisan could reconstruct a

different system using knowledge outside of Bassompière. It has not shown that Bassompière discloses or renders obvious the claimed invention. Because Petitioner has failed to prove unpatentability by a preponderance of the evidence, the Board should confirm the patentability of the challenged claims.

II. RELEVANT BACKGROUND

A. PATENT OWNER IS AN INVENTOR-LED COMPANY

CM HK is an inventor-led company formed to develop and commercialize advanced motion sensing and sensor fusion technologies. The patent at issue is the result of years of engineering work by the inventors, led by Dr. Shun-Nan Liou, who is the CEO of CM HK. Ex. 1001 (“Inventors: Shun-Nan Liou”); Ex. 2041 at ¶ 4.

The technology originated from research conducted at the Industrial Technology Research Institute (“ITRI”) of Taiwan, a leading government-supported research institution. That research was spun out to be commercialized into a venture-backed company called CyWee Group Ltd. (“CyWee Group”).

At CyWee Group from 2008-2010, the inventors worked on “research and product development activities related to motion sensing,” which resulted in the creation of a game controller known as the Z controller and the JIL Phone. Ex. 2039 at 4.

The Z controller was meant to play games on an external display. Ex. 2039 at 7. It contained a 3-axis accelerometer, and a gyroscope capable of outputting 3-axis

rotational motion, and is depicted below:



Ex. 2039 at 6-7.

The JIL Phone was a sophisticated prototype of a “smartphone with an integrated display that could be used as a 3D pointing device for game control.” *Id.* The JIL phone included a “3-axis accelerometer, 3-axis rotation output, and a 3-axis magnetometer.” *Id.* at 4. Below are pictures of the JIL Phone prototype and its use as a game controller:



Mobile Controller for Sports Games



Use the mobile phone as a controller to play sports games such as tennis and golf. Enjoy 1:1 response that match your natural movements.



Ex2039 at 64, 171 And the diagram below depicts the devices reference frame:

The phone coordinate is shown in figure below:

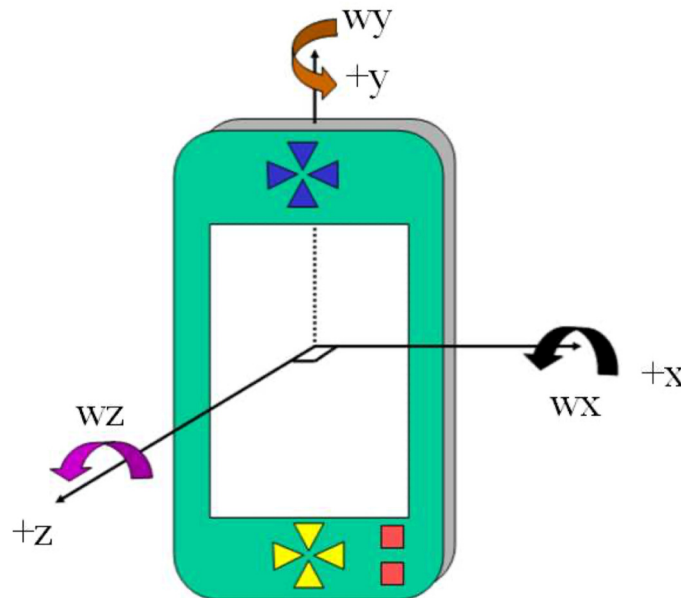


Figure 1

Ex. 2039 at 73. The JIL Phone project involved iterative hardware design, working prototypes, and multiple versions of source code implementing the claimed inventions. *See generally* Ex. 2039.

In 2014, CyWee spun out its motion sensing business unit into a new company known as the CyweeMotion group so that the technology could be further developed and commercialized under the direct leadership of its inventors. Ex. 2041, ¶¶ 3, 12-16; Ex. 2042, ¶¶ 6-8. Dr. Liou is the Chief Executive Officer and is responsible for guiding both the technology and business since then. Ex. 2041, ¶¶ 4, 12-16; Ex. 2042, ¶¶ 6-7.

Dr. Liou established CM HK as part of the CyweeMotion group in 2016 and assigned it the group's intellectual property. Ex. 2041 at ¶¶ 4, 12-24; Ex. 2042 at ¶¶ 6-7.

B. PRIOR CYWEE LITIGATION AND IPRs CONCERNING RELATED PATENTS

CyWee Group Limited previously accused Samsung of infringing the U.S. Patents 8,441,438 (the "'438 Patent") and 8,552,978 (the "'978 Patent") in a suit filed in February 2017 styled *CyWee Group Ltd. v. Samsung Electronics Co. Ltd., et al*, No. 2:17-cv-00140-WCB-RSP (E.D. Tex.) (the "CyWee Litigation"). The '438 and '978 Patents are related to and share specifications with U.S. Patent Nos. 10,852,846 (the "'846 Patent") and 11,698,687 (the "'687 Patent").

CyWee Group, Ltd.¹ also asserted the ‘438 and ‘978 Patents against Apple, LG, Huawei, HTC, Motorola, Google, and ZTE in the following cases:

CyWee Group Ltd. v. Apple Inc., No. 4:14-cv-01853 (N.D. Cal. 4/22/2014)

CyWee Group Ltd. v. Huawei Technologies Co., Inc. et al, No. 2:17-cv-00495 (E.D. Tex. 6/9/17)

CyWee Group Ltd. v. LG Electronics, Inc. et al, No. 3:17-cv-01102 (S.D. Cal. 5/31/17)

CyWee Group Ltd. v. HTC Corporation et al, No. 2:17-cv-00932 (W.D. Wa. 6/16/17)

CyWee Group Ltd. v. Motorola Mobility LLC, No. 1:17-cv-00780 (D. Del. 6/16/2017)

CyWee Group Ltd. v. ZTE Corp. et al, No. 3:17-cv-02130 (S.D. Cal. 10/17/17)

CyWee Group Ltd. v. Google, Inc., No. 1:18-cv-00571 (D. Del. 4/16/2018)

Petitions for *inter partes* review (“IPR”) were filed by nearly all these defendants and were consolidated into three IPRs: IPR2018-01257, IPR2018-01258, and IPR2019-00143 (collectively the “CyWee IPRs”). Samsung was granted permission to join IPR2018-01258 and IPR2018-01258. *See* IPR2019-00535, Paper 10; *and* IPR2019-00534, Paper 10.

In the IPRs, the following claims of the ‘438 Patent were found unpatentable:

¹ CyWee Group, Ltd. is a prior assignee of the portfolio of patents related to the ‘846 Patent.

IPR#	Patent	Unpatentable Claims	Reason
IPR2019-00143	8,441,438	1, 4, 5, 14-17, 19	§103: Yamashita & Bachmann
IPR2018-01258	8,441,438	1, 3-5	§103: Zhang & Bachmann
IPR2018-01257	8,552,978	10, 12	§103: Zhang & Bachmann

During prosecution, the CyWee IPRs were fully disclosed to the examiner. Ex. 1004 at 209-211, 328. And the '846 Patent overcame multiple rejections based on the same art, Bachmann and Yamashita, asserted in those IPRs:

Date	Title of Action	Rejections
11/26/18	Non-Final Rejection	35 USC § 102(b): Claims 1 and 9 are anticipated by Yamashita (8,267,785). 35 USC § 103: Claims 2-8 and 10-16 are unpatentable over Yamashita in view of Bachmann (7,089,148). <i>Id.</i> at 111-120.
5/24/19	Final Rejection	35 USC § 103: Claims 1-9 are unpatentable over Yamashita in view of Lu (2009/0062005). 35 USC § 103: Claims 2-8 and 10-16 are unpatentable over Yamashita and Lu and Bachmann (7,089,148). <i>Id.</i> at 145-155.
9/12/19	Non-Final Rejection	35 USC § 112: Claims 1-16 rejected as indefinite. 35 USC § 102(b): Claims 1 and 9 are anticipated by Yamashita (8,267,785). 35 USC § 103: Claims 2-8 and 10-16 are unpatentable over Yamashita in view of Bachmann (7,089,148). <i>Id.</i> at 178-190.
1/30/20	Final Rejection	35 USC § 103: Claims 1-4, 7-12, and 15-16 are unpatentable over Yamashita (8,267,785) in view of Bachmann (7,089,148). <i>Id.</i> at 225-236.

In addition, U.S. Patent Publication No. 2011/0199298 (“U.S. Bassompière”) was twice listed on an Information Disclosure Statement Submitted by Applicant and considered by the examiner during prosecution. Ex. 1004 at 103, 128; Pet. at 4.

U.S. Bassompière (Ex. 2015) is essentially identical to Bassompière (Ex. 1006). *Compare* Ex. 2015; *with* Ex. 1006; Ex. 2040, ¶ 87.

C. THE CALIFORNIA LITIGATION FILED BY PETITIONER

On September 18, 2024, Samsung filed a complaint for declaratory judgment in the Northern District of California seeking only a declaration that it *does not infringe* claims 1, 14, and 27 of the ‘687 Patent, claims 1 and 7 of the ‘846 Patent, claims 1 and 13 of U.S. Patent 10,275, 038 (the “’038 Patent”), and claims 1 and 10 of U.S. Patent 10,817,072 (the “’072 Patent”) (the “California Litigation”). Ex. 2002 at ¶¶ 1, 72, 78, 84, 90.

Petitioner limited its complaint to non-infringement claims to preserve its ability to file this IPR petition by sidestepping the statutory bar against doing so after challenging validity in court. See 35 U.S.C. § 315(a)(1).

III. PETITIONER FAILED TO IDENTIFY FOREIGN GOVERNMENT RPI

Patent Owner expressly preserves, and hereby raises, the argument that Petitioner Samsung Electronics Co., Ltd. has failed to identify all real parties in interest (“RPIs”) as required by 35 U.S.C. § 312(a)(2), and that this failure requires termination of this proceeding.

Specifically, Patent Owner believes that the National Pension Service of South Korea (“NPS”) is an undisclosed RPI. NPS is a statutory instrumentality of the South Korean government, established under the Korean National Pension Act. Ex. 2044 at 41. Its investment policies are set by the National Pension Fund Management Committee, which is chaired by the Korean Minister of Health and Welfare and manages NPS's assets “on behalf of the Minister.” *Id.*

It is widely reported that NPS holds approximately 7.25% of Samsung's outstanding ordinary shares, making it one of Samsung's largest individual shareholders. Ex. 2045 at 2. NPS actively exercises governance rights at Samsung, the full extent of which is unclear without further discovery. Ex. 2046.

Under the Director's recent precedential decision in *Tianma Microelectronics Co., Ltd. v. LG Display Co., Ltd.*, IPR2025-01579, Paper 12 (Director Mar. 18, 2026), and the Director's decision in *TikTok Inc. v. Cellspin Soft, Inc.*, IPR2024-00757, Paper 42 (Director Mar. 30, 2026), a foreign government and any entity a foreign government has the ability to control is not a “person” eligible to be a petitioner or RPI in an AIA proceeding. *See Return Mail, Inc. v. United States Postal Service*, 587 U.S. 618 (2019). Samsung's failure to identify NPS as an RPI is therefore fatal to this petition.

This evidence is sufficient to put Samsung's RPI identification into dispute. *See Worlds Inc. v. Bungie, Inc.*, 903 F.3d 1237, 1244 (Fed. Cir. 2018). The burden now

rests with Samsung to come forward with documentary evidence establishing that NPS is not an RPI. *Tianma*, Paper 12 at 9–10.

Patent Owner raises this issue here to preserve it fully and to provide Samsung and the Board with notice at the earliest opportunity. *See TikTok*, Paper 42 at 4 n.3 (addressing novel RPI issues on merits in interests of justice).

IV. TECHNOLOGY BACKGROUND

A. BASSOMPIÈRE (EX. 1006)

Bassompierre describes moving a pointer on a screen positioned in a vertical plane based on sensor data from a device in a device reference frame (X, Y, Z), by rotating that sensor data to a carrier reference frame (u, v, w), calculating angular velocities ω_v and ω_w about a vertical and horizontal axis of the carrier reference frame, and moving the pointer in the vertical plane of the screen based on the angular velocities ω_v and ω_w . Ex. 1006, 10:27-12:9, FIG. 2.²

Importantly, the pitch, roll, and yaw angles *themselves* are *not* used to determine movements of the pointer on the screen, but rather, Bassompierre uses angular rates ω_v and ω_w to move the pointer. Thus, the *absolute position* of the device in relation to the screen is immaterial. *See* Ex. 1006, 15:3-7, Figs. 2-6.

In physical terms, the user can move the cursor left and right by rotating around

² All pin cites to Bassompierre (Ex. 1006) refer to the documents internal pagination located at the top of the page.

the vertical carrier axis w and move the cursor up and down with tilt by rotating around the right-pointing carrier axis v regardless of the angle with which the pointer is held with respect to the carrier frame or display frame when moved. *Id.* at 11:10-20. The angular velocity ω_w determines left-right movement of the cursor while the angular velocity ω_v determines up-down movement. *Id.* at 11:10-12:8.

Bassompierre intentionally decouples pointer movement from the display plane to solve a problem it called the “tilt” or “torsion” problem in which the user holds the device at an angle, non-horizontally, resulting in motion of a pointer on a screen going in a diagonal direction relative to the movement of the device. *Id.* at 2:16-22, 10:28-29. Bassompierre’s solution decouples movements of the cursor on the screen from the actual orientation of the pointing device and instead bases movements on angular velocities ω_w and ω_v in the carrier reference frame. Ex. 2040, ¶ 77.

Bassompierre does not track yaw in Bassompierre’s reference frame transformation and it plays no role in cursor control. Ex. 1006, 11:25-30, 17:10-13 (“Here the angle represents the angle of yaw ... [h]owever, given the definition of these reference frames, this angle is zero...”). So, Bassompierre’s system, unlike the ’846 Patent, operates with only two degrees of freedom: roll and pitch. *Id.* at 12:3-12.

Bassompierre uses an Extended Kalman Filter (EKF) that fuses gyroscope and accelerometer measurements to estimate the pitch and roll angles of the pointer, with

respect to the carrier reference frame (user's body), in real time and then applies a coordinate transformation to re-express the raw sensor readings in the carrier reference frame, i.e. the user's body. *Id.* at 11:10-12:9, Figs. 2-6. The output of this process is the angular velocity components ω_v and ω_w in the carrier frame, which map directly to vertical and horizontal cursor displacement, in the display frame, respectively, regardless of how the user is holding the device. *Id.* at 11:25-12:9.

Bassompierre's architecture therefore requires three distinct reference frames, one each for its pointer, screen, and the carrier:

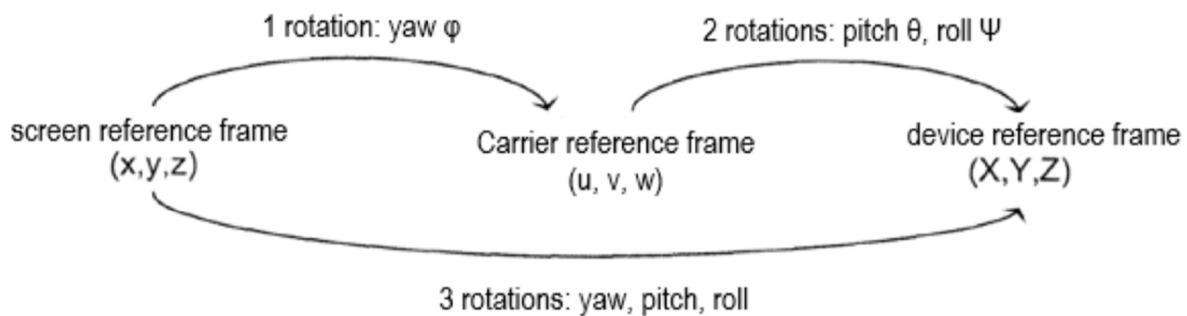


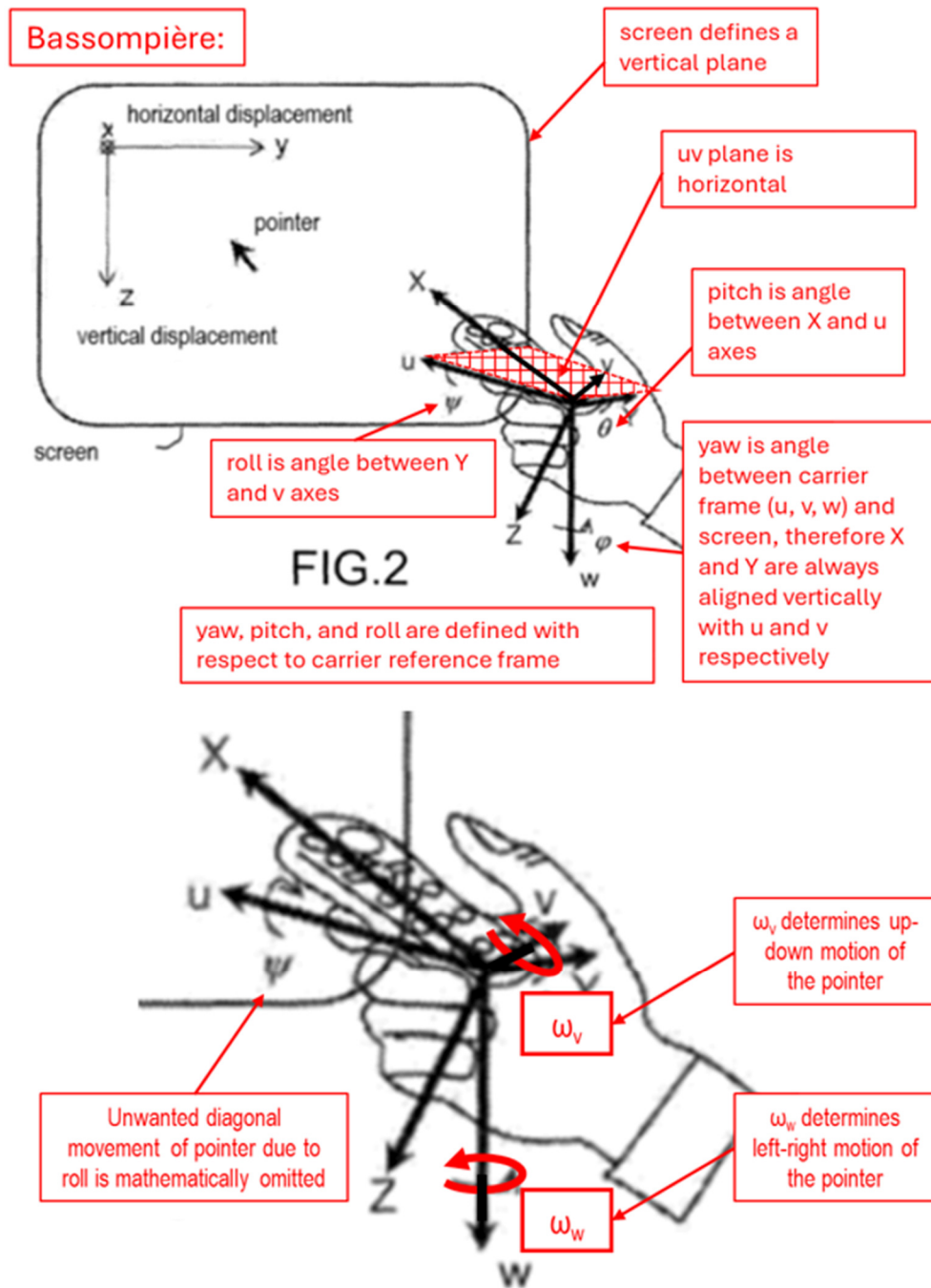
FIG.3

The pointer's frame of reference is labeled the "device reference frame" (X, Y, Z) and is where the accelerometer and gyroscope measurements are taken. Ex. 1006, 11:10-12:9, FIG. 3; Ex. 2040, ¶ 78. The "carrier reference frame" (u, v, w) is defined with u and v in a horizontal plane, respectively aligned vertically with X and Y, and w points down. Ex. 1006, FIG. 2, FIG. 3, 11:2-4; Ex. 2040, ¶ 78. Yaw, pitch, and

roll are defined with respect to the carrier reference frame. Ex. 1006, FIG. 2; Ex. 2040, ¶ 78. The screen reference frame includes a fixed vertical plane in which the horizontal and vertical displacement of the pointer is rendered. Ex. 1006, 10:30-31, 11:10-20, FIG. 2; Ex. 2040, ¶ 78.

None of Bassompierre's reference frames include both the pointer and the display. Ex. 2040, ¶ 84. In fact, the decoupling of the display and the device reference frames is required for Bassompierre to function. Ex. 2040, ¶ 85.

The relationship between the reference frames, angles, and angular velocities are depicted in Bassompierre FIG. 2 reproduced and annotated below.



Every equation in Bassompierre's EKF is expressed in Euler-angle form. Ex. 1006 at 17:9-19:11 (Eq. 11-24); Ex. 2035, 337:12-18 (confirming no quaternions on pages 18-19 of Bassompierre); EX. 2040, ¶ 79. Bassompierre "states in several places that

its EKF could be implemented using either Euler angles or quaternions in its state vector, expressing no preference for one over the other.” Ex. 2035 at 242:8-21, 246:21-247:5, 261:2-11, 265:5-8; Ex. 1006 at 6:3-8; 20:10-23:7; 27:13-17; Ex. 2040, ¶ 80.

Bassompierre discloses a general algebraic definition of a rotation quaternion (Equation 25), a continuous-time quaternion kinematic differential equation (Equation 26), and a frame transformation for angular velocities (Equation 27). Ex. 1006, 20:10-21:7; Ex. 2040, ¶ 82. But the quaternion variant was not implemented, derived, or disclosed in any form in Bassompierre that would allow a POSA to build it. Ex. 2040, ¶ 83; *see generally* Ex. 1006.

B. THE 10,852,846 PATENT

The '846 Patent takes a different approach from Bassompierre. It describes an electronic device (claims 1 and 3) and a method (claims 7 and 9) that perform calculations using quaternions to derive the electronic devices orientation in the spatial reference frame including yaw, pitch, and roll angles, and then translate the orientation into a real-time movement pattern in the display reference frame, which can be integrated into the electronic device.

In contrast, Bassompierre does not provide a full quaternion-based embodiment, ignores yaw angle entirely, and moves a cursor in a display reference frame based on angular velocities in a carrier reference frame, wherein the display reference

frame is necessarily decoupled from the device reference frame.

Claim 1 of the '846 patent recites:

1. An electronic device subject to movements and rotations in dynamic environments, comprising:
 - a display device associated with a display reference frame;
 - a motion sensor module comprising a rotation sensor and an accelerometer, the rotation sensor having sensor circuitry configured to generate measured angular velocities and the accelerometer having circuitry configured to generate measured axial accelerations, with both the rotation sensor and the accelerometer being associated with the movements and the rotations of the electronic device in a spatial reference frame; and
 - a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles associated with the movements and the rotations of the electronic device in the spatial reference frame by:
 - providing a previous quaternion corresponding to time $T-1$ based on the measured axial accelerations corresponding to time $T-1$ and the measured angular velocities corresponding to time $T-1$;
 - converting the measured angular velocities corresponding to time T based on the previous quaternion into a current quaternion and predicted axial accelerations without using the measured axial accelerations corresponding to time T ;
 - comparing the predicted axial accelerations, which are based on the measured axial accelerations corresponding to time $T-1$ and the measured angular velocities corresponding to time T , with the measured axial accelerations corresponding to time T to obtain a first comparison result;
 - obtaining an updated quaternion associated with time T based on the current quaternion and the first comparison result, which is based on the measured axial accelerations corresponding to time $T-1$, measured axial accelerations corresponding to time T , and

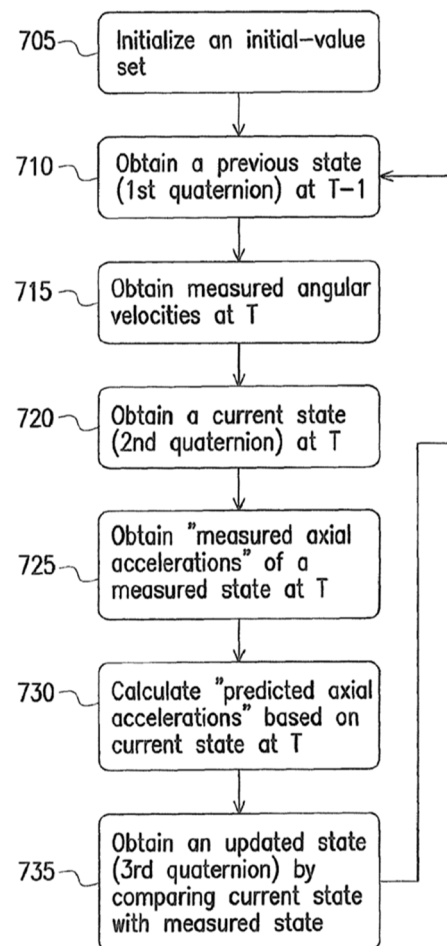
angular velocities corresponding to time T, and using the updated quaternion as a next occurrence of the previous quaternion; and

providing the resulting deviation based on the updated quaternion;

wherein the current quaternion and the predicted axial accelerations are converted from the measured angular velocities corresponding to time T so that the first comparison result and the updated quaternion correspond to time T; and

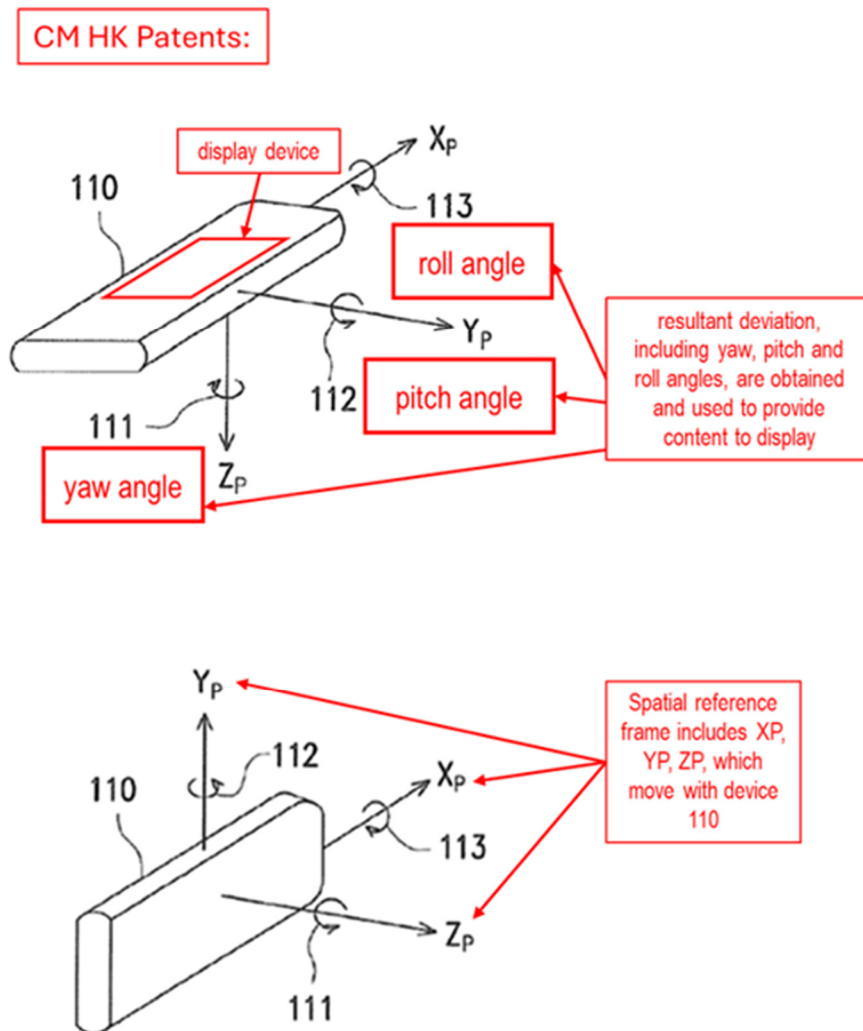
wherein the processor circuitry is further configured to translate the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame.

Claim 7 describes the same sensor fusion method recited in claim 1. The sensor fusion method described in claims 1 and 7 is shown in Figures 7, 8, 10, 11, 12. It starts with the previous quaternion from t-1 (**710** - first quaternion) and used in conjunction with measured angular velocities (**715**) and the differential equation described in Equation 1 to compute a current quaternion at time t (**720** - second quaternion). Ex. 1001 at 16:20-56. The current quaternion is used to compute the predicted axial accelerations (**730**). *Id.* at 17:12-18. Then the current



quaternion (second quaternion), the predicted axial accelerations, and the measured axial accelerations are used to compute an updated quaternion (**735** - third quaternion) using Equations 5-11. *Id.* at 17:38-18:4.

The updated quaternion is used to provide a resultant deviation including yaw, pitch, and roll which are mapped to a movement pattern on a display reference frame. *Id.* at 19:35-52, 20:20-29. The electronic device includes a display reference frame that moves with the spatial reference frame. *Id.* at 13:12-16, FIG. 6. Figs. 1 and 2 of the '846 patent are reproduced below and annotated to show the relationship between the resultant angles (yaw, pitch, roll), the spatial reference frame, and display reference frame.



V. PERSON OF ORDINARY SKILL IN THE ART

Petitioner proposes that a person having ordinary skill in the art at the time of the '846 Patent as of November 11, 2010, including late 2009 through early 2010, "would have had an undergraduate degree in electrical engineering, computer engineering, computer science, physics or a related field along with two years of work experience in the field of sensors (such as accelerometers, gyroscopes and magnetometers), sensor fusion algorithms, including Kalman Filters, quaternion

mathematics, and mobile computing technologies.” Pet. at 4-5; Ex. 1002 at ¶ 17.

And Dr. Sarrafzadeh testified that a POSA only “need to understand the basics of quaternion math, and in the case of work experience, have worked with them ... [e]nough to understand them.” Ex. 2035, 214:24-215:12.

Dr. LaViola agrees “that a person having ordinary skill in the art at the time of the ’846 Patent as of November 11, 2010, including late 2009 through early 2010, would have an undergraduate degree in electrical engineering, computer engineering, computer science, mechanical engineering, physics or a related field along with knowledge of sensors (such as accelerometers, gyroscopes and magnetometers), sensor fusion algorithms, Extended Kalman Filters, mobile computing technologies, and would understand the basics of quaternion math.” Ex. 2040, ¶ 34.

Basic quaternion math covers the algebraic definition of a quaternion, the multiplication rules for the basic elements i , j , and k , conjugation, norm, and unit quaternions. Ex. 2040, ¶ 35. It would also “include the Euler–Rodrigues–Hamilton theorem, which establishes that a vector can be rotated in three-dimensional space by multiplying the vector by a unit quaternion, and then multiplying the result by the conjugate of that quaternion.” Ex. 2040, ¶ 36.

In other words, quaternions are not merely a way to store orientation, but a mathematical tool that actively performs rotations by transforming vectors between

reference frames. Ex. 2040, ¶ 36. This transformation property forms the foundation for using quaternions in motion tracking and sensor fusion systems. Ex. 2040, ¶ 36; Ex. 2038 at 6-7.

Accordingly, a POSA would have an understanding of a quaternion-based EKF as a general concept. But that understanding would not be sufficient to convert a specific implementation of an Extended Kalman Filter written in Euler angles to an equivalent Extended Kalman Filter implementation that utilizes quaternions. Ex. 2040, ¶ 37.

VI. CLAIM CONSTRUCTIONS

Each of the claim terms addressed below is dispositive. Bassompierre does not disclose a single integrated “electronic device,” quaternion-based calculations, “predicted axial accelerations” derived from a quaternion, a “spatial reference frame” “associated with a unified device, or “resultant angles” under any construction consistent with the intrinsic record. The Petition survives only by leaving these terms unconstrued. When the claims are properly construed, as set forth below, Bassompierre fails to teach or suggest them, and the Petition fails on every ground.

Term	Claims	Patent Owner’s Construction	Petitioner’s Construction
quaternion	1, 3, 7, 9	Plain and ordinary meaning: A four-component mathematical representation used to	Plain and ordinary meaning

		represent three-dimensional orientation	
Predicted axial accelerations	1, 7	Gravitational acceleration along the electronic device's axes derived from the current quaternion	Plain and ordinary meaning
Electronic device	1, 3	A device comprising a display device and a motion sensor module, both subject to movement and rotations in the spatial reference frame	Plain and ordinary meaning
spatial reference frame	1, 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	reference frame associated with a 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
resultant angles	1, 7	Yaw, pitch, and roll angles	Plain and ordinary

A. QUATERNION – CLAIMS 1, 3, 7, 9

Patent Owner's Proposed Construction	Petitioner's Proposed Construction
A four-component mathematical representation used to represent three-dimensional orientation as a single rotation.	Plain and ordinary meaning

The parties do not meaningfully dispute that a quaternion is a four-component mathematical representation used to describe three-dimensional orientation. Petitioner's expert agrees that "[a] quaternion is a vector of four by one ... [that] can represent an angle in three dimensional space," having "a real part and three imaginary parts." Ex. 2035 at 251:22–252:7. Likewise, the Petition acknowledges that quaternions are "four-dimensional extensions of complex numbers" used to represent rotations. Pet. at 10 n.4; Ex. 1002 ¶ 24; Ex. 2031 ¶ 30.

This construction is dispositive for Petitioner's theory. Petitioner does not contend that Bassompierre discloses quaternions. Instead, it expressly acknowledges that the relevant equations in Bassompierre—Equations 21, 22, and 23—are written in Euler-angle form. Pet. at 34–35, 46–47. Dr. Sarrafzadeh likewise confirmed that Bassompierre's core Extended Kalman Filter equations are expressed in Euler angles and do not include quaternions. Ex. 2035 at 337:12–18.

Accordingly, the Board should construe "quaternion" according to its plain meaning: "A four-component mathematical representation used to represent three-dimensional orientation." Ex. 2040, ¶¶ 90-93.

B. PREDICTED AXIAL ACCELERATIONS – CLAIMS 1, 7

Patent Owner’s Proposed Construction	Petitioner’s Proposed Construction
Gravitational acceleration along the electronic device’s axes derived from the current quaternion	Plain and ordinary meaning

The claims and specification consistently define “predicted axial accelerations” as gravitational accelerations along the device’s axes at time T, derived from the current quaternion in relation to the measured angular velocities thereof:

converting the **measured angular velocities** corresponding to time T based on the previous quaternion into a **current quaternion** and **predicted axial accelerations** without using the measured axial accelerations corresponding to time T;

comparing the **predicted axial accelerations**, which are based on the measured axial accelerations corresponding to time T–1 and the measured angular velocities corresponding to time T, with the measured axial accelerations corresponding to time T to obtain a first comparison result;

Ex. 1001, Claim 1 (emphasis added).

In other words, two sets of axial accelerations may be obtained for the measured state of the nine-axis motion sensor module; one may be the measured axial accelerations Ax, Ay, Az in step **725** and the other may be the **predicted axial accelerations Ax’, Ay’, Az’ in step 730 calculated based on the abovementioned current state or second quaternion in relation to the measured angular velocities thereof**. Furthermore, in one embodiment, the computing processor may **use a data conversion utility to convert quaternion into the predicted axial accelerations Ax’, Ay’ and Az’**. This data conversion utility may be a software program represented by the following equations (2), (3) and (4). *Id.* at 17:18-30.

In other words, in one embodiment as shown in step 735, it is preferable to compare the second quaternion in relation to the measured angular velocities of the current state at present time T with the measured axial accelerations A_x , A_y , A_z as well as the **predicted axial accelerations A_x' , A_y' , A_z' also at present time T**. *Id.* at 17:37-52 (emphasis added).

And because “predicted axial accelerations” are computed from the current quaternion based on measured angular velocities they *only contain* gravitational accelerations along the device’s axes:

Since the predicted axial acceleration is derived from the second quaternion, and a person of ordinary skill in the art would understand that the second quaternion is normalized so that it represents orientation, then the predicted axial accelerations would represent and **only represent axial accelerations that would stem from gravity** (since gravitational acceleration is used to determine orientation). There would be no linear or centrifugal acceleration components as part of the predicted axial acceleration.

Ex. 2023, ¶ 23 (emphasis added); Ex. 2040, ¶¶ 95-96. This is what enables the system to decouple non-gravitational accelerations (i.e., “undesirable axial accelerations”) from gravity in the accelerometer data:

In a preferred embodiment of the present invention, said undesirable external interferences may further comprise or refer to **undesirable axial accelerations caused by undesirable external forces other than a force of gravity**; in another preferred embodiment, said undesirable external interferences may further comprise or refer to undesirable magnetism caused by undesirable electromagnetic fields. In other words, the method and algorithm provided by the present invention may preferably generate or provide an output of the resultant deviation of the nine-axis motion sensor module **excluding the abovementioned undesirable interferences**. In one example, external forces exerted to cause

axial accelerations of a nine-axis motion sensor of an electronic device of the present invention **may be decoupled or separated from a force of gravity...**

Ex. 1001, 18:43-57; Ex. 2040, ¶¶ 96.

Petitioner fails to construe this term; proposing only its “plain and ordinary meaning” without further explanation. Ex. 2007 at 3; Pet. at 22; Paper 14 at 4. Advocating for “plain and ordinary meaning” does not excuse a party from articulating what that meaning is; especially when the parties dispute the term’s scope because construction “at least to the extent necessary to resolve the dispute” is required. *WhereverTV, Inc. v. Comcast Cable Commc’ns, LLC*, No. 2023-2098, 2025 WL 2101946, at *4–5 (Fed. Cir. July 28, 2025) (citing *O2 Micro Int’l Ltd. v. Beyond Innovation Tech. Co.*, 521 F.3d 1351, 1360 (Fed. Cir. 2008)).

Moreover, it is impossible to determine what construction Petitioner has applied because Petitioner has asserted multiple, incompatible plain meanings in this IPR and the prior CyWee litigation, listed below chronologically:

CyWee Claim Construction (3/9/18): As with measured axial accelerations, a POSA would not have known whether the predicted axial accelerations are: (i) linear accelerations; (ii) centrifugal accelerations; (iii) gravitational accelerations; or (iv) a combination from among the three. Ex. 2025 at 13; Ex. 2026, ¶¶ 164-165.

Dr. Mercer’s Invalidity Report (10/8/18): I understand that CyWee and its experts have claimed that the “predicted measurement” is the direction of gravity obtained from a second quaternion representing orientation, as allegedly disclosed in

Equations 2–4 of the '438 Patent. However, because of the lack of guidance in the '438 Patent regarding the precise meaning of a “predicted acceleration,” in my opinion, *it is unclear what the scope of the claim term is* beyond that it is some predicted acceleration value. Ex. 2037, ¶¶ 363 (emphasis added), 954.

Dr. Mercer’s Noninfringement Report (12/3/18): Per Judge Bryson's opinion, the term “axial acceleration” encompasses the composite acceleration value (linear, centrifugal, and/or gravitational) that may be detected by an accelerometer at a particular point in time. A “predicted axial acceleration” can only reasonably be interpreted as a prediction of this composite value, not the gravitational acceleration component isolated from that composite value. Ex. 2036, ¶¶ 203, 262.

In particular, it is my opinion that the terms “estimated” and “predicted” are not interchangeable. While the term “prediction” refers to a determination of a future unknown value, as discussed above, an “estimation” refers to determination of a current value. *Id.*, ¶¶ 206, 246, 261.

IPR Petition (5/20/25): No construction necessary. Pet. at 22. But identifies the estimated gravitational accelerations calculated from Euler angles in equation 22 of Bassompierre as the “predicted axial accelerations.” Pet. at 42, 65 (“which, like the EKF of Bassompierre, predicts the acceleration, i.e., the gravity vector”); Ex. 2035, 91:16 (“predicted acceleration in equation 22 of Bassompierre is gravity.”).

Paper 14 (11/21/25): Samsung’s position, then and now, was simply that the term “axial acceleration” (whether predicted or measured) has a meaning well-understood by those of ordinary skill, *i.e.*, the term ordinarily encompasses three types of acceleration [linear, centrifugal, or gravitational]. Paper 14 at 4.

Paper 20 (1/7/26): Specifically, Patent Owner contends that “Bassompierre’s gravity-only prediction does not disclose ‘predicted axial accelerations’ that ‘encompass three types of acceleration,’ as Petitioner’s proposed construction requires. ... While it is true that “axial accelerations” can be one of three types of accelerations,

there is no requirement that Bassompière disclose each of the three types of acceleration, as Patent Owner's argument appears to require. Paper 20 at 7.

Deposition of Dr. Sarrafzadeh (2/27/26): Testified that the construction of “predicted axial accelerations” that he applied in his declaration is “a prediction of the axial acceleration, based on a prediction method.” Ex. 2035, 154:7-10, 84:15-21, 90:12-17, 124:12-19, 125:19-21.

Petitioner's shifting constructions have resulted in irreconcilable conflicts. Ex. 2040, ¶¶ 97-101. The Petition's identification of Bassompière's “*a priori* estimation of the [acceleration]” calculated by equation 22 as the “predicted axial accelerations” contradicts Samsung's noninfringement expert report, which stated the exact opposite, i.e., that “predicted axial accelerations” cannot just be gravitational accelerations. Ex. 2040, ¶¶ 98-100 (“A POSA would understand these to be literal opposites: a claim term encompasses gravity-only values or it does not.”). And that the terms “estimated” and “predicted” are not interchangeable because “prediction” is a future unknown value“ while an “‘estimation’ refers to determination of a current value.” Ex. 2040, ¶ 101-102. As Dr. LaViola explains, “[t]here is no technical basis on which both positions can simultaneously be correct.” *Id.*

Moreover, Dr. Sarrafzadeh declined to endorse any of Petitioner's claim construction positions for “predicted axial accelerations.” When presented with Samsung's claim construction brief, invalidity report, noninfringement report, Papers 14, and Paper 20, he said he needed to “think about it,” could not “comment

on that right now,” and would need to review “the entirety of the documents because the context does matter.” Ex. 2035 at 74:10–75:23, 89:15–90:11, 113:20–115:21, 154:7–15. The only construction he would commit to was his own: “a prediction of the axial acceleration, based on a prediction method.” *Id.* at 84:15–21, 90:12–17, 124:12–19, 125:19–21. But that construction resolves nothing. The parties' dispute is whether “predicted axial accelerations” are limited to gravitational accelerations or whether the term encompasses any type of acceleration. Dr. Sarrafzadeh’s applied construction does not resolve that question.

The Board previously excused the differences between Samsung’s claim construction positions in the CyWee litigation and this IPR “[b]ecause the district court determined ‘axial accelerations’ (and by implication, ‘predicted axial accelerations’) to be definite.” Paper 17 at 22-23. But that finding does not explain Petitioner’s inconsistent positions asserted in its invalidity and noninfringement expert reports that were served after that claim construction order issued. Ex. 2036, ¶ 39 (“I have reviewed Magistrate Judge Payne's Claim Construction Opinion and Judge Bryson's Order on ... Magistrate Judge Payne’s Claim Construction Opinion.”); Ex. 2037, ¶ 45 (same).

Petitioner's representation to this Board that its position on “predicted axial accelerations” is the same today as it was in CyWee makes matters worse. Paper 14 at 4. If Petitioner's position is truly unchanged, it is bound by its noninfringement

expert's conclusion that a "predicted axial acceleration" can only reasonably be interpreted as the composite acceleration value of linear, centrifugal, and gravitational accelerations and cannot just be gravity isolated from that composite. Ex. 2036 ¶¶ 203, 262. That construction defeats the Petition, because the Petition identifies gravity alone as the "predicted axial accelerations" in Bassompierre. Pet. at 42, 65; Ex. 2035 at 91:16.

Alternatively, if Petitioner has adopted a broader definition that encompasses any type of acceleration including gravity alone, it has done so without offering the Board any explanation for its change in position. Either way the Petition fails. And Petitioner's "then, and now" argument cannot be squared with this record.

The Petition suffers from a failure of proof on multiple levels. First, it failed to provide "a statement of how the challenged claim is to be construed." 37 C.F.R. § 42.104(b)(3). Second, Petitioner has advanced materially different, and fundamentally incompatible, constructions in different forums without explanation, which warrants dismissal under *Revvo* and *Wilus*. See *Revvo Techs., Inc. v. Cerebrum Sensor Techs., Inc.*, IPR2025-00632, Paper 20 at 3-4 (Director Nov. 3, 2025); *Samsung Elecs. Co. v. Wilus Inst.*, IPR2025-00988, Paper 12 at 7 (PTAB Nov. 7, 2025).

The consequences are concrete: without a stable, committed construction, Patent Owner faces a moving target, any argument advanced against one construction may

be met with a pivot to another. *TI Group Automotive Systems (North America), Inc. v. VDO North America, L.L.C.*, 375 F.3d 1126, 1139 (Fed. Cir. 2004) (“Our validity analysis is a two-step procedure: The first step involves the proper interpretation of the claims.”) Because Petitioner never commits to a construction of “predicted axial accelerations,” it necessarily fails to show that any prior art satisfies the claims under any consistent theory and cannot meet its burden under 35 U.S.C. § 103.

Accordingly, the Board should construe “predicted axial accelerations” to mean “gravitational acceleration along the electronic device’s axes derived from the current quaternion” as Patent Owner has consistently argued here and in the prior CyWee litigation. Ex. 2040, ¶ 15.

C. ELECTRONIC DEVICE – CLAIMS 1, 3

Patent Owner’s Proposed Construction	Petitioner’s Proposed Construction
A device comprising a display device and a motion sensor module, both subject to movement and rotations in the spatial reference frame	Plain and ordinary

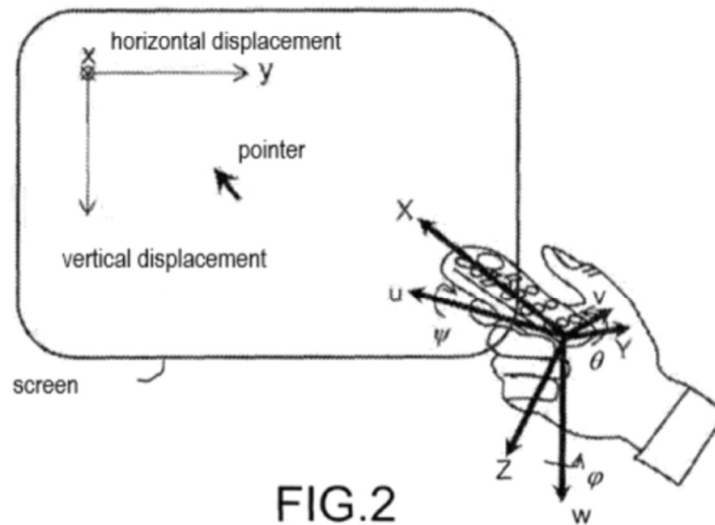
The dispute is whether the claimed “electronic device” must include a display that moves with the device, or whether it encompasses a split configuration in which a handheld pointer moves while a separate display remains stationary. The claim language resolves this dispute, and it is dispositive because Bassompierre discloses only a split configuration with a pointer and separate display.

The claim language requires the entire device to move together. The preamble and first two elements of claim 1 recite “an electronic device subject to movements and rotations in dynamic environments, comprising: a display device associated with a display reference frame; a motion sensor module ... being associated with the movements and the rotations of the electronic device within a spatial reference frame.” Ex. 1001 at 31:9-21. The entire device, not a portion of it, is the object that undergoes movements and rotations. A display that remains stationary while a separate pointer moves is not part of the “electronic device” as claimed.

The specification confirms this reading by including multiple embodiments of an “electronic device” that includes an integrated display, such as a “smartphone, tablet PC, or navigational equipment.” *Id.* at 13:8-16 (“The portable electronic device 600 may further comprise a built-in display 682; examples of the portable electronic device ... may include smartphone, tablet PC, or navigational equipment.”), 17:29-33 (same), 22:50-52 (same), 23:66-24:15 (same), 26:65-27:3 (same), 30:65-67 (same), FIG. 6.

Petitioner’s own positions confirm this construction. The Petitioner identified *the combination* of Bassompière’s pointer and separate display as the “electronic device”:

and accelerometer (30). (*Id.*, FIG. 1.) Figure 2 illustrates a system (“**electronic device**”), which includes a pointer and a screen.⁸



Pet. at 26. Dr. Sarrafzadeh testified that the “electronic device” described in the patent “includes a pointer and a screen.” Ex. 2035, 33:17-34:3. And Petitioner anticipated that Patent Owner would argue that “‘electronic device’ must include both a ‘display device’ and a ‘motion sensor module’ in the same housing.” Pet. at 64. But instead of arguing against that construction, the Petition argues that Nasiri meets this limitation because it “discloses a mobile phone with a display screen, gyroscope, and accelerometer, all held in the same housing.” *Id.* Petitioner cannot now argue for an alternative construction.

Accordingly, “electronic device” should be construed to mean “a device comprising a display device and a motion sensor module, both subject to movement

and rotations in the spatial reference frame.” Under this construction, Bassompierre’s split pointer-and-screen architecture does not qualify because the two are not subject to the movements and rotations in the same reference frame.

D. SPATIAL REFERENCE FRAME – CLAIMS 1, 7

Patent Owner’s Proposed Construction	Petitioner’s Proposed Construction
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	reference frame associated with a 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

The parties largely agree on the construction of this term, with the only dispute being whether it should be “a 3D pointing device,” as Petitioner contends, or “the electronic device” required by the claim.

Petitioner’s construction is incorrect because it imports a new limitation into the claim. Petitioner relies on a construction adopted in the CyWee IPRs, where the Board construed “spatial reference frame” to mean “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.” Pet. at 23. But the reason the Board and the parties agreed in the CyWee IPRs that this term required a 3D pointing device is because that is what the claims required:

1. **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.

The claims of the '846 Patent are different. They recite tracking the movements and rotations of an “electronic device” in a spatial reference frame, not a 3D pointing device:

1. An **electronic device** subject to movements and rotations in dynamic environments, comprising:

a display device associated with a display reference frame;

a motion sensor module ...; and

a computing processor having processor circuitry configured to calculate a resulting deviation comprising resultant angles associated with the **movements and the rotations of the electronic device in the spatial reference frame** by:

Ex. 1001 at 31:9-10, 31:22-26. Petitioner admits that claims 1 and 7 of the '846 Patent “do not recite the term ‘3D pointing device.’” Pet. at 23. It would therefore be improper to import a “3D pointing device” limitation into the claims. *See Amgen Inc. v. Hoechst Marion Rousell, Inc.*, 314 F.3d 1313, 1325 (Fed. Cir. 2003). (“The danger of improperly importing a limitation is even greater when the purported limitation is based upon a term not appearing in the claim.”).

Patent Owner’s proposed construction is supported by the specification, claim language, and plain and ordinary meaning as understood by a POSA. Ex. 2040, ¶¶

108-110.

By contrast, Petitioner’s construction rewrites the claims by replacing the “electronic device” with “a 3D pointing device.” The reason for this switch is because Petitioner’s expert testified that the “electronic device” is combination of a “pointer and a screen.” Ex. 2035, 32:24-34:3, 34:9-23. So, if the “spatial reference frame” applies to the whole “electronic device,” then Bassompierre cannot render the claims obvious because its pointer and display are not in the same reference frame. Pet. at 25-26 (only Bassompierre’s pointer is “subject to ‘movements and the rotations in a spatial reference frame’”).

Accordingly, the Board should adopt Patent Owner’s proposal and construe “spatial reference frame” to mean a “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.”

E. RESULTANT ANGLES – CLAIMS 1, 7

Patent Owner’s Proposed Construction	Petitioner’s Proposed Construction
yaw, pitch, and roll angles	plain and ordinary

Claims 1 and 7 require translating “the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern” in the display reference frame. Ex. 1001, 31:58-60, 33:13-16.

Under binding Federal Circuit precedent, the specification is the single best guide

to what disputed claim terms mean, and usually dispositive. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1315-16 (Fed. Cir. 2005) (en banc).

The specification defines “resultant angles” with precision and consistency. Throughout the ’846 Patent, the term “resultant angles” is used *exclusively* to refer to the yaw, pitch, and roll angles of the electronic device:

The electronic device comprises an accelerometer to measure or detect axial accelerations A_x , A_y , A_z , a magnetometer to measure or detect magnetism M_x , M_y , M_z and a rotation sensor to measure or detect angular velocities ω_x , ω_y , ω_z such that resulting deviation including ***resultant angles comprising yaw, pitch and roll angles*** in a spatial pointer frame of the electronic device... Ex. 1001 at 4:29-46, 4:59-5:4.

The ***resultant angles include the yaw angle 111, the pitch angle 112 and the roll angle 113*** as shown in FIG. 1 and FIG. 2. *Id.* at 10:57-59; Figs. 1, 2, 7, 8, 10, 11.

In step **1160**, the second updated state of the nine-axis motion sensor module of the present invention may be further calculated and converted to the resulting deviation including resultant angles associated with the spatial reference frame, wherein the ***resultant angles includes the yaw angle, pitch angle and roll angle*** of the 3D pointing device associated with the spatial reference frame, preferably about each of three orthogonal coordinate axes of the spatial reference frame. *Id.* at 26:4-12.

The term “absolute” associated with the resulting deviation including ***resultant angles such as yaw, pitch and roll*** in a spatial reference frame or 3D reference frame obtained and outputted by the device of the present invention may refer to the “actual” movements and rotations of the 3D pointer device of the present invention in said spatial reference frame. *Id.* at 30:41-47.

This is not a single isolated passage; it is the consistent teaching of the

specification across multiple embodiments. So, the specification functions as a lexicographer, defining “resultant angles” as the “yaw, pitch, and roll.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316 (Fed. Cir. 2005) (“[T]he specification may reveal a special definition given to a claim term by the patentee that differs from the meaning it would otherwise possess. In such cases, the inventor's lexicography governs.”).

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. Ex. 1001, 19:58-65, 22:50-57, 30:33-47 (“obtaining and outputting of deviation including 3D angles in a spatial reference frame in an ‘absolute’ manner of the present invention is too novel ... [and] cannot be easily achieved by any known arts or the combination thereof.”). The specification never uses “resultant angles” to refer to any other set of angles, and never suggests the term encompasses fewer than all three.

This construction is dispositive. Bassompierre fixes yaw at zero and tracks only pitch and roll. Ex. 2040, ¶ 76; Ex. 1006, 11:25-30, 17:10-13 (“Here the angle represents the angle of yaw ... [h]owever, given the definition of these reference frames, this angle is zero...”). A system that sets yaw to zero by design cannot disclose orientation as yaw, pitch, and roll angles.

Accordingly, the Board should construe “resultant angles“ to mean “yaw, pitch and roll angles.”

VII. PETITION SHOULD BE DENIED FOR FAILING TO CONSTRUE THE CLAIMS

The Petition is procedurally deficient because it fails to construe the challenged claims as required by PTAB rules. Failure to construe claim terms violates 37 C.F.R. § 42.104(b)(3), which requires that a petition must include “a statement of how the challenged claim is to be construed.” This is not optional. A petitioner must explain how each challenged claim should be interpreted so that the Board can evaluate whether the prior art teaches the claimed features.

Here, Samsung construes only one term, “spatial reference frame,” and offers no construction for any other limitation, including the term “predicted axial accelerations.” Pet. at 22-23. By failing to construe the other terms, Petitioner has deprived the Board of the framework it needs to evaluate the prior art.

Therefore, the Petition must be denied under 37 C.F.R. § 42.104(b)(3).

VIII. THE PETITION RESTS ENTIRELY ON BASSOMPIÈRE

Although the Petition nominally advances two grounds of unpatentability, both grounds rise and fall with Bassompierre. Ground 1 asserts that Bassompierre alone renders obvious claims 1, 3, 7, and 9. Ground 2 adds Nasiri as a secondary reference, but only for a single, contingent purpose: to address the possibility that the Board

construes “electronic device” to require the display and motion sensor module to occupy the same housing. Pet. at 64. Outside of that housing question, Ground 2 incorporates Ground 1’s analysis wholesale.

Regarding Ground 2, Nasiri teaches no element of the EKF algorithm, no quaternion-based measurement model, no predicted axial accelerations, and no sensor fusion methodology. It appears in the Petition solely to supply an embodiment in which a display and sensor coexist in a single device. In other words, Nasiri merely demonstrates that display devices having motion sensors exist and does not proffer any motivation to import the EKF algorithm of Bassompière to its device. However, Bassompière requires a stationary device reference frame separate from a pointer reference frame in order to function. Ex. 2040, ¶ 85. Prior art references can only be combined when there is a likelihood of success. *Elekta Ltd. v. ZAP Surgical Sys., Inc.*, 81 F.4th 1368, 1375 (Fed. Cir. 2023).

The practical consequence is that the Petition presents a single theory of unpatentability where Bassompière discloses every limitation of the claims.

IX. THE EXAMINER ALREADY CONSIDERED BASSOMPIÈRE

Institution should not have been granted under *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential). The Board applies a two-part framework: first, whether the same or substantially the same art was previously presented to the Office; and

second, if so, whether the petitioner has demonstrated that the Office erred in a manner material to patentability. The Petition satisfies Part 1 and fails Part 2.

As to Part 1, the Petition relies entirely on WO2009/156499 (Ex. 1005), a French-language PCT publication. Its official English translation, U.S. Patent Publication No. 2011/0199298 (“U.S. Bassompière”), is the national stage entry of the same PCT application and is identical to Bassompière. *Compare* Ex. 1006; *with* Ex. 2015; Ex. 2040 ¶ 87. U.S. Bassompière was disclosed by Applicant on an Information Disclosure Statement and considered by the Examiner during prosecution. Ex. 1004 at 103, 123. Under *Ecto World, LLC v. Rai Strategic Holdings, Inc.*, “challenging the claims using the same prior art that was previously presented on an IDS is sufficient to satisfy the first part of the Advanced Bionics framework.” IPR2024-01280, Paper 13 at 4 (PTAB May 19, 2025) (precedential). Part 1 is satisfied.

As to Part 2, Petitioner has not attempted to carry its burden. Petitioner’s only argument is that “Bassompière was not raised by the Examiner in any rejection.” Pet. at 4. But *Ecto World* directly rejected that as sufficient, holding that a petitioner “must provide an analysis even when the asserted prior art is on an IDS, but the Examiner did not apply the reference,” and that such analysis must address Becton Dickinson factors (c), (e), and (f). *Ecto World*, Paper 13 at 5. The Petition makes no mention of Becton Dickinson and offers no explanation of how the Examiner erred. That alone warrants denial. *See Wolfsped, Inc. v. Trustees of Purdue Univ.*,

IPR2022-00761, Paper 9 at 14–15 (PTAB Nov. 8, 2022); *Darfon Elecs. Corp. v. Shipman*, IPR2022-01008, Paper 11 at 14 (PTAB Dec. 2, 2022).

Nor could Petitioner show material error if it tried. The Examiner reviewed the English-language counterpart and declined to reject the claims over it. That decision was correct because Bassompierre fails to teach an integrated electronic device, quaternion-based calculations, predicted axial accelerations derived from a quaternion, or a spatial reference frame associated with a single device. The Examiner did not err. The Petition should be denied under 35 U.S.C. § 325(d).

X. BASSOMPIÈRE FAILS TO TEACH MULTIPLE LIMITATIONS

Before addressing each limitation individually, it is important to understand Bassompierre and the '846 Patent are directed to different systems with different architectures and objectives.

Bassompierre maps measured angular velocities from a handheld pointer into vertical and horizontal cursor movement on a separate, stationary display. Ex. 1006, 10:27–12:9. It does not compute the device's absolute orientation and does not determine yaw, pitch, or roll in a shared spatial reference frame. Instead, its Extended Kalman Filter processes angular velocity inputs to generate cursor movement, not to determine orientation in space.

The '846 Patent does the opposite. It is directed to continuously determining the device's absolute orientation—expressed as yaw, pitch, and roll—within a shared

spatial reference frame and translating that orientation into a real-time movement pattern in the display reference frame. Ex. 1001, Claim 1. That requires estimating orientation itself, not merely integrating angular velocity for display control.

This architectural difference is reflected in the mathematical framework of each system. Bassompierre's EKF is implemented using Euler angles and operates on pitch and roll to produce angular velocities. Ex. 1006, 17:9–20:9. The '846 Patent, by contrast, uses quaternions to represent and update three-dimensional orientation, from which yaw, pitch, and roll are derived. Ex. 1001, FIG. 7, 8, 10, 11, 12.

Petitioner's theory depends on converting Bassompierre's Euler-angle, angular-velocity-based system into a quaternion-based orientation-tracking system that outputs yaw, pitch, and roll. But that is not what Bassompierre teaches. It is what Petitioner's expert reconstructs.

This mismatch is dispositive. Bassompierre is not merely missing individual claim limitations, it is directed to a different class of system altogether. The element-by-element deficiencies discussed below are a direct consequence of that fundamental mismatch.

A. BASSOMPIÈRE FAILS TO TEACH AN “ELECTRONIC DEVICE”

Claim 1 requires an “electronic device ... comprising: a display device” and “processor circuitry configured to calculate a resulting deviation comprising resultant angles associated with the movements and the rotations of the electronic

device in the spatial reference frame.” The Petition maps Bassompierre’s pointer and display as this “electronic device,” and identifies the pointer’s reference frame (XYZ) as the “spatial reference frame.” Pet. at 25-26, 32-33; Ex. 1002, Appx., [1.pre], [1.c]. This mapping fails for two reasons.

First, Bassompierre’s pointer and display are separate physical components, not a single integrated device. Ex. 1006, Figs. 2 & 3. As shown in Figures 2 and 3, Bassompierre defines a pointer reference frame (X, Y, Z) and a wholly separate screen reference frame (x, y, z). Ex. 1006, Figs. 2 & 3. Because these components operate in different reference frames, they cannot both undergo “movements and rotations ... in the spatial reference frame” as claim 1 requires. Ex. 2040, ¶ 114. And Bassompierre’s display is stationary. *Id.* So, it does not undergo any movements and rotations. Accordingly, under Petitioner’s theory, the identified “electronic device” is not subject to a single set of movements and rotations in the claimed spatial reference frame. *Id.*

For these reasons, Bassompierre does not teach or suggest an “electronic device” as required by claims 1 and 3.

B. BASSOMPIÈRE FAILS TO TEACH “QUATERNIONS”

Claims 1 and 7 describe calculations that utilize quaternion math, reciting a “previous quaternion corresponding to time T-1,” a “current quaternion corresponding to time T,” and an “updated quaternion associated with time T.” Ex.

1001, 31:9-61, 32:40-33:15. Bassompierre discloses none of these elements.

Petitioner does not contend otherwise. For the “previous quaternion” and “current quaternion” elements, the Petition points to Equation 21 of Bassompierre, while conceding that “equation 21 ... include[s] the pitch and roll angles in Euler angle form.” Pet. at 34-35. Petitioner therefore falls back on the argument that “a POSA would have been motivated to modify equation 21 to include quaternions instead of Euler angles.” *Id.* (citing Ex. 1002, ¶¶ 48, 55-71). For the “updated quaternion” element, Petitioner likewise points to Equation 23, again conceding that it is “the ‘updated quaternion’ in Euler angle form,” and again arguing that “a POSA would have found it obvious to perform the calculations of equation 23 using quaternions instead of Euler angles.” Pet. at 46-47.

In other words, Petitioner’s invalidity theory rests entirely on modifying Bassompierre’s two-variable Euler angle EKF equations. Unmodified, it is undisputed that Bassompierre’s Equations 21, 22, and 23 disclose Euler angles, not quaternions. Ex. 2035, 337:12–18; Ex. 2040, ¶ 115. Patent Owner’s disagrees that a POSA would have had an apparent reason to make those modifications, for the reasons discussed in Section X below.

Because Bassompierre does not disclose a “previous quaternion,” “current quaternion,” or “updated quaternion” in its unmodified form, it does not teach or suggest those elements recited in claims 1, 3, 7, and 9 and required by all challenged

claims.

C. BASSOMPIÈRE FAILS TO TEACH “PREDICTED AXIAL ACCELERATIONS”

As discussed above, “predicted axial accelerations” should be construed as “gravitational accelerations along the electronic device’s axes derived from the current quaternion.” Under that construction, Bassompierre’s Equation 22 cannot meet this element.

The Petition identifies Bassompierre’s Equation 22 as the “predicted axial accelerations,” characterizing it as “a priori estimation of the [acceleration] measurement.” Pet. at 39-40; Ex. 1002, ¶¶ 53-57, 72-75, App’x [1.e]. But Equation 22 is written entirely in Euler angles and includes no quaternions. Ex. 1006 at 19 (Eq. 22); Ex. 2035, 337:12-23. The predicted acceleration in Equation 22 is derived from pitch and roll Euler angles; not from the “current quaternion” as the claim requires. Ex. 1006, 19:4-5; Ex. 2040, ¶ 118.

For these reasons, Bassompierre does not teach or suggest “predicted axial accelerations” as recited in claims 1 and 7 and required by all challenged claims. Ex. 2040, ¶¶ 116-120.

D. BASSOMPIÈRE FAILS TO TEACH “SPATIAL REFERENCE FRAME”

As discussed above, “spatial reference frame” should be construed as “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.” Under that construction, Bassompierre’s architecture cannot meet this element because it places the pointer and display in two distinct reference frames, (X, Y, Z) for the pointer and (x, y, z) for the screen, rather than a single unified frame associated with a single integrated device. Ex. 1006, FIG. 2; Ex. 2040 at ¶ 123.

Petitioner’s own mapping reveals the problem. The Petition identifies the pointer’s reference frame as the claimed “spatial reference frame,” Pet. at 31; Ex. 1002, Appx. [1.a], while simultaneously identifying the combination of the pointer and screen as the claimed “electronic device.” Pet. at 26. But these two positions cannot be reconciled. The “electronic device” must be a single integrated device including both a display and a motion sensor module that together undergo “movements and rotations“ within the “spatial reference frame.” Ex. 1001, 31:9-26; Ex. 2040 at ¶ 124.

Bassompierre’s display, however, is stationary. It is not subject to movements and rotations in the pointer’s reference frame that Petitioner identifies as the spatial reference frame. Ex. 2040, ¶ 125; Pet. at 25-26; Ex. 1002, Appx. [1.pre], [1.c]. And Bassompierre’s pointer, standing alone, cannot be the “electronic device” because it does not include a display. Ex. 2040, ¶ 126; Pet. at 26. Petitioner thus faces an inescapable dilemma: the component it identifies as defining the spatial reference frame is not the electronic device, and the components it identifies as the electronic device do not share a common spatial reference frame.

For these reasons, Bassompierre does not teach or suggest a “spatial reference frame” as recited in claims 1 and 7 and required by all challenged claims. Ex. 2040, ¶ 127.

E. BASSOMPIÈRE FAILS TO TEACH “RESULTANT ANGLES”

Bassompierre describes moving the pointer in the vertical plane of the screen based on the angular velocities ω_v and ω_v . Ex. 1006 FIG. 2, 10:27-12:9. This is true for every embodiment in Bassompierre, including the “first variant embodiment” where Eq. 27 is for obtaining the angular velocities ω_v and ω_v from a quaternion. The Euler angle embodiment of Bassompierre utilizes pitch and roll within the state vector but intentionally decouples cursor movements from the angles themselves. Ex. 1006, 4:18-7:9, 14:17-19 (“compensation of the pitch and roll angles is total, the displacement of the cursor on the screen then becomes independent of the orientation of the device on the carrier”).

For the “first variant embodiment”, there is no teaching in Bassompierre that yaw, pitch, and roll would be calculated at all; to the contrary, Bassompierre shows that the angular velocities ω_v and ω_v are obtained *directly* from quaternions. *Id.* Eq. 27 and Claim 14 at 32:8-10.

The angular velocities ω_v and ω_w are then obtained through the equation:

$$\begin{pmatrix} 0 \\ \omega_u \\ \omega_v \\ \omega_w \end{pmatrix} = q \otimes \begin{pmatrix} 0 \\ \omega_x \\ \omega_y \\ \omega_z \end{pmatrix} \otimes \bar{q} \quad \text{Eq. 27}$$

In other words, *even if*, as Samsung contends, a POSA were to motivated to, and capable of modifying equations 21-23 of Bassompierre to include quaternions instead of Euler angles, the result would not “translate the resultant angles of the resulting deviation in the spatial reference frame into a real-time movement pattern in the display reference frame” as recited in claim 1 and similarly in claim 7.

Petitioner and Dr. Sarrafzadeh erroneously rely on the pitch and roll angles of the Euler angle embodiment of Bassompierre to meet this limitation. Pet. 1 at 56, Ex. 1002 at 28. Conspicuously, there is *not even a single mention* of Bassompierre’s equation 27 in the Petition or Dr. Sarrafzadeh’s declaration. As such, Petitioner and its expert ignore one of the few quaternion equations provided in Bassompierre (i.e., Ex. 1006, 21:4-5 (Eq. 27)) to fit their hindsight bias.

For these reasons, Bassompierre does not teach or suggest “resultant angles” as recited in claims 1 and 7 and required by all challenged claims.

F. BASSOMPIÈRE FAILS TO TEACH A “DATA ASSOCIATION MODEL”

The Petition alleges that subtraction of terms shown highlighted in Eq. 23 of Bassompierre’s Euler-angle embodiment discloses the “data association model”

recited in claims 3 and 9.

$$\hat{x}_k = \hat{x}_k^- + K_k \left(\begin{bmatrix} \alpha_{x,k} \\ \alpha_{y,k} \\ \alpha_{z,k} \end{bmatrix} - \hat{y}_k^- \right)$$

Pet. at 57-58, 63.

There are two independent reasons why the Petitioner’s argument fails.

First, Equation 23 belongs to Bassompierre's Euler-angle embodiment and has no connection to quaternions. Ex. 1006, 19:9. Claims 3 and 9 require a data association model that “determine[s] whether compensation is needed to obtain the updated quaternion.” Ex. 1001, 32:9-17, 34:1-8. An equation that operates on Euler-angle state vectors cannot satisfy a limitation defined in terms of quaternions. Ex. 2040, ¶ 133.

Second, Petitioner’s own description of Equation 23 does not match what the claims require and Samsung’s notation exposes the error. Samsung contends that Equation 23 “determines the amount by which the $\hat{x}_k$ (‘current quaternion’) must be changed (compensated) to arrive at $\hat{x}_k$ (‘updated quaternion’).” Pet. at 58. Petitioner uses $\hat{x}_k$ to denote both the current and updated quaternion, rendering its own description incoherent. Ex. 2040, ¶ 134.

For these reasons, Bassompierre does not teach or suggest “data association model” as recited in claims 3 and 9.

XI. PETITION PROVIDES NO MOTIVATION TO MODIFY BASSOMPIÈRE

All challenged claims are patentable under 35 U.S.C. § 103 at least because all challenged claims require an EKF implementation using quaternions and Petitioner has failed to provide any reason or motivation to modify Bassompierre's Euler-angle EKF to use quaternions.

A single prior art reference can support an obviousness finding only “if it would have been obvious to modify that reference to arrive at the patented invention.” *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1361 (Fed. Cir. 2016). That requires “a showing of a suggestion or motivation to modify the teachings of that reference to the claimed invention.” *SIBIA Neurosciences, Inc. v. Cadus Pharm. Corp.*, 225 F.3d 1349, 1356 (Fed. Cir. 2000). Petitioner cannot meet that standard here.

The Petition argues that a POSA would have been motivated to modify Bassompierre's Equation 21 to substitute quaternions for Euler angles because Bassompierre states that doing so offers “the advantage of avoiding the computations of the sines and cosines of the pitch and roll angles that are greedy in terms of computational power.” Pet. at 35 (citing Ex. 1006, 22:10-19). That argument fails for six independent reasons.

First, the computational efficiency advantage of quaternions over Euler angles was well known to a POSA long before Bassompierre. Ex. 2035, 246:7-247:5; Ex.

2040, ¶ 136. Bassompierre knew about quaternions but chose Euler angles when he designed the system. A POSA reading Bassompierre would understand that choice as deliberate, not as an oversight to be corrected. *Id.* Far from motivating a modification, Bassompierre's author's informed decision to use Euler angles would have signaled to a POSA that they were the appropriate representation for this system. *Id.*

Second, and more fundamentally, Bassompierre provides a “first variant embodiment” including a quaternion state vector, but does not prefer this over the disclosed Euler angle embodiment. Ex. 1006 at 20:10-21:7, 27:13-14. Dr. Sarrafzadeh testified: “Bassompierre tells you that for any of these, you can use either Euler angles or quaternions.” Ex. 2035, 318:8-15, 242:8-21, 255:17-21, 262:4-22. And he admitted that “in some cases, quaternions performed easier type math. In some cases, Euler will be easier to use, “ and that “[p]eople use [both of] them all the time.” Ex. 2035, 245:16-246:4, 254:15-25. The Petition also argues the opposite; converting *from* quaternions *to* Euler angles would *also* have been obvious to a POSA “because Euler angles are more intuitive.” Pet. at 54. Accordingly, Bassompierre provides no reason to prefer quaternions over Euler angles. Ex. 2040, ¶¶ 136-148.

Third, even if a POSA were motivated to implement Bassompierre using quaternions, the implementation burden would have discouraged the modification.

Implementing a quaternion-based orientation tracker requires propagating a quaternion kinematic differential equation, a system of four coupled ordinary differential equations that must be discretized and integrated numerically at each timestep Δt , using a scheme such as fourth-order Runge-Kutta, which demands four derivative evaluations per step. Ex. 2040, ¶ 138. The practitioner must also carefully tune Δt to avoid truncation error and divergence and must normalize the quaternion after every integration step to prevent the unit-norm constraint from drifting due to floating-point accumulation. *Id.*

Dr. Sarrafzadeh admitted that implementing the quaternion kinematic equation requires a POSA to “integrate these differential equations over a time step Δt : $q_k \approx q_{k-1} + \dot{q}_{k-1}\Delta t$ followed by normalization of q_k to ensure it remains a unit quaternion,” and that quaternion Jacobians “can be more complex than the same thing done with Euler angles” and involve “a larger matrix to deal with.” Ex. 2035, 257:15-25, 298:1-6; Ex. 1002, ¶ 67. His own declaration confirms that the quaternion Kalman gain must be a 4×3 matrix to map three-dimensional measurements into four-dimensional quaternion space. Ex. 1002, ¶ 79. None of this additional overhead yields any benefit for a system that tracks only two degrees of freedom, i.e. pitch and roll. Ex. 2040, ¶ 140. Therefore, a POSA would have had every reason to avoid converting Bassompierre into quaternions. *Id.*

Fourth, Petitioner's approach is itself evidence of hindsight bias. Bassompierre

already includes a “first variant embodiment” built on a quaternion state vector. A POSA working from Bassompierre's disclosure would naturally start from the building blocks that embodiment provides: a rotation quaternion, a state vector, a state model (Eq. 26), a measurement model vector, and Equation 27 for obtaining angular velocities in the carrier reference frame. Ex. 1006, 20:15-21:5 (Eqs. 25, 26, 27). A POSA would then work *forward* from those building blocks toward Bassompierre's stated goal: calculating angular velocities around only two axes in the carrier reference frame. Petitioner and Dr. Sarrafzadeh do not do that.

Instead, they ignore the quaternion equations Bassompierre provides, start from the Euler-angle embodiment, and then use Dr. Sarrafzadeh's independent engineering knowledge and adopted equations from the '846 Patent to construct a quaternion EKF that matches the claims of the '846 Patent rather than Bassompierre's process. *See* Pet. at 35-57; Ex. 1002, ¶¶ 55-79. That backwards path from the Euler angle embodiment, through derivations Bassompierre never performs, to a quaternion system the claims require could only have been charted by someone already looking at the '846 Patent. Ex. 2040, ¶¶ 142-143. Making it textbook hindsight. *Id.*

Fifth, and independently, even if a POSA substituted quaternions for Euler angles throughout Bassompierre, the modified system would still not disclose the limitations the challenged claims require. Bassompierre and the asserted claims pursue fundamentally different objectives. Bassompierre's goal in every embodiment,

including the first variant quaternion embodiment, is to obtain angular velocities in the carrier reference frame and use them to move a pointer on a stationary external display. Ex. 1006, 21:4-5 (Eq. 27); Claim 14 at 30:8-10. To that end, Bassompierre decouples the pointer's absolute spatial orientation from cursor movement; pitch, roll, and yaw are not used to determine pointer orientation, and the absolute position of the device relative to the screen is immaterial. Ex. 1006, FIG. 6.

The '846 Patent's claims require the opposite. They translate the "resultant angles" (yaw, pitch, and roll) in a "spatial reference frame" into real-time movement pattern on a display. Ex. 1001, 31:58-61, 33:13-16. Substituting quaternions for Euler angles does not change Bassompierre's objective, which is calculating angular velocities in a carrier reference frame; not yaw, pitch, and roll angles in the spatial reference frame. Petitioner has therefore failed to show that even a motivated POSA could arrive at the claimed invention by modifying Bassompierre.

Sixth, because Dr. Sarrafzadeh starts 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. Bassompierre provides exactly 3 numbered equations for the first variant embodiment: 25, 26, and 27. Ex. 1006 at 20-21. Equation 25 provides a rotation quaternion which is a function of α , u_1 , u_2 , and u_3 ; conspicuously, neither Bassompierre nor Dr. Sarrafzadeh provide *any* derivations using these variables,

demonstrating that a POSA would not know how to apply these equations. Equation 26 is a quaternion kinematic differential equation that describes the rate of change of orientation; Petitioner mischaracterizes this as an orientation equivalent to Equation 21 (Pet. at 37) demonstrating that Bassompierre fails to teach a POSA what this equation is in the context of Bassompierre's EKF. Equation 27 is provided in Bassompierre as a final equation without any explanation of intermediate steps; Dr. Sarrafzadeh *never mentions* Eq. 27 demonstrating that a POSA would not know how to arrive at this equation. Ex. 1002, ¶¶ 57-85. These gaps in Bassompierre's meager quaternion description are improperly filled by Dr. Sarrafzadeh's expert testimony. And a reference that does not enable what it discloses cannot render a claim obvious. *See Raytheon Techs. Corp. v. Gen. Elec. Co.*, 993 F.3d 1374, 1381 (Fed. Cir. 2021) ("In the absence of such other supporting evidence to enable a skilled artisan to make the claimed invention, a standalone § 103 reference must enable the portions of its disclosure being relied upon.").

By any one of these six reasons, the Petition fails to demonstrate any reason to modify Bassompierre to utilize quaternions over Euler angles. Ex. 2040, ¶ 148.

XII. PETITION FILLS BASSOMPIÈRE'S GAPS WITH EXPERT TESTIMONY

Petitioner's theory requires building an entire quaternion EKF that does not exist in Bassompierre. The statute is clear, an IPR "may be instituted only on a ground that

could be raised under section 102 or 103 and only on the basis of prior art consisting of patents or printed publications.” 35 U.S.C. § 311(b) (emphasis added). The Board’s Trial Practice Guide reinforces this boundary: “expert testimony cannot take the place of disclosure from patents or printed publications.” Trial Practice Guide (2019) at 36. The USPTO’s recent memorandum to the PTAB removes any remaining doubt: “[A]pplicant admitted prior art (AAPA), expert testimony, common sense, and other evidence that is not ‘prior art consisting of patents or printed publications’ (collectively ‘general knowledge’) may not be used to supply a missing claim limitation.” Ex. 2028 (July 31, 2025 Memo) at 1; *see also Arendi*, 832 F.3d at 1361 (“[C]ommon sense is typically invoked to provide a known *motivation to combine*, not to supply a missing claim limitation.”). The Petition violates these principles for every challenged claim.

Because Bassompierre does not disclose a quaternion-based EKF, Dr. Sarrafzadeh derives one from scratch based entirely on engineering knowledge that Bassompierre never teaches. To the extent that Bassompierre includes a quaternion embodiment, Dr. Sarrafzadeh largely ignores and mischaracterizes that embodiment in favor of his own derivations.

The Petition asserts that “a POSA would have understood that equation 26 is a quaternion form representation of equation 21.” Pet. at 37 (citing Ex. 1002, ¶¶ 66-69). That assertion is incorrect. Equations 21 and 26 are fundamentally different

mathematical objects that serve different roles in an EKF framework, they are not equivalent representations of the same operation. Ex. 2040, ¶¶ 149-151. Equation 21 is a discrete-time update equation for Euler angles (pitch Θ and roll Ψ) that produces an estimated orientation at a specific point in time. Ex. 2040 at ¶ 150. Equation 26, by contrast, is a quaternion kinematic differential equation that describes the rate of change of orientation, not the orientation itself. Ex. 2040, ¶ 151.

Dr. Sarrafzadeh concedes this distinction when he states that “Equation 21 of Bassompierre can be expressed as the rate of change of an orientation quaternion based on the angular velocities from a gyroscope.” Ex. 1002, ¶ 66; Ex. 2040, ¶ 152. To convert Equation 26 into something that functions like Equation 21, a POSA would need to discretize and integrate the equation over a timestep Δt , then normalize the result to maintain the unit-norm constraint, which Dr. Sarrafzadeh agrees are necessary. Ex. 1002, ¶ 67. However, Bassompierre does not teach them. Ex. 2040, ¶ 153.

The same gap appears in Bassompierre’s measurement model. Equation 22 expresses the predicted gravity components (A_x , A_y , A_z) as explicit trigonometric functions of pitch (Θ) and roll (Ψ), written entirely in Euler angles, with no quaternions. Ex. 1006 at 19:3; Ex. 2040, ¶ 154. The Petition acknowledges this absence but dismisses it because “a person of ordinary skill in the art would know how to derive the predicted acceleration of Bassompierre in quaternion form.” Pet. at

42. Doing so requires constructing a direction cosine matrix $R(q)$, which is a 3×3 rotation matrix whose entries are quadratic functions of the four quaternion components, and applying it to the gravity vector. Ex. 2040, ¶ 155. Bassompierre never derives $R(q)$ and never expresses predicted accelerations as functions of quaternion components. *Id.* A quaternion measurement model simply does not exist in Bassompierre. *Id.*

These are not isolated instances; they reflect a consistent pattern of gap-filling throughout the Petition. In each instance where a quaternion EKF component is absent from Bassompierre, the Petition substitutes Dr. Sarrafzadeh's derivation for Bassompierre's disclosure:

Thus, a POSA would have been motivated to modify equation 21 to include quaternions instead of Euler angles. Pet. at 35.

A POSA would have understood that equation 26 is a quaternion form representation of equation 21. Pet. at 37.

it would have been obvious to use quaternions in place of Euler angles. Pet. at 38.

a person of ordinary skill in the art would know how to derive the predicted acceleration of Bassompierre in quaternion form. Pet. at 42.

While Bassompierre's equation 23 involves Euler angles, a POSA would have found it obvious to utilize quaternions in place of Euler angles. Pet. at 45.

In each case, what the Petition describes is what Dr. Sarrafzadeh derives using knowledge beyond Bassompierre, not what Bassompierre discloses or teaches. Ex.

2040, ¶ 157.

At deposition, Dr. Sarrafzadeh admitted that each of the following is absent from Bassompierre:

how to convert the Euler angle-based rotation matrix on page 18 into an equivalent quaternion-based rotation matrix, Ex. 2035, 274:8-21;

the rotation matrix in quaternion form, which he described as “knowledge that every person of ordinary skill in the art would have,” Ex. 2035, 279:12-16;

Equations 2 through 4 of the ’846 and ’687 Patents, Ex. 2035, 281:16-282:9;

how to convert quaternions to Euler angles, which he called “[b]asic knowledge,” Ex. 2035, 314:6-9;

the order of quaternion multiplication necessary to calculate a new quaternion based on pitch and roll, Ex. 2035, 291:8-293:10; and

quaternion multiplication itself, which he characterized as “basic knowledge, using matrix multiplication.” Ex. 2035, 301:11-14.

Each of these gaps represents nontrivial knowledge necessary for Dr. Sarrafzadeh’s derivations that is completely absent from Bassompierre. Ex. 2040, ¶ 159. As researchers in the field have confirmed, implementing orientation tracking using quaternions “is significantly more complex than the Kalman filter using Euler angles.” Ex. 2027 at 1.

Accordingly, the Petition has not shown that Bassompierre discloses a quaternion EKF. It has shown only that Dr. Sarrafzadeh could construct one using his own independent engineering knowledge beyond what Bassompierre teaches. Ex. 2040, ¶

160. But expert testimony cannot supply what the prior art lacks. 35 U.S.C. § 311(b); Ex. 2028. Accordingly, all challenged claims of the '846 Patent are not unpatentable.

XIII. DR. SARRAFZADEH'S TESTIMONY IS NOT CREDIBLE.

The Board has broad discretion to weigh expert testimony, but such testimony must rest on sufficient facts and a reliable methodology. 37 C.F.R. § 42.65(a); Fed. R. Evid. 702. Where an expert fails to articulate or consistently apply the claim constructions underlying his opinions, that testimony is entitled to little or no weight. That is the case here.

First, Dr. Sarrafzadeh did not adopt or apply Petitioner's own claim construction. In Papers 14 and 20, Petitioner represented that "axial acceleration" encompasses linear, centrifugal, or gravitational acceleration, and clarified that Bassompierre need not disclose all three. Paper 14 at 4; Paper 20 at 7. When asked whether he agreed, Dr. Sarrafzadeh testified that he "need[ed] to think about it" and "cannot comment on that right now," and admitted he had not analyzed whether "predicted axial accelerations" correspond to linear, centrifugal, gravitational, or combined acceleration for purposes of his declaration. Ex. 2035, 74:10–75:23, 123:22–124:11. He likewise declined to confirm agreement with Paper 20, stating only that he would need to review the "entirety of the documents." *Id.* at 89:15–90:11. An expert who does not apply his own client's claim construction cannot reliably opine that the prior art satisfies the claims under that construction.

Second, Dr. Sarrafzadeh did not consider, adopt, or distinguish the constructions Petitioner and its experts advanced in the CyWee litigation. There, Samsung argued that a POSA would not have known whether “predicted axial accelerations” referred to linear, centrifugal, gravitational, or combined acceleration. Ex. 2025 at 13. Samsung's expert Mercer opined that the patent does not disclose that “predicted axial accelerations” are gravitational accelerations and that the term must refer to a composite of linear, centrifugal, and gravitational accelerations—not gravity alone. Ex. 2036, ¶¶ 203, 262; Ex. 2037, ¶ 954. When asked whether he agreed, Dr. Sarrafzadeh declined, stating he would need to review the materials or had not opined on those issues. Ex. 2035, 113:20–115:21, 154:7–15. He made no attempt to reconcile those prior positions with his opinions here.

Third, Dr. Sarrafzadeh could not answer basic questions about the basis, development, and consistency of his opinions. He could not recall how much he had been paid in these IPRs, despite billing by the hour and acknowledging that such records existed. Ex. 2035, 57:4–58:18, 59:1–12. He could not state how much expert-witness income he earned last year, what percentage of his income came from expert work, or his total annual income. Ex. 2035, 51:3–52:22, 53:6–14. He could not recall how many hours he spent preparing his declarations, despite maintaining billing records. Ex. 2035, 59:13–60:8. When asked about the origin of the claim constructions he applied, he could not identify whether they were developed

independently or in consultation with counsel, Ex. 2035, 64:3–65:12, and could not say whether he or counsel determined to apply “plain and ordinary meaning,” Ex. 2035, 68:9–19. He could not recall whether he or counsel identified the Kim reference, or what references he himself located. Ex. 2035, 70:2–15, 71:6–14. This pattern of non-responsiveness goes to the core bases of his opinions.

Obviousness must be evaluated against properly construed claims. An expert who cannot articulate, adopt, or consistently apply those constructions cannot provide a reliable invalidity opinion. Where an expert cannot explain the origins, consistency, or substance of his analysis, his testimony is entitled to little, if any, weight. 37 C.F.R. § 42.65(a).

Accordingly, the Board should give Dr. Sarrafzadeh’s testimony little or no weight.

XIV. PETITIONER’S FILING DATE AND OBVIOUSNESS ARGUMENTS ARE IRRECONCILABLE

Petitioner’s filing date and obviousness positions are irreconcilable. Petitioner argues the provisional ‘558 application lacks written description for the quaternion-based claims because it “presents no equations using quaternions.” Pet. at 73–74. But Dr. Sarrafzadeh admitted at deposition that the quaternion equations and benefits disclosed in Bassompierre’s would have been known by a POSA independent of Bassompierre’s disclosures and that he “never said” a POSA could not derive

quaternion equivalents of the Euler angle equations in the ‘558 application. Ex. 2035 at 333:4–8, 334:2-337:9. He admitted that “some Euler angles in the provisional can certainly be converted to quaternion” and clarified that he was “not saying if you could or could not” perform that conversion; all he was “saying is that the provisional makes no mention of presents no equations using quaternion.” *Id.* A POSA reading the provisional would therefore have possessed the same knowledge that allegedly motivated and enabled a POSA to derive quaternion versions of Bassompierre’s Euler angle EKF.

Petitioner cannot have it both ways. If the provisional’s Euler angle equations are insufficient to support quaternion-based claims, then Bassompierre’s Euler angle equations cannot render those same claims obvious for the same reason. Conversely, if a POSA’s background knowledge is sufficient to bridge the gap from Bassompierre’s Euler angles to the claimed quaternions, that same knowledge bridges the identical gap in the provisional. Petitioner must pick a position and live with its consequences on both fronts.

XV. CONCLUSION

Petitioner bears the burden to prove, by a preponderance of the evidence, that the challenged claims are unpatentable. It has not done so for any challenged claim.

Petitioner's case rests entirely on Bassompierre, yet Bassompierre does not teach a quaternion-based sensor fusion system, does not generate predicted axial

accelerations from a quaternion, does not operate on a single integrated electronic device, and does not translate device orientation into a movement pattern on a display. These are not minor gaps; they are fundamental mismatches between the prior art and the claimed invention. Petitioner attempts to bridge them through expert reconstruction, but obviousness must be grounded in what the prior art actually teaches and what a skilled artisan would have been motivated to do, not what can be derived after the fact using the patent as a roadmap. Bassompierre itself recognized quaternions yet deliberately implemented its system using Euler angles. A design choice Petitioner asks this Board to undo for no apparent reason. Petitioner and their expert ignore and mischaracterize the quaternion equations of Bassompierre, which demonstrates that a POSTA cannot implement any quaternion-based EFK using Bassompierre, let alone the specific quaternion-based steps required by the challenged claims.

Petitioner's inability to articulate and consistently apply a construction of "predicted axial acceleration" independently defeats the Petition. Without a stable construction, Petitioner cannot establish that any prior art meets the claims under a coherent theory.

Because Petitioner has failed to prove unpatentability by a preponderance of the evidence, all challenged claims should be held not unpatentable.

Respectfully Submitted,

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

The undersigned hereby certifies that the word count for the foregoing Patent Owner Response (“this paper”) totals 13,754 words, as counted by the word processing software used to produce this document, in compliance with 37 C.F.R. § 42.24(b).

This paper 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.

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April 6, 2026

Date

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

The undersigned hereby certifies that the above document was served April 6, 2026 by filing this document through the Patent Trial and Appeal Case Tracking System (P-TACTS) as well as delivering a copy via electronic mail to the following practitioners of record for Petitioners:

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