

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.,
Petitioner,

v.

THALES VISIONIX, INC.,
Patent Owner.

IPR2022-01304
Patent 6,922,632 B2

Before WILLIAM V. SAINDON, HYUN J. JUNG, and
JASON W. MELVIN, *Administrative Patent Judges*.

JUNG, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. Background and Summary

Meta Platforms, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting institution of an *inter partes* review of claims 1–9, 11–29, and 66–69 of U.S. Patent No. 6,922,632 B2 (Ex. 1001, “the ’632 patent”). Thales Visionix, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 8 (“Prelim. Resp.”). With our authorization, the parties filed additional briefs directed solely to the issue of our discretion under 35 U.S.C. § 314(a). Papers 9, 10.

Under 35 U.S.C. § 314, an *inter partes* review may not be instituted “unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” Upon consideration of the Petition and for the reasons explained below, we determine that Petitioner has shown a reasonable likelihood of prevailing with respect to at least one of the challenged claims.

Thus, we institute an *inter partes* review of claims 1–9, 11–29, and 66–69 of the ’632 patent on all presented challenges. *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018).

B. Real Parties in Interest

Petitioner identifies Meta Platforms, Inc. and Meta Platforms Technologies, LLC as real parties in interest. Pet. 1. Patent Owner identifies Thales Visionix, Inc. and Gentex Corporation as real parties in interest. Paper 4, 1.

C. Related Matters

The parties identify *Gentex Corp. v. Meta Platforms, Inc.*, 4:22-cv-03892 (N.D. Cal.) as a related matter.¹ Pet. 1–2; Paper 4, 1. Patent Owner additionally identifies as related matters IPR2022-01305 that also challenges the same patent and IPR2022-01308 that challenges a related patent. Paper 4, 1–2.

We instituted an *inter partes* review of claims 30–36, 44, 45, 47–55, and 57–61 of the ’632 patent in IPR2022-01305. *Meta Platforms, Inc. v. Thales Visionix, Inc.*, IPR2022-01305, Paper 12 (PTAB Mar. 13, 2023) (Decision Granting Institution).

D. The ’632 Patent (Ex. 1001)

The ’632 patent issued on July 26, 2005 from an application filed on August 11, 2003 and claims priority to a provisional application filed on August 9, 2002. Ex. 1001, codes (22), (45), (60). The ’632 patent “relates to tracking, navigation, pose estimation, localization, auto-calibration, scene modeling, structure-from-motion and/or map-building based on sensor inputs.” *Id.* at 1:12–15. Reproduced below is Figure 1 of the ’632 patent.

¹ The case was originally filed in the U.S. District Court for the Western District of Texas (No. 6:21-cv-00755-ADA) and was subsequently transferred to the U.S. District Court for the Northern District of California. Pet. 2. The parties incorrectly identify the case number in the Northern District of California as “5:22-cv-03892.” *Compare* Pet. 2; Paper 4 (Patent Owner’s Mandatory Notices), 1, *with* Ex. 2002 (Joint Order Regarding Claim Construction and Discovery).

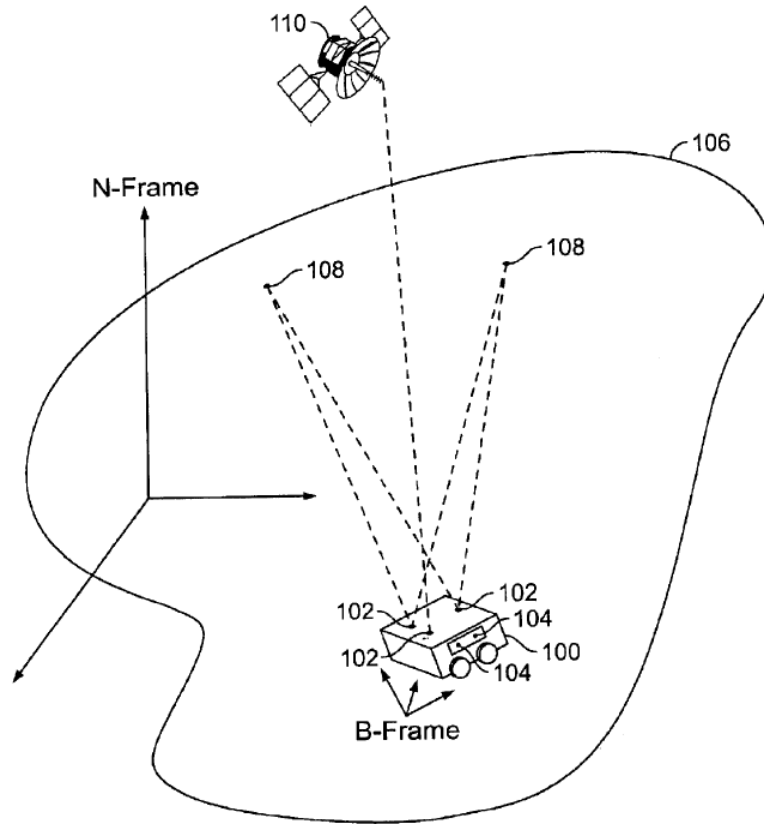


FIG. 1

Figure 1 “shows a vehicle navigating an environment.” Ex. 1001, 11:48. Navigation system 90 (shown in Figure 2 reproduced below) tracks vehicle 100 in environment 106, in particular “the position and the orientation (together referred to as the 6-dimensional ‘pose’) of vehicle 100 based on both inertial measurements as well as sensor measurements between sensing devices or targets in the vehicle 100 and sensing devices or targets that are fixed in the environment 106.” *Id.* at 12:3–4, 12:11–16.

Sensors and targets fixed to vehicle 100 or environment 106 are collectively referred to as pose sensing elements (“PSE”). Ex. 1001, 13:6–8. The ’632 patent states that “[f]or an ‘inside-out’ measurement, the sensor is attached to the vehicle and the target is fixed in the environment,” and “[f]or an ‘outside-in’ measurement, a sensor fixed in the environment observes a

target fixed to the moving vehicle.” *Id.* at 14:47–51. Reproduced below is Figure 2 of the ’632 patent.

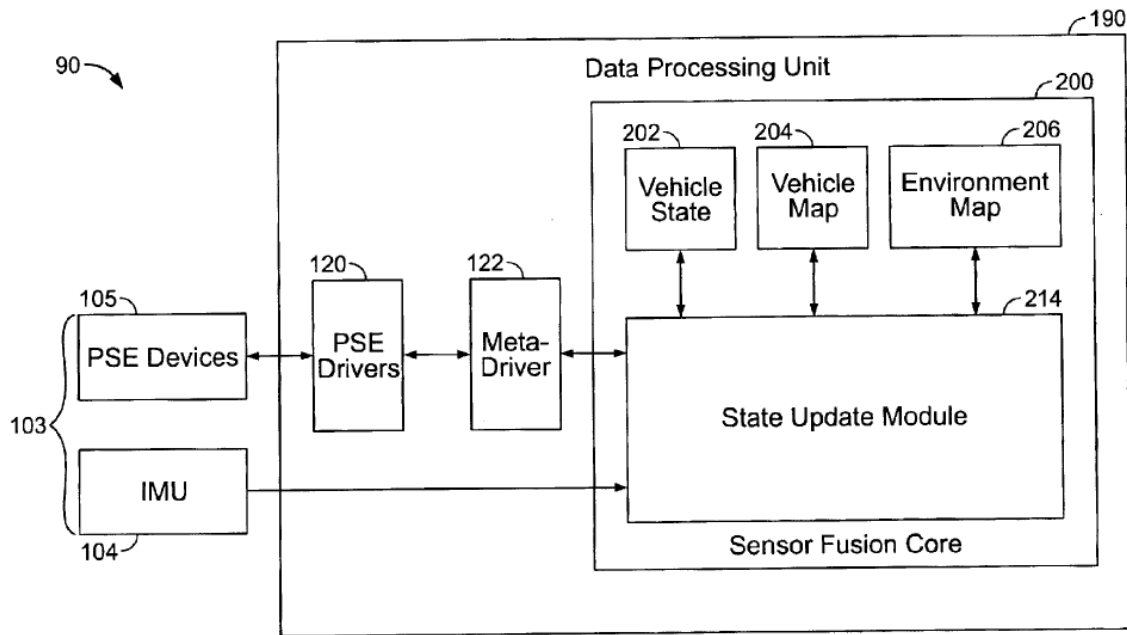


FIG. 2

Figure 2 is a block diagram of a navigation system. Ex. 1001, 11:49. Navigation system 90 includes sensors 103 and data processing unit 190. *Id.* at 12:5–7. Sensors 103 include PSE devices 105 and inertial measurement unit (“IMU”) 104. *Id.* at 12:45–48.

According to the ’632 patent, “a wide variety of sensors and targets may be used” because “[n]avigation system 90 is modularized and configurable such that different sensors and targets can be selected for a particular vehicle without necessarily having to re-implement and re-test the implementation of the navigation system.” Ex. 1001, 13:32–37. The ’632 patent “provides a ‘plug and track’ capability in which sensors and targets and their associated software drivers can be ‘plugged’ into the navigation system 90.” *Id.* at 13:37–40.

“[S]ensor specific computations are isolated in PSE drivers 120” that “are software modules,” and “meta-driver 122 provides an interface between the PSE drivers 120 and a sensor fusion core 200, which does not need to include sensor-specific aspects.” Ex. 1001, 16:40–44, 16:46. “By dividing data processing unit 190 into portions specific to PSE devices 105 and a portion specific to updating the states of the navigation system 90, the navigation system can be easily reconfigured.” *Id.* at 17:29–32. Sensor fusion core 200 “processes information from sensors 103” that updates estimates of vehicle location and orientation. *Id.* at 16:57–58. Sensor fusion core 200 includes state update module 214 that has measurement management unit (“MMU”) 304. *Id.* at 16:59, 17:40–44, 18:24–25, Figs. 2, 3.

“When system 90 powers up, it starts in initialization mode, which includes the enumeration and self-configuration procedures.” Ex. 1001, 22:54–56. MMU 304 requests meta driver 122 to “enumerate the sensing hardware,” and meta driver 122 then loads available PSE drivers and requests each PSE driver 120 enumerate PSE devices 105 available to navigation system 90. *Id.* at 18:39–43, 18:48–49; *see also id.* at 22:15–36 (describing the enumeration process). Meta driver 122 also “receives the configuration information from PSE drivers 120.” *Id.* at 18:59–60. “By using meta-driver 122 to enumerate the PSEs available upon power-up of navigation system 90, the navigation system is able to automatically reconfigure itself.” *Id.* at 19:1–3.

“Once a valid system configuration has been achieved and stored in the requisite configuration files,” “the system moves into acquisition mode . . . to find out the approximate location or pose of the vehicle.” Ex. 1001, 22:57–61. “This initial pose estimate allows the system 90 to enter the

tracking update loop, which involves a recursive estimation filter that uses an approximate initial guess of states.” *Id.* at 22:62–64. A “difference between expected measurement based on the estimated pose . . . and the actual sensor measurement . . . is referred to as the ‘innovation’ in the measurement.” *Id.* at 15:48–51.

“In tracking mode, MMU 304 communicates with meta-driver 12[2] to determine which PSE pairs (including target and sensor) are available to make measurements during the next measurement cycle,” and “selects a pair of PSEs from among the pairs of PSEs that are available to make measurements.” Ex. 1001, 19:29–34. The selection is “based on an ‘information gain’ that represents the utility (or usefulness) of a measurement by the pair of PSEs to navigation system 90.” *Id.* at 19:34–37.

E. Illustrative Claim

The ’632 patent includes 69 claims, of which Petitioner challenges claims 1–9, 11–29, and 66–69 in this proceeding. Claims 1, 66, 68, and 69 are independent, and reproduced below is claim 1.

1. A method for tracking an object comprising:
 - coupling a sensor subsystem to an estimation subsystem, said sensor subsystem enabling measurement related to relative locations or orientations of sensing elements;
 - accepting configuration data from the sensor subsystem;
 - configuring the estimation system according to the accepted configuration data;
 - repeatedly updating a state estimate, including
 - accepting measurement information from the sensor subsystem, and,
 - updating the state estimate according to the accepted configuration data and the accepted measurement data.

Ex. 1001, 46:19–31.

F. Asserted Prior Art and Proffered Testimonial Evidence

Petitioner identifies the following references as prior art in the asserted grounds of unpatentability:

Name	Reference	Exhibit
Kramer	US 5,592,401, issued Jan. 7, 1997	1030
Horton	US 5,615,132, issued Mar. 25, 1997	1010
Welch Thesis	Gregory F. Welch, SCAAT: Incremental Tracking with Incomplete Information (Oct. 1996).	1009
Welch 1997	Greg Welch & Gary Bishop, SCAAT: Incremental Tracking with Incomplete Information (1997).	1008
Chen	Steven C. Chen & Kang Lee, <i>A Mixed-Mode Smart Transducer Interface for Sensors and Actuators</i> , SOUND & VIBRATION, Apr. 1998 at 24.	1024
Welch 2001	Greg Welch et al., <i>High-Performance Wide-Area Optical Tracking</i> , PRESENCE TELEOPERATORS AND VIRTUAL ENVIRONMENTS, Feb. 2001 at 1.	1007

Petitioner contends that Welch 2001, Welch 1997, Welch Thesis, and Horton are prior art under §§ 102(a) and (b) and Kramer and Chen are prior art under only § 102(b).² Pet. 4–5. Petitioner also provides a Declaration of Dr. Ulrich Neumann. Ex. 1005.³

² The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284 (Sept. 16, 2011), took effect on March 16, 2013. Because the ’632 patent issued from an application filed before that date, our citations to 35 U.S.C. §§ 102 and 103 in this Decision are to their pre-AIA versions. *See also* Pet. 4 n.1 (“Based on the claimed priority date of the ’632 Patent, Pre-AIA versions of § 102(a) and § 103 apply.”).

³ Petitioner also includes several declarations directed toward the public availability of several references. *See, e.g.*, Exs. 1018–1021, 1027–1029.

G. Asserted Grounds

Petitioner asserts that claims 1–9, 11–29, and 66–69 are unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–9, 11–22, 24–29	103(a)	Welch 2001, Welch 1997
23	103(a)	Welch 2001, Welch 1997, Welch Thesis
1–9, 11–24, 28, 29	103(a)	Horton
25–27	103(a)	Horton, Welch 1997
66–68	103(a)	Kramer, Chen
69	103(a)	Kramer, Chen, Welch 2001

Pet. 4–5.

II. 35 U.S.C. § 314(a)

A. Parallel Litigation

As noted above in Section I.C., the parties identify a related matter in the U.S. District Court for the District of Northern California. Pet. 1–2; Paper 4, 1.

Petitioner argues that most of the factors of *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”) weigh against exercising our discretion under § 314(a) to deny the Petition. Pet. 7–9. According to Petitioner, only factors 1 and 4 are neutral. *Id.* at 7, 8. Patent Owner responds that trial in the related litigation will take place in late January 2024, before a Final Written Decision is expected in this proceeding. Prelim. Resp. 56. Patent Owner also argues that factors 4–6 weigh in favor of discretionary denial. *Id.* at 57. With our authorization, the parties filed reply arguments that elaborate on the arguments summarized above. Papers 9, 10.

Fintiv instructs us to consider whether to deny institution in certain circumstances when there is parallel district court litigation, upon consideration of six factors:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
2. proximity of the court's trial date to the Board's projected statutory deadline for a final written decision;
3. investment in the parallel proceeding by the court and the parties;
4. overlap between issues raised in the petition and in the parallel proceeding;
5. whether the petitioner and the defendant in the parallel proceeding are the same party; and
6. other circumstances that impact the Board's exercise of discretion, including the merits.

Fintiv, Paper 11 at 6.

Our analysis of *Fintiv* is guided by the USPTO Director's Memorandum issued on June 21, 2022, titled "Interim Procedure for Discretionary Denials in AIA Post Grant Proceedings with Parallel District Court Litigation" ("Director's Memo").⁴ We turn to the *Fintiv* factors.

1. Factor 1: Stay

Neither party has moved for a stay of the district court proceeding. Pet. 7; Paper 9, 2; Paper 10, 5. This factor is, thus, neutral.

2. Factor 2: Proximity to Trial Date

The parallel litigation began in the U.S. District Court for the Western District of Texas, but was transferred to the U.S. District Court for the

⁴ Available at https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf.

Northern District of California. Pet. 8; Prelim. Resp. 55–56. No trial date has been set. Pet. 8. Patent Owner argues that we should deny institution based on the expected trial date using the median time to trial from when the case was filed in the Western District of Texas. *See, e.g.*, Prelim. Resp. 56; Paper 10, 2.

Fintiv factor 2 discusses consideration of a *trial date*. The Director’s Memo states that it may be useful to compare a trial date with evidence of a median time to trial. Director’s Memo 8. The purpose of doing so is in order to ascertain the likelihood of the scheduled trial date actually occurring on or around that date. *Id.* at 8 (“Stakeholders correctly noted that scheduled trial dates are unreliable and often change[,]” and a “scheduled trial date . . . is not by itself a good indicator of [when] the district court trial will occur.”). The Director’s Memo does not state that median time-to-trial statistics are themselves a trial date, or otherwise replace consideration of a trial date under *Fintiv* factor 2. And, in the circumstances here, where the case was transferred from the Western District of Texas, the usefulness of the median time to trial statistics is less clear. Ultimately, though, we will not speculate on when a trial may be scheduled. Accordingly, factor 2 favors not exercising our discretion to deny institution.

3. *Factor 3: Investment in Parallel Proceeding*

Patent Owner argues that “[t]he parties have fully briefed claim construction and exchanged infringement and invalidity contentions, and are almost eight months into general fact discovery.” Prelim. Resp. 56. Petitioner argues that “the most burdensome parts of the case still remain,” for example fact discovery does not close for several months, and expert discovery has yet to begin. Paper 9, 3. Petitioner also notes that there have not been any claim construction rulings. *Id.* Patent Owner responds that

“Petitioner has proposed that all document production be substantially complete by March 16, 2023.” Paper 10, 4 (citing Ex. 2003, 1).

We determine that factor 3 does not favor discretionary denial. Although there has been work completed, as Petitioner points out, “the most burdensome parts of the case still remain.” Paper 9, 3; *see also* Ex. 1031 (Case Management and Pretrial Order).

4. *Factor 4: Overlap with Parallel Proceeding*

Petitioner offers to file a *Sand Revolution* type of stipulation, indicating that it will not pursue the grounds raised in this proceeding in the parallel litigation if we institute trial. Paper 9, 3–4; *Sand Revolution II, LLC v. Cont’l Intermodal Grp. Trucking LLC*, IPR2019-01393, Paper 24 at 11–12 (PTAB June 16, 2020) (informative) (finding that a stipulation not to pursue the same grounds in the parallel litigation “mitigates to some degree the concerns of duplicative efforts”). Patent Owner argues that such a narrow stipulation does not mitigate the concerns of overlap. Paper 10, 4–5.

We are not aware of any precedent that *Sand Revolution* type stipulations are no longer valid or not entitled to weight in the *Fintiv* analysis. We recognize that *Sand Revolution* stipulations are narrower in scope than *Sotera* type stipulations, and perhaps may require a different result in a case with different facts. *See Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 18–19 (PTAB Dec. 1, 2020) (precedential as to § II.A) (finding that a broad stipulation not to pursue any ground raised or that could have been reasonably raised in the parallel litigation weighs strongly toward institution). Here, Petitioner’s stipulation still eliminates specific overlap with the parallel proceeding. As in *Sand Revolution*, we weigh this factor as marginally favoring not exercising our discretion to deny institution. *Sand Revolution*, Paper 24 at 12.

5. *Factor 5: Whether Petitioner and Defendant are the Same Party*

“If a petitioner is unrelated to a defendant in an earlier court proceeding, the Board has weighed this fact against exercising discretion to deny institution” *Fintiv*, Paper 11 at 13. Petitioner is also a defendant in the related district court litigation. *See* Pet. 1–2; Prelim. Resp. 55. Thus, this factor weighs marginally in favor of exercising our discretion to deny institution. *Sotera*, Paper 12 at 19.

6. *Factor 6: Merits and Other Considerations*

Patent Owner argues that Petitioner does not make out a compelling case on the merits. Prelim. Resp. 57. As specified in the Director’s Memo, “compelling, meritorious challenges will be allowed to proceed at the PTAB even where district court litigation is proceeding in parallel.” Director’s Memo 4. Accordingly, the Director’s Memo states that the *Fintiv* analysis will not lead to discretionary denial if it can be established that a case presents compelling merits. *Id.* at 4–5. But, the Director’s Memo does not require a Petitioner to establish compelling merits to avoid discretionary denial.

Additionally, the Director recently clarified the Interim Procedure, stating that “[t]he Board should first assess *Fintiv* factors 1–5; if that analysis supports discretionary denial, the Board should engage the compelling merits question.” *CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01242, Paper 23 at 6 (PTAB Feb. 27, 2023) (precedential). Here, we determine that, on balance, *Fintiv* factors 1–5 do not favor exercising our discretion to deny institution and, therefore, there is no need to determine whether the Petition establishes compelling merits.

7. *Conclusion on Fintiv Factors*

Based on a holistic analysis of the *Fintiv* factors taking into consideration “whether efficiency and integrity of the system are best served by denying or instituting review” (*Fintiv*, Paper 11 at 6), we decline to exercise our discretion under 35 U.S.C. § 314(a) to deny institution of *inter partes* review.

B. *Multiple Petitions*

As noted above in Section I.C., Petitioner filed two petitions challenging the same patent. Petitioner contends that “[m]ore than one petition is . . . necessary to sufficiently address all the challenged claims” of the ’632 patent. Paper 3, 1. According to Petitioner, a large number of claims have been asserted in the parallel litigation “that are distinct from one another, that collectively comprise several thousand words of claim language.” *Id.* Petitioner ranks this Petition as “A” and the Petition in IPR2022-01305 as “B.” *Id.* at 1–2. Petitioner also explains its reasoning for the grouping of the claims challenged in each petition and contends that there is no overlap between the two petitions. *Id.* at 2–3.

Patent Owner did not file a response to the Notice. Nor did Patent Owner otherwise dispute Petitioner’s contentions that two petitions are necessary. *See generally* Prelim. Resp.

On the present record, we see no reason to exercise our discretion to deny institution on the basis of Petitioner filing two petitions to address the large number of claims asserted in the related litigation. *See* PTAB Consolidated Trial Practice Guide, 59 (Nov. 2019)⁵ (recognizing that one

⁵ Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

circumstance in which more than one petition may be necessary is when a patent owner asserts a large number of claims in related litigation).

III. ANALYSIS

A. *Legal Standards*

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent [claim] it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016). This burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). The Board may authorize an *inter partes* review if we determine that the information presented in the Petition shows that there is a reasonable likelihood that Petitioner will prevail with respect to at least one of the claims challenged in the petition. 35 U.S.C. § 314(a).

Petitioner contends that the challenged claims of the ’632 patent are unpatentable under § 103. Pet. 4–5. A claim is unpatentable under § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also “determine whether there was an apparent reason to combine the known

elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of elements produces a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

B. Level of Ordinary Skill in the Art

Petitioner argues that one of ordinary skill in the art “would have had a Bachelor’s degree in Computer Science, or an equivalent field, and three to five years of experience working with computer implemented tracking systems.” Pet. 13 (citing Ex. 1005 ¶ 37). Petitioner also argues that “[a]dditional education might compensate for less experience, and vice-versa.” *Id.* (citing Ex. 1005 ¶ 37).

“For purposes of this preliminary response only, Patent Owner accepts the Petition’s proposed definition of a person of ordinary skill in the art.” Prelim. Resp. 12–13 (quoting Pet. 13). “However, for any other purpose, Patent Owner disagrees with Petitioner that such [a person of ordinary skill in the art] should be limited to a maximum of five years’ experience and reserves the right to offer an alternative definition based on expert evidence.” *Id.* at 13.

Based on the preliminary record, we adopt Petitioner’s asserted level of ordinary skill only to determine whether there is a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in the Petition.⁶

⁶ We also adopted the same proposed level of ordinary skill in IPR2022-01305 to determine whether there was a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims in that proceeding.

C. Claim Construction

In an *inter partes* review, the claims are construed

using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

37 C.F.R. § 42.100(b) (2021); *see Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

Petitioner argues that “no terms need construction because the claims read on the prior art under any construction consistent with *Phillips*.”

Pet. 13. Patent Owner also does not propose expressly any interpretation for any claim term. *See generally* Prelim. Resp.

At this preliminary stage, because determining whether Petitioner shows a reasonable likelihood of prevailing does not depend on a particular interpretation for any claim term, we determine that no claim term requires express interpretation.⁷ *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms that . . . are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

D. Asserted Obviousness Based on Welch 2001 and Welch 1997

1. Welch 2001 (Ex. 1007)

Welch 2001 is an article titled “High-Performance Wide-Area Optical Tracking” and presents “a complete description of our recent electro-optical

⁷ We also determined that no claim term in IPR2022-01305 required express interpretation.

system, the HiBall Tracking System.” Ex. 1007, 1. Reproduced below is Figure 6 of Welch 2001.

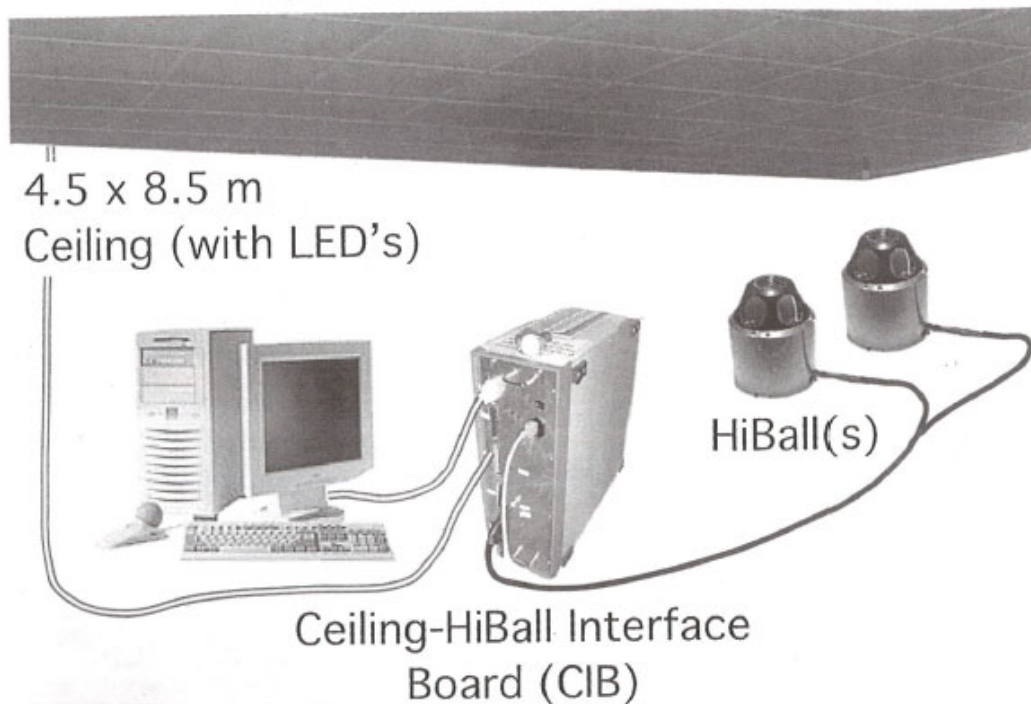


Figure 6.

Figure 6 shows that the “HiBall Tracking System consists of three main components.” Ex. 1007, 5. “An outward-looking sensing unit” called the HiBall “is fixed to each user to be tracked” and “observes a subsystem of fixed-location infrared LEDs” called the Ceiling. *Id.*; *see also id.* at 4 (explaining that the system uses “an *inside-looking-out* configuration, in which the optical sensors are on the (moving) user and the landmarks (for instance, the LEDs) are fixed in the laboratory,” and a “corresponding *outside-looking-in* alternative would be to place the landmarks on the user and to fix the optical sensors in the laboratory”), Fig. 4 (showing the HiBall unit and the unit on a person), Fig. 5 (depicting the outside-looking-in and inside-looking-out configurations).

“Communication and synchronization between the host computer and these subsystems is coordinated by the Ceiling-HiBall Interface Board (CIB).” Ex. 1007, 5–6. “Each HiBall observes LEDs through multiple sensor-lens views that are distributed over a large solid angle.” *Id.* at 6. “LEDs are sequentially flashed (one at a time) such that they are seen via a diverse set of views for each HiBall,” and “[i]nitial acquisition is performed using a brute-force search through LED space, but, once initial lock is made, the selection of LEDs to flash is tailored to the views of the active HiBall units.” *Id.* “Pose estimates are maintained using a Kalman-filter-based prediction-correction approach known as *single-constraint-at-a-time* (SCAAT) tracking” that “has been extended to provide self-calibration of the ceiling, concurrent with HiBall tracking.” *Id.*

2. *Welch 1997 (Ex. 1008)*

Welch 1997 is a paper titled “SCAAT: Incremental Tracking with Incomplete Information.” Ex. 1008, 1. It “present[s] a promising new mathematical method for tracking a user’s pose (position and orientation)” that is referred to as “single-constraint-at-a-time or SCAAT tracking.” *Id.* at Abstr.

3. *Claim 1*

For “[a] method for tracking an object,” Petitioner argues that Welch 2001 and Welch 1997 disclose the preamble. Pet. 18 (citing Ex. 1005 ¶ 58; Ex. 1008, Abstr., § 3).

For “coupling a sensor subsystem to an estimation subsystem, said sensor subsystem enabling measurement related to relative locations or orientations of sensing elements,” Petitioner argues that Welch 2001 and Welch 1997 disclose the limitation because “the ‘Ceiling-HiBall Interface Board (CIB)’ couples LED targets and HiBall sensors (the claimed ‘sensor

subsystem’) with a PC (the claimed ‘estimation subsystem’).” Pet. 18–19 (citing Ex. 1007, Fig. 6). Petitioner also argues that the PC performs calculations to estimate a tracked object’s position and location, as described in the ’632 patent for the “estimation subsystem.” *Id.* at 19 (citing Ex. 1001, 2:35–46, 4:11–20; Ex. 1007, 6; Ex. 1008 § 3.1.2). Petitioner further argues that the HiBall sensors enable measurements related to sensing elements’ relative locations or orientations, and the sensing elements include the HiBall sensors and source LEDs. *Id.* (citing Ex. 1007, 10–11, Fig. 6).

For “accepting configuration data from the sensor subsystem,” Petitioner argues that Welch 2001 would have rendered obvious the limitation because it describes “generating and using calibration measurements from the sensor subsystem” by performing three measurements to determine an LED’s ideal position coordinates, similar to the ’632 patent’s description of sensor configuration data. Pet. 20 (citing Ex. 1001, 7:15–26; Ex. 1005 ¶¶ 62–63; Ex. 1007, 10). Petitioner also argues that the HiBall sensor system determines a noise estimate for each LED. *Id.* (citing Ex. 1007, 10).

For “configuring the estimation system according to the accepted configuration data,” Petitioner argues that Welch 2001 would have rendered obvious the limitation because it describes the HiBall sensor system estimating pose of a HiBall using the SCAAT tracking approach of Welch 1997. Pet. 20 (citing Ex. 1005 ¶¶ 64–65; Ex. 1007, 10–13).

For “repeatedly updating a state estimate, including accepting measurement information from the sensor subsystem, and, updating the state estimate according to the accepted configuration data and the accepted measurement data,” Petitioner argues that Welch 2001 and Welch 1997 would have rendered obvious the limitation because the SCAAT approach

“repeatedly updates both the location and orientation (i.e., pose) estimate of a HiBall according to the accepted measurement and configuration data from the sensor subsystem.” Pet. 21 (citing Ex. 1001, 2:60–61; Ex. 1005 ¶¶ 66–67; Ex. 1007, 10–13; Ex. 1008 § 3.1).

Regarding a motivation to combine, Petitioner argues that one of ordinary skill in the art “would have understood that the SCAAT calculations performed by the PC use the online configuration measurements as inputs to estimate the HiBall’s pose, and that using these measurements as inputs constitutes ‘configuring the estimate system’” and “would have understood that the SCAAT tracking approach described in Welch 2001 and Welch 1997 updates the sensor state estimate according to the accepted measurement and configuration data from the sensor subsystem.” Pet. 16–17 (citing Ex. 1005 ¶¶ 56, 57; Ex. 1007, 10–13; Ex. 1008 § 3.1).

a) Patent Owner’s Preliminary Response

Patent Owner responds that Petitioner fails to explain how Welch 2001’s CIB “constitutes ‘coupling a sensor subsystem to an estimation subsystem’” because Welch 2001 teaches that the CIB is a separate component connected to HiBall sensors and ceiling LEDs. Prelim. Resp. 15–16 (citing Pet. 18–19; Ex. 1007, 5–6, 9, Fig. 6). Patent Owner also argues that Petitioner does not indicate that the CIB is part of either the estimation subsystem or the sensor subsystem. *Id.* at 16 (citing Pet. 18–19). Patent Owner further argues that Petitioner does not explain how the CIB “can satisfy the claim’s requirement.” *Id.* at 17.

At this stage, Petitioner’s arguments for the “coupling” step of claim 1 are sufficient for institution. Pet. 18–19. Petitioner contends that the CIB couples the asserted sensor and estimation subsystems. *See id.* On the present record, the term “coupling” can be broad enough to include

Petitioner's asserted coupling. Claim 1 does not appear to narrow the broad term "coupling" to exclude Welch 2001's CIB coupling the asserted sensor and estimation subsystems. This dispute about "coupling" would, however, benefit from developing the record further because it presents an issue that may require a proposed claim construction from Patent Owner.

Patent Owner also responds that Petitioner fails to show "accepting configuration data from the sensor subsystem." Prelim. Resp. 17–20. Patent Owner argues that neither the relied-upon "'ideal' position coordinates" nor the "measurement noise estimate for the Kalman filter" constitute "configuration data" for a sensor. Prelim. Resp. 17 (citing Pet. 20). Patent Owner contends that Petitioner acknowledges that the recited "configuration data" is "sensor configuration data," but the cited LEDs are targets detected by sensors, not the sensors. *Id.* at 17–18 (citing Pet. 20; Ex. 1007, 5, 7).

Patent Owner also contends that Petitioner cites measurements for both "configuration data" and "measurement information," but claim 1 distinguishes the two, as apparently acknowledged by Petitioner in arguments for the next recited step. Prelim. Resp. 18 (citing Pet. 20; Ex. 1007, 10). Patent Owner additionally argues that Petitioner "does not explain how Welch 2001 discloses 'accepting configuration data *from the sensor subsystem*'" because Petitioner fails to show that the asserted configuration data is provided from the HiBall units and LEDs to the PC. Prelim. Resp. 19. Patent Owner contends that Petitioner makes the assertion with no citation to Welch 2001, and Welch 2001 does not support Petitioner's assertion. *Id.* at 19–20 (citing Pet. 20). Patent Owner also contends that Welch 2001 teaches that the PC performs the calculations for calibration, not the HiBall units, so Welch 2001 cannot disclose nor render

obvious “accepting configuration data from the sensor subsystem.” *Id.* at 20 (citing Ex. 1007, 6–10).

Petitioner’s position appears to be that, by making “three measurements to determine each LED’s ‘ideal’ position coordinates” or making a measurement to determine a noise estimate for a Kalman filter, Welch 2001 teaches accepting configuration data from the sensor subsystem because the asserted measurements provide “configuration data.” *See* Pet. 20. On the present record, Petitioner presents sufficient arguments that making measurements to determine “‘ideal’ position coordinates” or to determine a noise estimate is “configuration data” and making measurements for the SCAAT approach is “measurement data.” *See id.* at 20–21. This issue, however, would benefit from further development of the record.

Patent Owner further responds that Petitioner fails to show “configuring the estimation system according to the accepted configuration data.” Prelim. Resp. 20–21. According to Patent Owner, “Petitioner never identifies what disclosure or teaching in Welch 2001 constitutes “**configuring**” the PC, as the claim requires, much less configuring the PC “according to the accepted configuration data.” *Id.* (citing Pet. 20).

Petitioner, however, appears to argue that Welch 2001 would have rendered obvious configuring its PC by using the asserted “configuration data” of the arguments for the “accepting” step. *See* Pet. 20 (referring to arguments for “Section XII.A.2.c.” or “accepting configuration data from the sensor subsystem”). At this stage, for the reasons discussed above, Petitioner provides sufficient argument for institution, and Welch 2001 indicates that the “three measurements to determine each LED’s ‘ideal’ position coordinates” or measurement to determine a noise estimate for a

Kalman filter would aid the PC in making pose estimates. *See* Pet. 20; Ex. 1005 ¶¶ 64–65; Ex. 1007 § 5.3.

Patent Owner additionally responds that Petitioner fails to show “repeatedly updating a state estimate, including accepting measurement information from the sensor subsystem, and updating the state estimate according to the accepted configuration data and the accepted measurement data.” Prelim. Resp. 21–22. According to Patent Owner, Petitioner’s arguments “are incomplete at best,” and “Petitioner never identifies or explains how” Welch 2001 and Welch 1997 disclose or would have rendered obvious “accepting measurement information” and “updating the state estimate according to the accepted configuration data.” *Id.* at 22 (citing Pet. 21).

Petitioner, however, argues that “[t]he ‘recursive pose estimation’ SCAAT tracking approach described in Welch 2001 and Welch 1997 repeatedly updates both the location and orientation (i.e., pose) estimate of a HiBall according to the accepted measurement and configuration data from the sensor subsystem.” Pet. 21 (citing Ex. 1005 ¶ 66; Ex. 1007, 10–11). Petitioner also argues that “a single measurement” is used to “incrementally update and improve a previous state estimate . . . , and the process repeats to reduce measurement noise and generate a more accurate estimate of the sensor’s pose.” *Id.* (citing Ex. 1007, 11–13; Ex. 1008 § 3.1). Petitioner appears to be arguing that the “single measurement” teaches the “accepted measurement information.” *See id.*

Based on the arguments presented in the Petition and the evidence cited in the record, Petitioner shows a reasonable likelihood of prevailing in its obviousness challenge to claim 1 based on Welch 2001 and Welch 1997.

4. *Dependent Claims 2–4*

Claim 2 depends from claim 1 and recites “wherein coupling the sensor subsystem to the estimation subsystem includes coupling software modules each associated with one or more of the sensing elements.”

Ex. 1001, 46:32–35. Petitioner argues that Welch 2001 and Welch 1997 disclose the limitations of claim 2 because “a distinct SCAAT Kalman filter is defined for each LED and for each sensor within the HiBall” and that each Kalman filter “constitutes a ‘software module.’” Pet. 21–22 (citing Ex. 1005 ¶¶ 68–69; Ex. 1007, 11–13; Ex. 1008 § 3.2.1).

Patent Owner responds that “Petitioner previously contended that *hardware* connections between the CIB, LED targets and HiBall sensors, and a PC satisfied the ‘coupling a sensor subsystem to an estimation subsystem,’” but claim 2 “further narrows that ‘coupling’ process.” Prelim. Resp. 23 (citing Pet. 18–19, 21–22). Patent Owner argues that Petitioner improperly relies on “different disclosures entirely.” *Id.* at 23. Patent Owner also argues that Welch 2001’s Kalman filters “reside entirely within the PC,” and that “Petitioner does not explain how the alleged existence of various software components on the PC can constitute ‘coupling the sensor subsystem to the estimation subsystem,’ or even how the existence of separate Kalman filters constitutes ‘*coupling* software modules.’” *Id.* at 24 (citing Ex. 1007, 5–6, 10–13).

Petitioner, however, appears to be arguing that, because claim 2 recites “coupling the sensor subsystem to the estimation subsystem *includes* coupling software modules . . . ,” the coupling of HiBall sensors, the asserted sensor subsystem, to the PC, the asserted estimation subsystem, would include a coupling in the software of the PC so that the SCAAT tracking approach can estimate pose. *See* Pet. 18–19, 21–22. At this stage,

claim 2 does not appear to require that the recited “software modules” be within the CIB, as argued by Patent Owner. Separate hardware and software couplings appear to be within the scope of claims 1 and 2.

Claim 3 depends from claim 2 and recites “wherein each of the software modules provides a software interface for receiving information related to an expected sensor measurement and providing measurement information that depends on said received information.” Ex. 1001, 46:36–40. Petitioner argues that Welch 2001 would have rendered obvious claim 3 because “[t]he HiBall sensors make measurements in sync with LED control,” “[t]he actual sensor measurement depends on having received the trigger,” and the “information is communicated via” Welch 2001’s CIB. Pet. 22 (citing Ex. 1005 ¶¶ 70–72; Ex. 1007, 10). Petitioner also argues that one of ordinary skill in the art would have understood this process “to include a ‘software interface’ for communicating the trigger information from the LED to the HiBall sensors and for communicating the measurement information from the HiBall sensors to the Kalman filter.” *Id.* (citing Ex. 1005 ¶ 71; Ex. 1007, Fig. 6).

Patent Owner refers to its arguments for claim 2, from which claim 3 depends. Prelim. Resp. 24. Patent Owner also responds that “in claim 2 Petitioner identified the Kalman filters ‘defined for each LED and for each sensor’ as the claimed ‘software modules,’” but “for claim 3 Petitioner now points to a purported ‘software interface’ included within the CIB.” *Id.* at 24–25 (citing Pet. 21–22). Patent Owner further argues that “Petitioner does not identify or explain how Welch 2001 renders obvious the ‘expected sensor measurement’ aspect of claim 3.” *Id.* at 25.

According to Petitioner, “[e]ach Kalman filter . . . constitutes a ‘software module’” in arguments for claim 2, but the CIB would have been

understood “to include a ‘software interface’ for communicating the trigger information from the LED to the HiBall sensors and for communicating the measurement information from the HiBall sensors to the Kalman filter” in arguments for claim 3. Pet. 22 (citing, for claim 2, Ex. 1005 ¶ 68; Ex. 1007, 11–13) (citing, for claim 3, Ex. 1005 ¶ 71; Ex. 1007, Fig. 6). At this stage, the arguments for claims 2 and 3 do not appear to explain sufficiently why Kalman filters teach software modules for claim 2, but not for claim 3. See Pet. 21–22. If both Kalman filters and CIB software each teach software modules, the arguments for claims 2 and 3 do not appear to address what, if any, relationship there is between the two, so that one can be relied on for claim 2 and the other for claim 3. See *id.*

The Petition repeats the cited testimonial evidence, and that testimony also does not explain how the CIB software is related to Kalman filters so that they can both teach the recited “software modules” of claims 2 and 3. See Ex. 1005 ¶¶ 68, 71. This issue should be developed further during trial.

Claim 4 depends from claim 3 and recites “wherein each of the software modules implements calculations that are independent of a representation of the state in the estimation subsystem.” Ex. 1001, 46:41–43. Petitioner argues that Welch 2001 would have rendered obvious claim 4 because “each Kalman filter associated with each individual sensor makes a separate calculation that is independent of the overall estimation computed by the estimation subsystem.” Pet. 23 (citing Ex. 1005 ¶¶ 73–74; Ex. 1007, 10–11). For the reasons discussed above for claim 3, at this stage, Petitioner’s arguments for claim 4 do not appear to resolve the potential issues we identified above with claim 3.

5. Dependent Claims 5–9, 20, 21, and 24–29

Claim 5 depends from claim 1 and recites “wherein the state estimate characterizes an estimate of a location of the object.” Ex. 1001, 46:44–45. Petitioner argues that Welch 2001 and Welch 1997 disclose the limitation of claim 5 because the HiBall system estimates a tracked user’s pose, which would include the location. Pet. 23 (citing Ex. 1005 ¶ 75; Ex. 1007, 2, 4, 10; Ex. 1008, Abstr.).

Claim 6 depends from claim 1 and recites “wherein the state estimate characterizes configuration information for one or more sensing elements fixed to the object.” Ex. 1001, 46:46–48. Petitioner argues that Welch 2001 and Welch 1997 would have rendered obvious claim 6 because the HiBall sensing unit is attached to a user and “autocalibrates the system with respect to each LED sensing element using measured device parameters.” Pet. 23–24 (citing Ex. 1005 ¶¶ 76–77; Ex. 1007, 4, 13; Ex. 1008 § 3.2).

Claim 7 depends from claim 6 and recites “wherein the configuration information for the one or more sensing elements fixed to the object includes information related to position or orientation of said sensing elements relative to the object.” Ex. 1001, 46:49–52. Petitioner argues that Welch 2001 and Welch 1997 would have rendered obvious claim 7 because “the SCAAT method is used for autocalibration with respect to each LED sensing element based on extrinsic parameters” that include “information about the geometric relationship (i.e., relative position and/or orientation) of the LED sensing elements to the tracked object.” Pet. 24 (citing Ex. 1005 ¶¶ 78–79; Ex. 1008 §§ 2.2, 2.3).

Claim 8 depends from claim 6 and recites “wherein the configuration information for the one or more sensing elements fixed to the object includes operational parameters for the one or more sensing elements.” Ex. 1001,

46:53–56. Petitioner argues that Welch 2001 and Welch 1997 would have rendered obvious claim 8 because a “sensor’s inherent electrical noise” is one of the “device-related parameters used by the measurement function to autocalibrate the system with respect to each LED sensing element.”

Pet. 24–25 (citing Ex. 1005 ¶¶ 80–81; Ex. 1008 §§ 3.1, 3.2). According to Petitioner, one of ordinary skill in the art “would have understood that electrical noise is an ‘operational parameter[]’ of the sensor” and “would need to be incorporated into the autocalibration function.” *Id.* at 25 (citing Ex. 1005 ¶ 80).

Claim 9 depends from claim 1 and recites “wherein the state estimate characterizes configuration information for one or more sensing elements fixed in an environment of the object.” Ex. 1001, 46:57–59. Petitioner argues that Welch 2001 and Welch 1997 would have rendered obvious claim 9 because “the LEDs in the HiBall system constitute sensing elements” and “are affixed to the ceiling.” Pet. 25 (citing Ex. 1005 ¶¶ 82–83; Ex. 1007, 8–9, 13). Petitioner also argues that “the SCAAT system autocalibrates a separate state vector and covariance matrix for each LED source in the system” and “[t]his autocalibration data constitutes ‘configuration information’ for each LED sensing element.” *Id.* (citing Ex. 1005 ¶ 82; Ex. 1007, 13; Ex. 1008 § 3.2.2).

Claim 20 depends from claim 1 and recites “wherein repeatedly updating the state further includes: selecting a pair of sensing elements for measurement; and providing an identification of the selected pair to the sensing subsystem.” Ex. 1001, 47:36–40. Petitioner argues that Welch 2001 discloses the limitations of claim 20 because Welch 2001 teaches using a sensor and an LED for measurement and instructing the CIB to flash an LED to take the measurement. Pet. 32–33 (citing Ex. 1005 ¶¶ 106–109; Ex. 1007,

13, 17). Petitioner also argues that one of ordinary skill in the art would have understood that “the flashing of the LED, in coordination with the HiBall sensor, constitutes an ‘identification’ of the LED-HiBall pair within the system.” *Id.* (citing Ex. 1005 ¶ 108).

Claim 21 depends from claim 20 and recites “wherein selecting the pair of sensing elements includes selecting said elements according to an expected utility of a measurement associated with said elements to the updating of the state.” Ex. 1001, 47:41–44. Petitioner argues that Welch 2001 discloses the limitations of claim 21 because Welch 2001 teaches selecting an LED in a “least-recently-used fashion to ensure a diversity of constraints,” which would be based on the expected utility of the measurement. Pet. 33 (citing Ex. 1001, 19:35–37; Ex. 1005 ¶¶ 110–111; Ex. 1007, 13).

Claim 24 depends from claim 1 and recites “wherein updating the state estimate includes applying a Kalman Filter approach.” Ex. 1001, 47:54–55. Petitioner argues that Welch 2001 discloses claim 24’s limitation because the HiBall system uses Kalman filters to calculate “prediction-and-correction state estimates.” Pet. 34 (citing Ex. 1005 ¶¶ 114–115; Ex. 1007, 6, 11).

Claims 25 depends from claim 1 and recites “wherein each of said sensing elements comprises at least one of a sensor and a target.” Ex. 1001, 47:56–57. Petitioner argues that Welch 2001 discloses claim 25’s limitation because Welch 2001 teaches that its sensing elements are the HiBall sensors and source LEDs which would have been known to be a target. Pet. 34–35 (citing Ex. 1001, 1:21–24; Ex. 1005 ¶¶ 116–117; Ex. 1007, Fig. 6).

Claim 26 depends from claim 25 and recites “wherein the target comprises an active device that interacts with the sensor.” Ex. 1001, 47:58–

59. Petitioner argues that Welch 2001 discloses claim 26’s limitation because the source LEDs flash to perform a measurement and would be an “active” target according to the ’632 patent’s explanation of an active target. Pet. 35–36 (citing Ex. 1001, 13:24–28; Ex. 1005 ¶¶ 118–119; Ex. 1007, 6, 10).

Claim 27 depends from claim 26 and recites “wherein the target comprises at least one of a man-made signal reflector and a natural feature of an environment.” Ex. 1001, 47:60–62. Petitioner argues that Welch 2001 would have rendered obvious claim 27 because “the source LEDs, which are man-made signal reflectors” and “Welch 2001 also contemplates that the HiBall system could be ‘scaled indefinitely’ and ‘evolve’ to use ‘natural features’ as targets.” Pet. 36 (citing Ex. 1005 ¶¶ 120–121; Ex. 1007, 4–5).

Claim 28 depends from claim 1 and recites

wherein the object is selected from a group consisting of a vehicle, a robot, *a person*, a part of a person, a flying object, a floating object, an underwater moving object, an animal, a camera, a sensing apparatus, a helmet, a tool, a piece of sports equipment, a shoe, a boot, an article of clothing, a personal protective equipment, a rigid object having a dimension between 1 nanometer to 109 meters.

Ex. 1001, 47:63–48:3 (emphasis added). Petitioner argues that Welch 2001 discloses claim 28 because Welch 2001 teaches a tracked object is a person. Pet. 36–37 (citing Ex. 1005 ¶¶ 122–123; Ex. 1007, Figs. 4, 5).

Claim 29 depends from claim 1 and recites “wherein the state estimate comprises information related to a position or an orientation of the object relative to a reference coordinate frame.” Ex. 1001, 48:4–6. Petitioner argues that Welch 2001 and Welch 1997 disclose claim 29’s limitation because, in the SCAAT approach, the state estimate for a sensor includes

information related to target position and orientation. Pet. 37 (citing Ex. 1005 ¶¶ 124–125; Ex. 1008 § 3.1.1).

Patent Owner responds that, for the challenged dependent claims, Petitioner fails to show Welch 2001 and Welch 1997 would have rendered them obvious because Petitioner fails to show claim 1 would have been rendered obvious. Prelim. Resp. 22–23. Patent Owner does not provide any arguments specific to the limitations of claims 5–9, 20, 21, and 24–29. *See id.* at 22–26. At this stage, Petitioner’s arguments for claim 1 are sufficient for institution. Pet. 18–21.

Patent Owner also responds that Petitioner fails to incorporate its arguments for the independent claims into the arguments for the dependent claims. Prelim. Resp. 26–28 (citing Pet. 21–37). Petitioner’s arguments for claims 5–9, 20, 21, and 24–29, however, rely on arguments made for claim 1. Pet. 23–25, 32–33, 34–37. For example, Petitioner’s arguments for the recited state estimate of dependent claim 5 build on the arguments for the asserted state estimate of claim 1. *See id.* at 21, 23.

Based on the preliminary record, Petitioner shows a reasonable likelihood of prevailing with respect to at least one of claims 5–9, 20, 21, and 24–29 in its obviousness challenge based on Welch 2001 and Welch 1997.

6. Dependent Claims 11–19 and 22

Claim 11 depends from claim 1 and recites “wherein repeatedly updating the state further includes: providing to the sensor subsystems information related to an expected sensor measurement; and wherein accepting the measurement information from the sensor subsystem includes accepting information related to an actual sensor measurement.” Ex. 1001, 46:64–47:3.

Petitioner argues that Welch 2001 discloses the limitations of claim 11 because Welch 2001 teaches that “at each estimation cycle, [the CIB selects] a particular view from the sensor and a particular LED” and “[o]nce the view and LED are selected, the CIB flashes the selected LED and the HiBall takes a single measurement” that “is compared with a prediction obtained using the HiBall 2-D sensor measurement model equation.” Pet. 26 (citing Ex. 1005 ¶¶ 84–86; Ex. 1007, 9, 10, 12–13).

According to Petitioner, “[t]he measurement prediction generated by the model equation constitutes an ‘expected sensor measurement’” and “[t]his calculation is performed by the computer within the system, and then is ‘provid[ed] to the sensor subsystem[.]’” (i.e., the CIB and the HiBall sensor/LED pairs) when it is compared against the actual measurement from the LED and HiBall sensor.” Pet. 26 (citing Ex. 1005 ¶ 85). Petitioner also argues that “[t]he HiBall measurement is an ‘actual sensor measurement,’ and the system’s comparison of an actual measurement to a measurement prediction from the model constitutes ‘accept[ance]’ of the actual sensor measurement.” *Id.* at 27 (citing Ex. 1005 ¶¶ 87–88; Ex. 1007, 13).

Patent Owner responds that Petitioner’s argument “is both inconsistent with Petitioner’s previous contentions and with Welch 2001.” Prelim. Resp. 25 (citing Pet. 26). Patent Owner argues that “Welch 2001 does not disclose or suggest that the ‘prediction’ generated by the PC is then provided to the CIB” because “[t]he comparison between the measurement and the prediction is performed by the PC, not the CIB.” *Id.* at 26 (citing Ex. 1007, 11–13).

On the present record, it is not clear how Welch 2001 teaches providing to the asserted sensor subsystem (the CIB, HiBall sensor, and LED) information related to an expected sensor measurement. Pet. 26–27

(citing Ex. 1005 ¶¶ 84–88; Ex. 1007, 9, 10, 12–13). The cited portions of Welch 2001 describe how a measurement is taken and how the measurement “is used to update the filter state and covariance matrices using the Kalman gain matrix.” Ex. 1007, 9, 10, 12–13. The cited portions also state that “[t]he Ceiling-HiBall Interface Board (CIB) (figure 11) provides communication and synchronization between a host personal computer, the HiBall (section 4.1), and the ceiling (section 4.2)” and that “[o]nce a particular view and LED have been chosen in this fashion, the CIB (section 4.3) is instructed to flash the LED and take a measurement as described in section 5.2.” *Id.* at 9, 13.

None of the cited portions appears to expressly teach that the CIB, HiBall sensors, and LEDs are provided information related to an expected sensor measurement. *See* Ex. 1007, 9, 10, 12–13. Petitioner’s arguments substantially repeat the cited testimonial evidence. *Compare* Pet. 26–27, *with* Ex. 1005 ¶¶ 84–88. The testimony also does not explain further how the measurement prediction is provided to the CIB, HiBall sensors, and LEDs. *See* Ex. 1005 ¶ 85.

Furthermore, Petitioner’s asserted motivation to combine argues that one of ordinary skill in the art “would have understood that the SCAAT calculations performed by the PC use the online configuration measurements as inputs to estimate the HiBall’s pose, and that using these measurements as inputs constitutes ‘configuring the estimate system,’” and that “the SCAAT tracking approach described in Welch 2001 and Welch 1997 updates the sensor state estimate according to the accepted measurement and configuration data from the sensor subsystem.” Pet. 16–17 (citing Ex. 1005 ¶¶ 56, 57). These asserted understandings for the motivation to combine do

not seem to relate to providing information related to an expected sensor measurement. *See id.*

The other asserted reference, Welch 1997, describes that, when a measurement becomes available, the SCAAT algorithm cycles through steps that include predicting the measurement and computing the residual between the actual and predicted measurements. Ex. 1008 § 3.1.2. The section concludes with a statement in parenthetical that the “SCAAT filter computations” were executed “on a 200 MHz PC-compatible computer.” *Id.*; *see also id.* at § 4.4 (stating that the “SCAAT algorithm [was demonstrated] with the HiBall tracker, a head-mounted display, and a real application” and that “[t]he SCAAT code runs on a 200 MHz PC-compatible computer with a custom interface board”). Welch 1997 appears to indicate that information related to the predicted measurement is not provided to the asserted sensor subsystem.

To the extent that Petitioner is attempting to argue that there is a connection between the predicted measurement and the instruction sent from the PC to the CIB to flash a particular LED, Petitioner cites to a portion of Welch 2001 states that “[a]t each estimation cycle, the next of the 26 possible views is chosen randomly,” “[o]ne of the candidate LEDs is then chosen in a least-recently-used fashion to ensure a diversity of constraints,” and “[o]nce a particular view and LED have been chosen in this fashion, the CIB (section 4.3) is instructed to flash the LED and take a measurement.” Ex. 1007, 13. These statements in Welch 2001 indicate that random selection and time since last measurement, not the predicted measurement, influence which LED is flashed for the next measurement “to ensure diversity of constraints” for the SCAAT algorithm. *See id.*

On the present record, the cited portions of the asserted references do not appear to support Petitioner’s argument regarding providing to the asserted sensor subsystem (the CIB, HiBall sensor, and LED) information related to an expected sensor measurement. Pet. 26–27; Ex. 1008 §§ 3.1.2, 4.4.

Claims 12–19 and 22 depend ultimately from claim 11. Ex. 1001, 47:4–36, 47:46–49. Petitioner’s analysis for these claims does not appear to resolve the potential issues we identified above with claim 11. Pet. 27–32, 33–34.

E. Asserted Obviousness Based on Welch 2001, Welch 1997, and Welch Thesis

1. Welch Thesis (Ex. 1009)

The Welch Thesis is titled “SCAAT: Incremental Tracking with Incomplete Information.” Ex. 1009, 1. It describes a “new approach [referred to] as *single-constraint-at-a-time* or SCAAT tracking.’ *Id.* at Abstr. It also provides “A Simple Hybrid Example” that describes “an inertial-acoustical hybrid tracking system composed of three accelerometers, three rate gyros, and an acoustical line-of-sight system.” *Id.* at § 2.4.3.

2. Claim 23

Claim 23 depends from claim 20 and recites “wherein repeatedly updating the state further includes: updating the state according to accepted measurements from inertial sensors.” Ex. 1001, 47:50–53. Petitioner argues that Welch 2001, Welch 1997, and the Welch Thesis would have rendered obvious claim 23 because the Welch Thesis teaches using SCAAT in a hybrid tracking system that incorporates inertial sensors. Pet. 38 (citing Ex. 1005 ¶ 126; Ex. 1009 §§ 2.4.3, 7.7). Petitioner also argues that one of ordinary skill in the art “would have understood that the state estimates for

the tracked object described in Welch 2001 could also incorporate inertial sensor measurements into the SCAAT algorithm.” *Id.* (citing Ex. 1005 ¶ 126).

Patent Owner responds that Petitioner fails to incorporate its arguments for claims 1 and 20 into its assertions for claim 23. Prelim. Resp. 28 (citing Pet. 38). Patent Owner also responds that Petitioner fails to show Welch 2001 and Welch 1997 would have rendered obvious claim 23 because Petitioner fails to show claim 1 would have been rendered obvious. Prelim. Resp. 28–29.

Patent Owner does not provide any arguments specific to the limitations of claim 23. *See* Prelim. Resp. 28–29. Petitioner’s arguments for claim 23 also implicitly build on its arguments for claims 1 and 20. *See* Pet. 21, 32–33, 38. For the reasons discussed above, Petitioner sufficiently shows at this stage that Welch 2001 and Welch 1997 would have rendered obvious claims 1, 20, and 23.

Based on the preliminary record, Petitioner shows a reasonable likelihood of prevailing in its obviousness challenge to claim 23 based on Welch 2001, Welch 1997, and Welch Thesis.

F. Asserted Obviousness Based on Horton

1. Horton (Ex. 1010)

Horton “relates to tracking systems, particularly to such systems that determine position and orientation of an object in a limited volume using accelerometers.” Ex. 1010, 1:9–11. Reproduced below is Figure 1 of Horton.

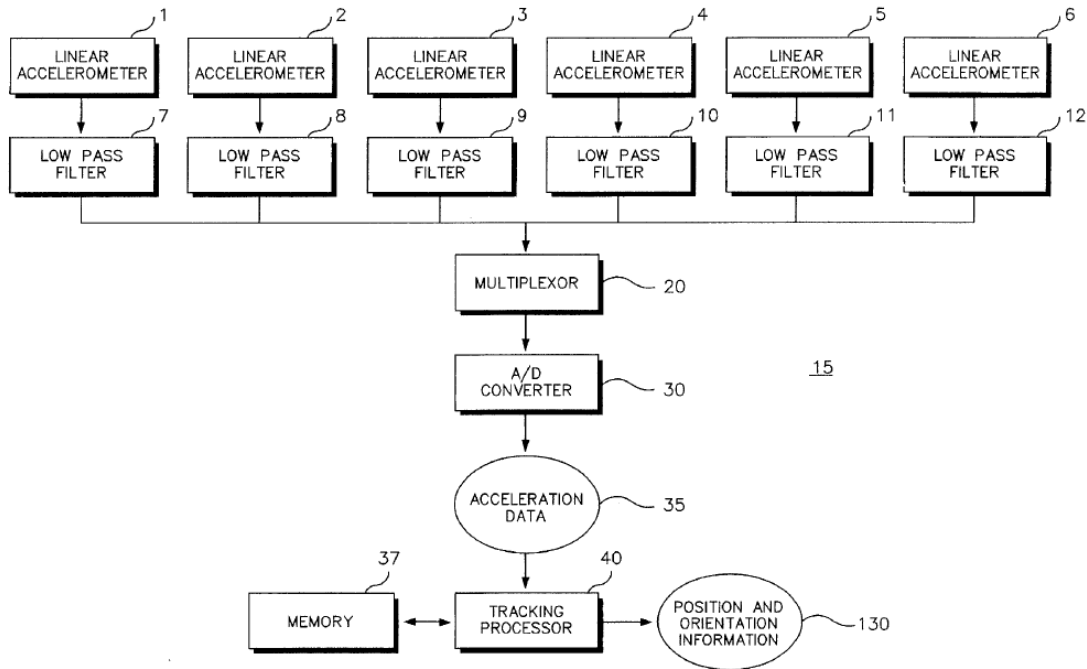


FIGURE 1

Figure 1 “is a simplified block diagram illustrating the components used in the tracking system.” Ex. 1010, 3:3–5, 3:27–28. Conventional accelerometers 1–6 each measure acceleration in one dimension to track six degrees of freedom of an object. *Id.* at 3:28–30, 3:41–42, 3:63. Accelerometers 1–6 are coupled to low pass filters 7–12, and their output provides, through multiplexer 20 and analog to digital converter 30, acceleration data 35 for tracking processor 40. *Id.* at 4:5–6, 4:11–15, 4:32, 4:35. Reproduced below is Figure 3 of Horton.

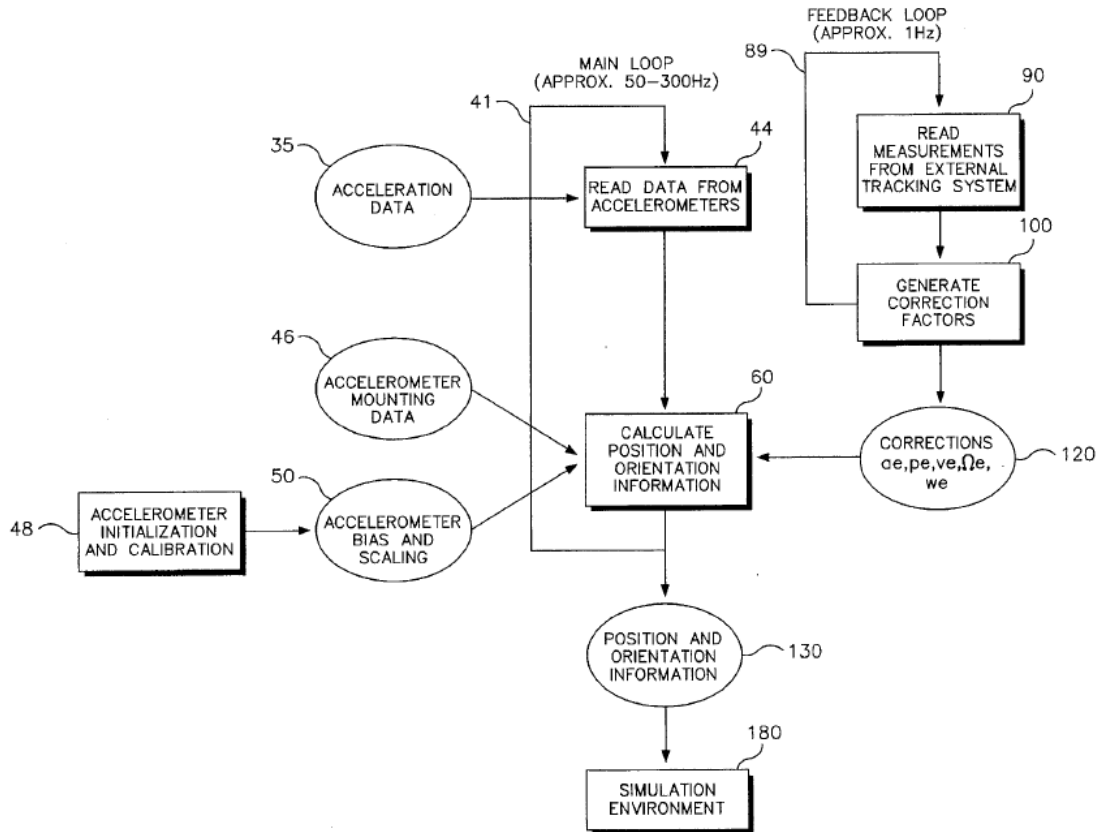


FIGURE 3

Figure 3 “is a simplified flow chart depicting one embodiment of the tracking system.” Ex. 1010, 3:11–12, 5:59. Tracking system 15 is implemented on tracking processor 40 and includes accelerometer initialization and calibration 48 that “is initiated prior to each system use to correct for the bias and scaling factors of the accelerometers due to such factors as time, temperature, mechanical jarring and the like.” *Id.* at 5:59–64.

“Accelerometers 1–6 are initialized 48 by loading the values of the accelerometer biases which are pre-specified at the factory or obtained from accelerometer specifications.” Ex. 1010, 5:64–67. “Calibration 48 of accelerometers 1–6 is accomplished by running tracking system 15 while the object to be tracked . . . remains stationary.” *Id.* at 5:67–6:3. Feedback filter loop 89 compares calculated position and orientation measurements 130

with known, stationary position and orientation measurement and “uses discrepancies between the two measurements to solve for bias and scaling factors 50 for each accelerometer 1-6.” *Id.* at 6:5–12.

“In main loop 41 tracking processor 40 reads 44 acceleration data 35 from accelerometers 1–6 and calculates 60 position and orientation information 130.” Ex. 1010, 6:25–27. “Feedback loop 89 (also known as a Kalman filter) comprises reading tracking measurements 90 (e.g., position, orientation, and/or velocity) from external tracking system” and “generating 100 correction factors 120.” *Id.* at 6:34–38. “Correction factors 120 are used in calculation 60 of position and orientation information 130.” *Id.* at 6:40–42. “External tracking system 170 is a conventional tracking system using, for example, radar, sonar, infrared, optical, acoustic/ultrasonic, or magnetic tracking technology.” *Id.* at 6:48–51.

2. Independent Claim 1

Petitioner argues that Horton discloses “[a] method for tracking an object.” Pet. 38 (citing Ex. 1005 ¶ 127; Ex. 1010, code (54), 2:15–17). Petitioner also argues that Horton teaches using accelerometers and external tracking sensors to measure a tracked object’s position and orientation. *Id.* at 39–40 (citing Ex. 1010, 3:41–46, 5:59–6:24, 6:48–54, Fig. 3).

According to Petitioner, one of ordinary skill in the art “would have understood that **initialization routine 48** and related data constitute a ‘**sensor subsystem**’” and “that the **main loop 41** and the Kalman Filter (i.e., **feedback loop 89**) executed by the tracking processor 40 constitutes an ‘**estimation subsystem.**’” Pet. 40 (citing Ex. 1005 ¶ 129; Ex. 1010, 2:25–30, 2:41–44, 7:56–64). Petitioner contends that Horton would have rendered obvious “coupling a sensor subsystem to an estimation subsystem, said sensor subsystem enabling measurement related to relative locations or

orientations of sensing elements,” because the ’632 patent describes that coupling includes coupling software modules and main loop 41 couples the asserted sensor and estimation subsystems. *Id.* at 39 (citing Ex. 1001, 2:50–51; Ex. 1005 ¶¶ 128–130), 41.

Petitioner argues that Horton discloses “accepting configuration data from the sensor subsystem” because Horton teaches loading accelerometer biases for initializing accelerometers 1–6, using mounting data 146 to determine correction factors 120, and calibrating the accelerometers when the tracked object is stationary. Pet. 41 (citing Ex. 1005 ¶¶ 131–133; Ex. 1010, 5:64–6:11, 6:34–42). In Petitioner’s view, the data collected for calibration constitutes “configuration data.” *Id.* (citing Ex. 1010, Fig. 3).

Petitioner also argues that Horton would have rendered obvious “configuring the estimation system according to the accepted configuration data” because Horton compares position and orientation data 130 from calibration with known measurements to determine bias and scaling factors. Pet. 42 (citing Ex. 1005 ¶¶ 134–135; Ex. 1010, 6:5–11, Fig. 3). Petitioner contends that main loop 41 is repeated for calibration and that one of ordinary skill in the art “would have understood that this calibration of the tracking processor is completed ‘according to the accepted configuration data’ from the sensor calibration process.” *Id.* (citing Ex. 1010, 6:11–13, Fig. 3).

Regarding “repeatedly updating a state estimate, including accepting measurement information from the sensor subsystem, and updating the state estimate according to the accepted configuration data and the accepted measurement data,” Petitioner argues that Horton teaches repeatedly reading acceleration data 35 and calculating position and orientation information 130. Pet. 42 (citing Ex. 1005 ¶¶ 136–137; Ex. 1010, 5:64–6:11, 6:25–27).

Petitioner also argues that Horton teaches using external measurements 90 to determine correction factors 120, and incorporating correction factors 120 to provide position and orientation information 130. *Id.* at 42–43 (citing Ex. 1010, 6:58–62, 7:1–5).

a) Patent Owner’s Preliminary Response

Patent Owner responds that Petitioner does not articulate how Horton differs from the claims, as required for an obviousness analysis. Prelim. Resp. 29, 30–32. Petitioner, however, apparently acknowledges that Horton does not expressly teach “a sensor subsystem” and “an estimation subsystem” because Petitioner argues one of ordinary skill in the art would have understood Horton includes such subsystems. Pet. 40–41. On the present record, this acknowledgement filled in with the understanding of an ordinarily skilled artisan identifies sufficiently a difference between Horton and claim 1.

Patent Owner also responds that Horton does not have a sensor subsystem or estimation subsystem. Prelim. Resp. 29. In Patent Owner’s view, the “simple system of Horton” does not need separate sensor and estimation subsystems and, thus, would not need a coupling. *Id.* at 33. Patent Owner argues that Petitioner’s argument shows that its asserted sensor and estimation subsystems are overlapping, not separate as the claim requires. *Id.* at 34–35 (citing Pet. 39–41). Patent Owner also argues that Horton teaches that the asserted subsystems are not distinct because Horton explains that main loop 41 is executed for initialization routine 48. *Id.* at 35 (citing Ex. 1010, 6:11–13). Patent Owner further argues that coupling the subsystems includes software modules, as acknowledged by Petitioner. *Id.* at 35–36 (citing Pet. 39, 40; Ex. 1001, 2:50–56).

As discussed above, the term “coupling” can be broad enough to include Petitioner’s asserted coupling. Patent Owner’s arguments regarding the subsystems and their coupling implicate a claim construction that has not yet been presented. Further, the plain language of claim 1 does not require “software modules,” but dependent claim 2 recites “wherein coupling the sensor subsystem to the estimation subsystem includes coupling software modules each associated with one or more of the sensing elements.” Ex. 1001, 46:32–35. Claim 2 indicates that the coupling of claim 1 does not require software modules. *See id.*

Patent Owner also responds that Petitioner conflates “configuration data” and “measurement information,” even though they are recited separately. Prelim. Resp. 29, 33. Patent Owner argues Petitioner’s argument that pose data for calibration “improperly collapses distinct claim limitations,” and that Horton does not disclose collecting pose data during calibration. *Id.* at 36–37 (citing Pet. 41; Ex. 1010, 5:67–6:5).

On the present record, Petitioner provides sufficient arguments for institution. Petitioner contends that collecting position and orientation data for calibration teaches “accepting configuration data from the sensor subsystem.” Pet. 41 (citing Ex. 1010, 5:64–6:11). The cited portion of Horton indicates that the collected data is used to solve for bias and scaling factors 50 of accelerometers 1–6, and so this data collection is distinguishable from measurements for position and orientation information 130. *See* Ex. 1010, 5:67–6:11. The issue, however, would benefit from developing the record at trial.

Patent Owner further responds that “Petitioner does not show that [configuration] data is ever received ‘from the sensor subsystem,’ as the claim requires.” Prelim. Resp. 33. Patent Owner argues that Petitioner does

not explain how Horton discloses accepting configuration data from initialization routine 48 (the asserted sensor subsystem) by main loop 41 and Kalman filter (the asserted estimation subsystem). Prelim. Resp. 37 (citing Pet. 40). In Patent Owner's view, Horton calibrates by collecting data while the tracked object is stationary, and main loop 41, part of Petitioner's estimation subsystem, then calculates position and orientation 130. *Id.* (citing Pet. 41; Ex. 1010, 5:67–6:5, 6:3–13). Patent Owner, thus, argues that position and orientation 130 cannot be accepted from the asserted sensor subsystem. *Id.* Patent Owner additionally argues that Petitioner does not show that the data collected during the calibration process, the asserted configuration data, is accepted from the sensor subsystem and “admits that this data is only used during the calibration process itself—i.e., used by the sensor subsystem . . . —to generate position and orientation information.” *Id.* at 39 (citing Pet. 40, 41; Ex. 1010, 5:60–6:12). Patent Owner also notes that Petitioner does not propose modifying Horton for this limitation. *Id.*

At this stage, Petitioner's argument that “[t]he data collected in this calibration process (Fig. 3, data 46 and 50) constitutes ‘configuration data’” is sufficient. Pet. 40. The “data collected” referred to by Petitioner is the data collected while the tracked object is stationary. *Id.* (citing Ex. 1010, 5:64–6:11). The cited portion of Horton indicates that this data comes from accelerometers 1–6 and is used to solve for bias and scaling factors 50 of accelerometers 1–6. Ex. 1010, 5:67–6:11. Petitioner does not appear to be relying additionally on main loop 41's calculation of position and orientation information 130, as argued by Patent Owner. *See* Pet. 41.

Patent Owner additionally responds that Petitioner asserts without citation to Horton or testimonial evidence that Horton would have rendered obvious “configuring the estimation subsystem according to the accepted

configuration data.” Prelim. Resp. 38 (citing Pet. 42). Patent Owner argues that Petitioner does not explain how data collected while the tracked object is stationary affects the configuration of the estimation subsystem. *Id.* at 38–39. Patent Owner also argues that Petitioner does not propose modifying Horton to meet this limitation. *Id.* at 39.

As discussed above, Petitioner sufficiently shows at this stage that Horton uses the data collected while the tracked object is stationary to solve for bias and scaling factors 50 of accelerometers 1–6. Pet. 42. Horton indicates that such bias and scaling factors 50 are used to calculate position and orientation information 60 in main loop 41, thereby “configuring” the asserted estimation subsystem. Ex. 1010, Fig. 3. Petitioner, thus, adequately shows on the present record that Horton would have rendered obvious “configuring the estimation system according to the accepted configuration data.” Pet. 42 (citing Ex. 1005 ¶¶ 134–135; Ex. 1010, 6:5–13, Fig. 3).

Patent Owner also responds that Petitioner insufficiently shows “repeatedly updating a state estimate, including accepting measurement information from the sensor subsystem, and updating the state estimate according to the accepting configuration data and the accepted measurement data.” Prelim. Resp. 39. In particular, Patent Owner argues that Petitioner fails to show how accepted, known measurements are used in calculating position and orientation information. *Id.* at 39–40 (citing Pet. 42; Ex. 1010, 6:25–27). Patent Owner also argues that Petitioner fails to argue the relevance of citing to Horton’s disclosure of using software specification information as an input to generation 100 of correction factors 120. *Id.* at 40 (citing Pet. 42–43; Ex. 1010, 6:58–62). According to Patent Owner, the antecedent basis of “accepted configuration data” is the previously recited

“configuration data.” *Id.* Patent Owner also notes that Petitioner does not propose modifying Horton for this limitation. *Id.*

Petitioner, however, sufficiently argues at this stage that Horton teaches repeating main loop 41 in which acceleration data 35 is read to calculate at block 60 position and orientation information 130. Pet. 42; Ex. 1005 ¶¶ 136–137; Ex. 1010, 5:64–6:11, 6:25–27. As discussed above, Petitioner also sufficiently shows at this stage that Horton uses the data collected while the tracked object is stationary to solve for bias and scaling factors 50 that are input into block 60 to determine position and orientation information 130. *See* Pet. 41, 42; Ex. 1010, 5:64–6:1, Fig. 3. Petitioner relies on the same asserted data for “configuration data” and “accepted configuration data.” *See* Pet. 41, 42.

As for Petitioner’s additional citation to Horton’s “software specification,” it does not appear to affect Petitioner’s argument regarding “repeatedly updating a state estimate, including accepting measurement information from the sensor subsystem, and updating the state estimate according to the accepted configuration data and the accepted measurement data.” Pet. 42–43 (citing Ex. 1010, 6:58–62, 7:1–5). That argument alone is sufficient for institution.

For the reasons above, Petitioner shows a reasonable likelihood of prevailing on its obviousness challenge to claim 1 based on Horton.

3. *Dependent Claims 2–4*

Petitioner argues Horton would have rendered obvious claim 2 because main loop 41 couples an estimation subsystem to a sensor subsystem, and Figure 4 of Horton shows that tracking processor 40 reads acceleration data 35 from accelerometers 1–6. Pet. 43 (citing Ex. 1005 ¶¶ 138–141; Ex. 1010, 7:6–7, Figs. 3, 4). Petitioner also argues that one of

ordinary skill in the art “would have understood that the main loop 41 of the sensor subsystem includes coupling software modules associated with each accelerometer.” *Id.* (citing Ex. 1005 ¶ 140).

Patent Owner responds that Petitioner cannot show that main loop 41 couples an estimation subsystem to a sensor subsystem. Prelim. Resp. 41 (citing Pet. 43). For the reasons given above for the coupling of claim 1, Petitioner’s arguments are sufficient for institution.

Patent Owner also responds that Petitioner does not identify what discloses software modules, “each associated with one or more of the sensing elements,” as recited by claim 2. Prelim. Resp. 41 (citing Pet 43; Ex. 1005 ¶ 140). In Patent Owner’s view, Petitioner’s argument and cited testimony are conclusory and omit what are the disclosed “software modules associated with each accelerometer.” *Id.* at 41–42.

Petitioner, however, appears to be arguing that, because, measurements from accelerometers 1–6 are being read at block 44 as shown in Figure 4, there is a “software module” for reading in each accelerometer measurement. *See* Pet. 43. Petitioner’s declarant further explains that “[t]he tracking processor’s collection of data and performance of calculations constitutes software modules as set forth in this limitation, such that a [person of ordinary skill in the art] would have understood that main loop 41 of the sensor subsystem includes coupling software modules associated with each accelerometer.” Ex. 1005 ¶ 140. Petitioner’s argument for claim 2 is sufficient at this stage, but the issue would benefit from further development of the record.

We also note that, for claim 1, Petitioner argues that “**main loop 41** and the Kalman Filter (i.e., **feedback loop 89**) executed by the tracking processor 40 constitutes an ‘**estimation subsystem**’ within the overall

system.” Pet. 40–41 (citing Ex. 1005 ¶ 129; Ex. 1010, 7:56–64). For claim 2, Petitioner argues that “main loop 41 *of the sensor subsystem* includes coupling software modules associated with each accelerometer.” *Id.* at 43 (emphasis added) (citing Ex. 1005 ¶ 140). Petitioner apparently relies on main loop 41 for the asserted estimation subsystem of claim 1 and as a part of the asserted sensor subsystem of claim 2. Pet. 40, 43.

For claim 3 which depends from claim 2, Petitioner argues that Horton would have rendered obvious the claim because “feedback filter loop 89 (the claimed ‘software interface’) incorporates correction factors 120 (such as accelerometer mounting data) in order to calculate position and orientation information 130.” Pet. 43–44 (citing Ex. 1001, 3:16–24; Ex. 1005 ¶¶ 142–143; Ex. 1010, 7:1–14, Figs. 3, 4). Petitioner also argues that Horton teaches that accelerometer mounting data 46 includes locations and directions of mounted accelerometers. *Id.* at 44–45 (citing Ex. 1005 ¶ 142; Ex. 1010, 5:37–51, Table 1).

Patent Owner responds that Petitioner has failed to establish a reasonable likelihood of showing that Horton would have rendered obvious claim 3 for the same reasons given for claim 2. Prelim. Resp. 42–43 (citing Pet. 43–44; Ex. 1001, 3:16–19, 15:44–47). Patent Owner also responds Petitioner does not show that Horton has the recited “software interface.” *Id.* at 43 (citing Ex. 1010, 5:59–60, 6:34–36, 7:1–14).

As discussed above for claim 2, Petitioner appears to be arguing that there is a “software module” for reading in each accelerometer measurement. *See* Pet. 43. For claim 3, however, Petitioner appears to be arguing that this asserted software module also provides feedback filter loop 89, the asserted software interface of the software module. *See id.* at 43–44 (citing Ex. 1010, 7:1–14, Figs. 3, 4). At this stage, it is unclear

whether Horton supports that whatever reads in an accelerometer measurement also “provides a software interface for receiving information related to an expected sensor measurement and providing measurement information that depends on said received information,” as recited by claim 3.

The Petition cites testimony that does not appear to explain how reading in accelerometer measurements and feedback filter loop 89 are related so that reading in the measurement provides the feedback filter loop 89 in the manner required by claim 3. This issue should be developed further during trial.

For claim 4 which depends from claim 3, Petitioner argues that Horton would have rendered the claim obvious because Horton’s tracking processor calculates position and orientation of a stationary tracked object during calibration, and the “calculation is performed separately from and without reference to the known position and orientation measurement for the accelerometer, so that the known measurement can be compared to the calculated measurement.” Pet. 45 (citing Ex. 1005 ¶¶ 144–145; Ex. 1010, 5:64–6:11, Fig. 3).

Petitioner’s analysis for claim 4 does not appear to resolve the potential issue we identified above for claim 3. Pet. 45. Claim 4 also recites “each of the software modules,” and Petitioner’s argument appears to rely on tracking processor 40, instead of what was relied upon for claim 2 or 3. *See id.* at 43, 45.

4. Dependent Claims 5–9, 24, 28, and 29

For claim 5, Petitioner argues that Horton would have rendered obvious “wherein the state estimate characterizes an estimate of a location of

the object” because Horton estimates an object’s location during calibration. Pet. 46 (citing Ex. 1005 ¶¶ 146–147; Ex. 1010, 5:7–13).

For claim 6, Petitioner argues that Horton discloses “wherein the state estimate characterizes configuration information for one or more sensing elements fixed to the object,” because (1) Horton estimates position and orientation by using Kalman filters during calibration, (2) “the estimates constitute configuration (calibration) information,” and (3) Horton’s accelerometers are fixed to an object. Pet. 46 (citing Ex. 1005 ¶¶ 148–149; Ex. 1010, 5:7–13).

For claim 7, Petitioner argues that Horton discloses “wherein the configuration information for the one or more sensing elements fixed to the object includes information related to position or orientation of said sensing elements relative to the object,” because the asserted configuration information relates the position and orientation of the accelerometers. Pet. 46–47 (citing Ex. 1005 ¶¶ 150–151; Ex. 1010, 5:7–13, 5:60–6:5).

For claim 8, Petitioner argues that Horton would have rendered obvious “wherein the configuration information for the one or more sensing elements fixed to the object includes operational parameters for the one or more sensing elements,” because the asserted configuration information includes bias and scaling factors or operational parameters. Pet. 47 (citing Ex. 1005 ¶¶ 152–153; Ex. 1010, 6:5–11).

For claim 9, Petitioner argues that Horton would have rendered obvious “wherein the state estimate characterizes configuration information for one or more sensing elements fixed in an environment of the object,” because the data collected during Horton’s calibration process “constitutes a state estimate that characterizes ‘configuration information’” and one of ordinary skill in the art would have understood that accelerometers are fixed

in an environment of an object during calibration. Pet. 47–48 (citing Ex. 1005 ¶¶ 154–155; Ex. 1010, 5:37–51, 5:66–6:11, 7:6–14, Fig. 3).

For claim 24, Petitioner argues that Horton discloses “wherein updating the state estimate includes applying a Kalman Filter approach,” because Horton teaches that feedback loop 89 is a Kalman filter. Pet. 57 (citing Ex. 1005 ¶¶ 186–187; Ex. 1010, 2:41–44, 6:34–39).

For claim 28, Petitioner argues that Horton discloses its limitation because Horton’s accelerometers can be mounted on a user. Pet. 57–58 (citing Ex. 1005 ¶ 188; Ex. 1010, 5:10–13).

For claim 29, Petitioner argues that Horton discloses “wherein the state estimate comprises information related to a position or an orientation of the object relative to a reference coordinate frame,” because Horton measures position and orientation in six-degrees of freedom, such as x, y, z position coordinates with roll, pitch, and yaw components. Pet. 58 (citing Ex. 1005 ¶¶ 189–190; Ex. 1010, 2:15–20, 5:31–35).

Patent Owner responds that Petitioner fails to incorporate its arguments for the independent claims into the arguments for the dependent claims. Prelim. Resp. 32 (citing Pet. 43–58). Petitioner’s arguments for the dependent claims, however, rely on arguments made for claim 1. Pet. 43–58. For example, Petitioner’s arguments for dependent claim 6 refers back to arguments for claim 1. *See id.* at 46 (referencing Pet. §§ XII.C.1.d, XII.C.1.e).

Based on the preliminary record, Petitioner shows a reasonable likelihood of prevailing in its obviousness challenge to claims 5–9, 24, 28, and 29 based on Horton.

5. *Dependent Claims 11–19 and 22*

Petitioner argues that Horton would have rendered obvious claim 11’s “wherein repeatedly updating the state further includes: providing to the sensor subsystems information related to an expected sensor measurement.” Pet. 48 (citing Ex. 1005 ¶¶ 156–157). Petitioner contends that, in Horton, “the tracking processor uses known position and orientation measurements (i.e., expected measurements for the sensor) compared to calculated position and orientation measurements to calibrate the accelerometers.” *Id.* (citing Ex. 1005 ¶ 156; Ex. 1010, 6:5–11).

For claim 11’s “wherein accepting the measurement information from the sensor subsystem includes accepting information related to an actual sensor measurement,” Petitioner argues that Horton discloses the limitation because, “[d]uring calibration, the accelerometers collect data for the tracked object while it is stationary, and the tracking processor accepts and uses that data to calculate position and orientation.” Pet. 48–49 (citing Ex. 1005 ¶¶ 158–159; Ex. 1010, 5:64–6:5, Fig. 3). According to Petitioner, “[t]he data from the accelerometers constitutes ‘information related to an actual sensor measurement.’” *Id.* at 49.

Patent Owner responds that known position and orientation measurements cannot be the expected measurements for accelerometers that measure acceleration in one direction. Prelim. Resp. 44 (citing Pet. 48; Ex. 1010, 3:27–32, 6:25–27).

For claim 1, from which claim 11 depends, Petitioner contends that one of ordinary skill in the art “would have understood that **initialization routine 48** and related data constitute a ‘**sensor subsystem.**’” Pet. 40 (citing Ex. 1005 ¶ 129). At this stage, it is unclear whether Horton provides known position and orientation measurements (the asserted “information

related to an expected sensor measurement”) to initialization routine 48 and related data (the asserted sensor subsystem), as required by claim 11. This issue would benefit from developing the record further.

Claims 12–19 and 22 which depend from claim 11. Ex. 1001, 47:4–36, 47:46–49. Petitioner’s analysis for these claims does not appear to resolve the potential issues we identified above with claim 11. Pet. 49–54, 55–56.

6. Dependent Claims 20, 21, and 23

For claim 20’s “wherein repeatedly updating the state further includes: selecting a pair of sensing elements for measurement,” Petitioner argues that Horton discloses the limitation because Horton can include optical tracking systems and one of ordinary skill in the art “would have understood that an optical tracker would necessarily utilize a pair of sensing elements (i.e., a camera and a target) for measurement of position and orientation.” Pet. 54 (citing Ex. 1005 ¶¶ 175–177; Ex. 1010, 6:48–54, claim 9).

Petitioner also argues that Horton teaches that “two accelerometers can be selected to track an object in one-dimensional space” and “[l]imiting the measurement to one dimension and two accelerometers also constitutes ‘selecting a pair of sensing elements for measurement.’” Pet. 54 (citing Ex. 1010, 3:49–51).

For claim 20’s “providing an identification of the selected pair to the sensing subsystem,” Petitioner argues that Horton discloses the limitation because an external tracking system generating position and orientation information would “necessarily identify the pair of sensing element” because both a camera and a target would be needed. Pet. 54–55 (citing Ex. 1005 ¶¶ 178–179). Petitioner also argues that “the use of only two accelerometers

within the system to track the object in one dimension would require the system to identify the particular two accelerometers to be used for that purpose.” *Id.* at 55 (citing Ex. 1005 ¶ 178; Ex. 1010, 3:49–51).

Patent Owner responds that “Horton fails to describe ‘selecting’ any sensors” and “merely describes that different numbers of accelerometers could be used, not that different sensors are selected, contrary to Petitioner’s citation.” Prelim. Resp. 45 (citing Pet. 55).

Petitioner cites to a portion of Horton that describes external tracking system 170 as “conventional” and being, for example, an “optical” tracking system that provides “data including position, orientation, and/or velocity measurements 90.” Pet. 54; Ex. 1010, 6:48–54. At this preliminary stage, the cited portion alone does not appear to describe “*selecting* a pair of sensing elements for measurement” (emphasis added), even if it were understood that optical tracking systems use a pair of sensing elements. *See* Ex. 1010, 6:48–54.

Petitioner also cites to a portion of Horton that states “[f]ewer accelerometers (e.g., four) could be used to track the object, for example, in a two-dimensional space or one-dimensional space (e.g., two accelerometers).” Pet. 54, 55; Ex. 1010, 3:49–51. On the present record, the cited statement alone does not appear to teach or suggest “selecting a pair of sensing elements for measurement” or “providing an identification of the selected pair to the sensing subsystem.” Prelim. Resp. 45; Ex. 1010, 3:49–51. Thus, based on the above, we agree with Patent Owner that the cited portions of Horton do not appear to teach selecting sensors from a larger number of sensors. Prelim. Resp. 45.

Petitioner cites declarant testimony for claim 20. Pet. 54–55 (citing Ex. 1005 ¶¶ 175–179). The Petition largely repeats the cited testimony.

Compare id., with Ex. 1005 ¶¶ 175–179. The cited testimony also does not include support or further explanation regarding “selecting” or “selected.” *Id.* This issue would benefit from further development.

Claims 21 and 23 depend from claim 20. Ex. 1001, 47:42–45, 47:51–53. Petitioner’s analysis for these claims does not appear to resolve the potential issues we identified for claim 20. Pet. 55, 57.

G. Asserted Obviousness Based on Horton and Welch 1997

1. Claims 25–27

Petitioner argues that Horton and Welch 1997 would have rendered obvious claim 25. Pet. 59 (citing Ex. 1005 ¶¶ 192–194). According to Petitioner, Horton teaches using a “conventional” external tracking system that can be an optical tracking system. *Id.* (citing Ex. 1010, 6:48–51). Petitioner also argues that one of ordinary skill in the art would have recognized that such an optical tracking system was well known as evidenced by Welch 1997 and that Welch 1997’s system could have been used in Horton. *Id.* 59–60 (citing Ex. 1005 ¶¶ 192–193).

For claim 26 which depends from claim 25, Petitioner argues that Horton and Welch 1997 would have rendered obvious claim 26 and that one of ordinary skill in the art “would have understood that the tracking system using these ‘active’ targets in Welch 1997 . . . could have been used as the external tracking system described in Horton.” Pet. 60 (citing Ex. 1005 ¶¶ 195–196).

Petitioner argues that Horton and Welch 1997 would have rendered obvious claim 27 with reference to its contentions for the same claim challenged as obvious in view of Welch 2001 and Welch 1997. Pet. 60 (citing Ex. 1005 ¶¶ 197–198).

Petitioner argues that one of ordinary skill in the art “would have been motivated to use the camera-based system described in Welch 1997 as the external tracking system with Horton as it is specifically used as a ‘wide area’ tracking system in a larger space.” Pet. 59 (citing Ex. 1008 §§ 2.1, 4; Ex. 1010, 6:43–44); *see also id.* at 58–59 (contending that both references disclose estimating and tracking position and orientation of an object and are directed to the same field and solution) (citing Ex. 1005 ¶ 191; Ex. 1008, Abstr. § 1.2; Ex. 1010, Abstr., 6:48–51).

Patent Owner responds that Petitioner does not incorporate its arguments for claim 1 and fails to establish a reasonable likelihood that Horton would have rendered obvious claim 1. Prelim. Resp. 46 (citing Pet. 58–60).

Based on the preliminary record, Petitioner shows a reasonable likelihood of prevailing in its obviousness challenge to claims 25–27 based on Horton and Welch 1997.

H. Asserted Obviousness Based on Kramer and Chen

1. Kramer (Ex. 1030)

Kramer relates to “rapid, accurate determination of position of an entity.” Ex. 1030, 1:8–9. Kramer provides an apparatus and method “for quickly, accurately and/or reliably determining position of an entity by employing a combination of individual devices where the combination provides a position measurement which is superior to any of the individual devices comprising the combination when taken separately.” *Id.* at 2:63–3:1.

According to Kramer, “[t]here are two main technologies presently being used to capture the motion data: (1) optical tracking; and (2) electromagnetic tracking.” Ex. 1030, 1:18–20. “Various sensors may be

used in conjunction with the optical tracker to correct the faults of the optical tracker,” such as an accelerometer and electromagnetic sensor. *Id.* at 8:61–9:23. Figure 2 of Kramer is reproduced below.

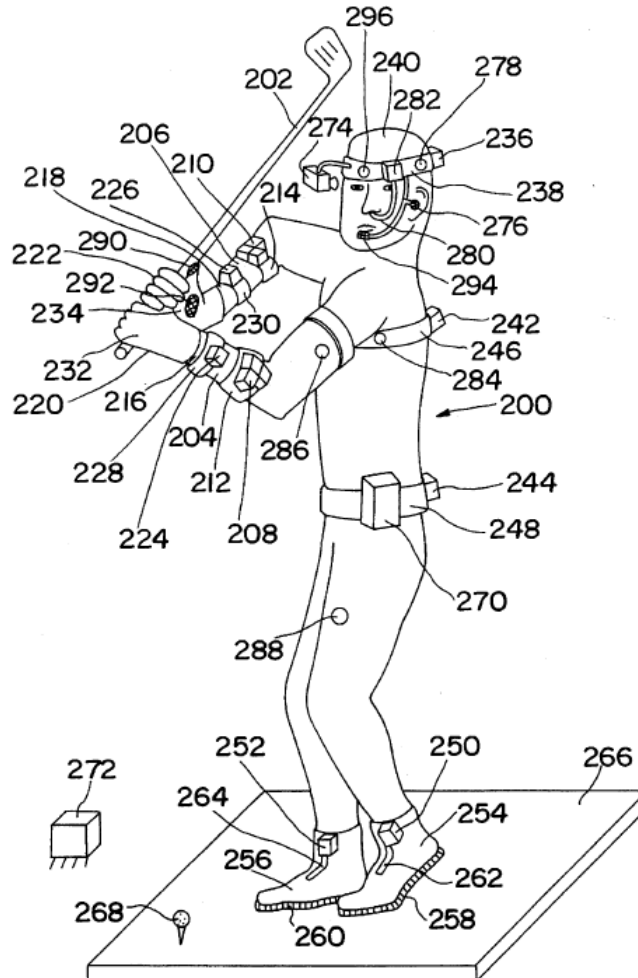


FIG. 2

Figure 2 shows a golfer wearing Kramer’s apparatus. Ex. 1030, 3:35–36, 14:58. Golfer 200 has sensors “distributed about the body to determine the movement of the body parts during the swing.” *Id.* at 14:65–67. Sensors can include electromagnetic reference sensor 505 and light sensors 508, 509 of an optical tracking system. *Id.* at 18:35–45, 19:10–26, Fig. 5.

Information from sensors is transmitted to data processor 270. *Id.* at 16:63–64. “The data processor receives the spatial placement information from each pair of 6-DOF-E and 6-DOF-A sensors, performs the necessary mathematical manipulations and calculations, and produces the corrected spatial placement information.” *Id.* at 17:14–18. Kramer also describes using “other techniques for estimating error terms,” such as Kalman filtering. *Id.* at 5:51–67.

2. *Chen (Ex. 1024)*

Chen is an article titled “A Mixed-Mode Smart Transducer Interface for Sensors and Actuators.” Ex. 1024, 24. Chen describes “the issue of interfacing analog transducers with additional smart features to legacy systems.” *Id.* It states that a “project, IEEE P1451.4, was established to develop a standard that allows analog transducers to communicate digital information (mixed-mode operation) for the purposes of self-identification and configuration.” *Id.* According to Chen, “IEEE P1451 Working Groups have been working on a uniform approach for connecting sensors and actuators to communication networks, control systems and measurement systems.” *Id.* Chen also discusses Transducer Electronic Data Sheets (“TEDS”) that include “relevant information that help the user” such as “Identification Parameters,” “Device Parameters,” “Calibration Parameters,” and “Application Parameter.” *Id.* at 24–25.

3. *Independent Claim 66*

Petitioner argues that Kramer discloses the preamble, “[a] method,” because “Kramer is directed to a method for reporting movement of an object.” Pet. 62 (citing Ex. 1030, 20:23–25).

For “receiving sensor configuration information indicating a set of sensing elements available to a tracking or navigation system,” Petitioner

argues that Kramer and Chen would have rendered the step obvious because Chen teaches analog transducers communicating digital information, so that the proposed combination would have an “embedded controller or software” to extract data from sensors. Pet. 62 (citing Ex. 1005 ¶ 205; Ex. 1024, 26).

For “configuring a data processing module of the tracking or navigation system based on the sensor configuration information,” Petitioner argues that Kramer discloses the step because Kramer describes an embodiment with various sensors that send information to a data processor to calculate estimated position. Pet. 63 (citing Ex. 1005 ¶¶ 206–207; Ex. 1030, 14:58–67, 17:16–19, Fig. 2). Petitioner also argues that Kramer describes sensor information being used with Kalman filtering to track an object, and that “Kalman filtering incorporates knowledge of the sensing devices, among other parameters, to produce an accurate estimate of the position/orientation of the tracked object.” *Id.* (citing Ex. 1005 ¶ 207; Ex. 1030, 5:51–57). Petitioner further argues that “Kramer indicates that pose estimation algorithms such as Kalman filtering can be implemented on a data processor.” *Id.* (citing Ex. 1030, 5:63–64).

For “configuring a data processing module . . . to selectively perform one of (a) receiving data from at least one inside-out bearing sensor, and updating an estimated pose of an object based on data received from the inside-out bearing sensor,” Petitioner argues that Kramer and Chen would have rendered obvious the step because Kramer discloses electromagnetic sensors in an inside-out configuration. Pet. 63–64 (citing Ex. 1001, 14:20–25, 23:53–54; Ex. 1005 ¶¶ 208–209; Ex. 1030, Fig. 2).

For configuring the data processing module to selectively perform “(b) receiving data from at least one outside-in bearing sensor, and updating an estimated pose of an object based on data received from the outside-in

bearing sensor,” Petitioner argues that Kramer and Chen would have rendered obvious the step because Kramer teaches using alternate sensors, like an optical tracking system with light sources that would be in an outside-in configuration. Pet. 65 (citing Ex. 1005 ¶ 210; Ex. 1030, 8:61–9:23, 18:35–45, Fig. 5).

For configuring the data processing module to selectively perform “(c) receiving data from at least one inside-out bearing sensor and at least one outside-in bearing sensor, and updating an estimated pose of an object based on data received from the outside-in bearing sensor and the inside-out bearing sensor,” Petitioner argues that Kramer and Chen would have rendered obvious the step because Kramer teaches using data from both the optical sensor and electromagnetic sensor to update pose estimation. Pet. 66 (citing Ex. 1005 ¶ 211; Ex. 1030, 5:51–67, 8:61–9:23, 19:10–26). Petitioner, thus, argues that Kramer teaches updating pose estimates based on both inside-out and outside-in sensors. *Id.* (citing Ex. 1005 ¶ 211).

As for a motivation to combine, Petitioner argues that Kramer describes using various sensors to provide more reliable, more accurate, and less delayed measurements and Kalman filtering to produce an accurate estimate of position and orientation of a tracked object. Pet. 60–61 (citing Ex. 1005 ¶ 201; Ex. 1030, Abstr., 1:18–20, 2:63–3:1, 5:51–54, 8:61–64). Petitioner also argues that Kramer “does not explicitly describe how sensor information utilized by the Kalman algorithm is obtained by the processor.” *Id.* at 61.

Petitioner turns to Chen for teaching analog transducers “communicat[ing] digital information for self-identification and configuration to interface with legacy data acquisition systems.” Pet. 61 (citing Ex. 1024, 24–25). Petitioner contends that Chen describes a TEDS

standard that enables transducers “to have plug and play functionality and communicate relevant information, including identification parameters, device parameters (e.g., sensor type and sensitivity), calibration parameters, and application parameters.” *Id.* (citing Ex. 1024, 24–25).

Petitioner, thus, argues that one of ordinary skill in the art “would have been motivated to update Kramer’s data processor to interface with a set of sensors having a TEDS” to “provide standard compliance” and so that sensors would “sell better . . . due to the interoperability of components.” Pet. 61–62 (citing Ex. 1005 ¶ 203). Petitioner also argues that there would have been a reasonable expectation of success in making the modification, as explained in Chen. *Id.* (citing Ex. 1005 ¶ 203).

a) Patent Owner’s Preliminary Response

Patent Owner responds that Chen is not analogous art because Chen’s field of endeavor is sound and vibration testing and, thus, not from the same field of endeavor. Prelim. Resp. 46–49 (citing Ex. 1024, 24). Patent Owner contends that the field of endeavor of the ’632 patent is navigation or motion tracking system. *Id.* at 48 (citing Ex. 1001, Abstr., 2:21–25). Patent Owner also contends that Petitioner does not argue what the field of endeavor should be. *Id.* at 49 (citing Pet. 13–16). Patent Owner further contends that Chen is not reasonably pertinent to the field of navigation or motion tracking systems. *Id.* at 49–50 (citing Ex. 1001, 12:2–5).

Petitioner, however, argues that “Chen describes how analog transducers *such as the sensors employed by Kramer* communicate digital information for self-identification and configuration to interface with legacy data acquisition systems.” Pet. 61 (emphasis added) (citing Ex. 1024, 24–25). At this stage, this argument appears to indicate that Petitioner contends that Chen is reasonably pertinent. *See id.* The preliminary record also

supports that Chen is reasonably pertinent. *See, e.g.*, Ex. 1024 (“IEEE P1451 Working Groups have been working on a uniform approach for connecting sensors and actuators to communication networks, control systems and measurement systems.”). The issue would benefit from further development by the parties.

Patent Owner also responds that Chen “merely discloses that a standard will be ‘proposed’ in the future for ‘mixed-mode transducer communication schemes’” but fails to suggest that “‘analog transducers’ include ‘the sensors employed by Kramer.’” Prelim. Resp. 50 (citing Pet. 61, 71; Ex. 1024, 24). According to Patent Owner, “Chen is silent as to the types of sensors it addresses, and does not teach that the sensors disclosed in Kramer . . . would even be compatible with anything that eventually would be proposed.” *Id.* at 50–51 (citing Pet. 60).

Patent Owner also argues that Petitioner does not explain why one of ordinary skill in the art would even seek compliance with a standard that was not yet proposed. Prelim. Resp. 51. Patent Owner further argues that Chen does not indicate that the standard existed and expressly teaches that modification of legacy systems would be required, contrary to Petitioner’s argument. *Id.* (citing Pet. 62; Ex. 1024, 26).

Petitioner argues for “reasonable expectation of success” that the proposed combination of Kramer and Chen can be done “without modification or additional hardware.” Pet. 62 (citing Ex. 1005 ¶ 203). As Patent Owner points out, Chen states under a section titled “Compatibility with Legacy System” that “[t]his will require modification of the legacy systems” and that “[a]dditional hardware is necessary.” Ex. 1024, 26; *see also id.* (stating that “[e]xtra circuitry can be added at the front-end to control the P1451.4 transducers and to decode the TEDS”). On the present

record, Chen appears to indicate that Petitioner's proposed modification, even with additional hardware and extra circuitry, would have been within ordinary skill in the art. The issue, however, would benefit from further development.

Patent Owner additionally responds that Kramer and Chen fail to teach selective performance, and that Petitioner does not even argue that selective performance is met by the asserted references. Prelim. Resp. 52–53 (citing Pet. 64–66, 72). In Patent Owner's view, Petitioner merely points to Kramer's description of several types of sensors but does not cite any evidence that the prior art teaches selective performance. *Id.* at 53.

Petitioner does not appear to argue expressly that the proposed combination configures a data processing module “to selectively perform one of” the receiving data steps, as required by claim 66. *See* Pet. 63–66. Petitioner's declarant also does not appear to address configuring a data processing module “to selectively perform one of” receiving data from alternative sensors. *See* Ex. 1005 ¶¶ 206–211.

Kramer does not indicate clearly that it selectively performs receiving data from its various sensors. *See, e.g.,* Ex. 1030, 3:6–8 (“The position sensing process continuously takes samples from both the slow and fast devices.”), 17:6–11 (“The data processor 270 may serve to simply log the conditioned or calculated data from the array of sensors mounted to measured body parts and/or it may calculate and/or log the spatial placement of one or more unmeasured body parts (links) or other desirable motion parameters.”). This issue would benefit from further development.

Patent Owner further responds that Petitioner fails to show that Kramer and Chen configure a data processing module “based on the sensor configuration information.” Prelim. Resp. 54. Patent Owner contends that

Petitioner does not rely on Chen for this limitation and “instead asserts that Kramer sends information from sensors.” *Id.* Patent Owner also contends that Kramer does not teach a sensor sending both configuration information and sensed data information and does not teach receiving data based on sensor configuration information. *Id.* Patent Owner further contends that Petitioner relies on receiving data from configured sensors. *Id.*

Petitioner, however, argues that, in Kramer, the “information from these sensors is sent to a data processor to configure the processor to calculate estimated position of the body parts.” Pet. 63 (citing Ex. 1030, 17:16–19). On the present record, Petitioner’s argument is sufficient for institution; however, the issue of what Kramer teaches would be better decided on a full record.

For the reasons above, on the present record, Petitioner shows a reasonable likelihood of prevailing in its challenge to claim 66 based on Kramer and Chen.

4. Dependent Claim 67

Claim 67 depends from claim 66 and recites “further comprising configuring the data processing module to selectively perform one of” additional steps. For selectively performing “(d) receiving data from at least one range sensor, and updating an estimated pose of an object based on data received from the range sensor,” Petitioner argues that Kramer and Chen would have rendered obvious the step because Kramer teaches using an ultrasonic or GPS sensor. Pet. 66–67 (citing Ex.1001, 2:63–3:28, 14:18–20; Ex. 1005 ¶ 213; Ex. 1030, 7:36–46).

For configuring the data processing module to selectively perform “(e) receiving data from at least one range sensor and at least one inside-out bearing sensor, and updating an estimated pose of an object based on data

received from the range sensor and the inside-out bearing sensor,” Petitioner argues that Kramer and Chen would have rendered obvious the step because Kramer discloses using electromagnetic sensors in an inside-out configuration with ultrasonic and optical sensors for updating a pose estimate. Pet. 67 (citing Ex. 1005 ¶¶ 214–215; Ex. 1030, 7:36–43, 9:5–13).

For configuring the data processing module to selectively perform “(f) receiving data from at least one range sensor and at least one outside-in bearing sensor, and updating an estimated pose of an object based on data received from the range sensor and the outside-in bearing sensor,” Petitioner argues that Kramer and Chen would have rendered obvious the step because Kramer discloses using an optical tracking system in an outside-in configuration in conjunction with other sensors. Pet. 68–69 (citing Ex. 1005 ¶ 216; Ex. 1030, 9:5–13, 18:35–45, Fig. 5).

For configuring the data processing module to selectively perform “(g) receiving data from at least one range sensor, at least one outside-in bearing sensor, and at least one inside-out bearing sensor, and updating an estimated pose of an object based on data received from the range sensor, the inside-out bearing sensor, and the outside-in bearing sensor,” Petitioner argues that Kramer and Chen would have rendered obvious the step because Kramer contemplates receiving data from the ultrasonic sensor, optical tracker, and electromagnetic sensor to update pose estimate. Pet. 69 (citing Ex. 1005 ¶ 217; Ex. 1030, 2:63–3:28, 8:61–9:23).

Patent Owner does not provide arguments specifically for claim 67, other than the ones presented for claim 66, which we address above. *See generally* Prelim. Resp. On the present record, Petitioner shows a reasonable likelihood of prevailing in its challenge to claim 67 based on Kramer and Chen.

5. *Independent Claim 68*

For the preamble of claim 68, “[a]n apparatus,” Petitioner argues that Kramer discloses an apparatus that reports movement of an object. Pet. 69 (citing Ex. 1005 ¶ 218; Ex. 1030, 20:23–26).

For “an estimation module to estimate a pose of an object based on measurement data from sensing elements, the estimation module configured to enable selective performance of,” Petitioner argues that Kramer and Chen would have rendered the recited estimation module obvious because Kramer describes an embodiment with various sensors that provide inputs to an estimation filter that predicts sensor value. Pet. 70 (citing Ex. 1005 ¶ 219; Ex. 1030, 5:51–67, 14:58–67, Fig. 2). Petitioner also argues that one of ordinary skill in the art “would have understood that Kalman filtering incorporates knowledge of the sensing devices, among other parameters, to produce an accurate estimate of the position/orientation of the tracked object.” *Id.* (citing Ex. 1005 ¶ 219).

For the remaining limitations, which are similar to the receiving steps of claim 66, Petitioner refers to arguments for that claim. Pet. 70–71.

Patent Owner does not provide arguments specifically for claim 68, other than the ones presented for claim 66. *See generally* Prelim. Resp. On the present record, Petitioner shows a reasonable likelihood of prevailing in its challenge to claim 68 based on Kramer and Chen.

I. *Asserted Obviousness Based on Kramer, Chen, and Welch 2001*

1. *Independent Claim 69*

Petitioner refers to its arguments for claim 66 to contend that Kramer and Chen would have rendered obvious the preamble of claim 69, “[a]n apparatus comprising: . . .” Pet. 72. Petitioner also refers to its arguments for claim 66 to contend that Kramer and Chen would have rendered obvious

“an estimation module to estimate a pose of an object based on measurement data from sensing elements, the estimation module configured to enable selective performance of one of” (*id.*), “(a) updating an estimate of the position or orientation of the object relative to an environment” (*id.*) and “(b) updating an estimate of the position or orientation, relative to the object, of at least one sensing element fixed to the object” (*id.* at 72–73).

For “(c) updating an estimate of the position or orientation, relative to the environment, of at least one sensing element fixed in the environment,” Petitioner acknowledges that “Kramer does not describe estimating the position of the transmitter” but argues that Welch 2001’s autocalibration techniques “would enable estimation of the position of the transmitter in the world, relative to the environment.” Pet. 71 (citing Ex. 1007, 13), 73 (citing Ex. 1007, 13).

Petitioner also argues that one of ordinary skill in the art would have been motivated to combine Kramer and Welch 2001 so that Kramer performs an estimation of receiver position relative to a tracked object using Welch 2001’s autocalibration technique. Pet. 71 (citing Ex. 1005 ¶ 225), 73. According to Petitioner, Welch 2001 describes that estimating the position of a target was a known problem in the art and that its technique improves the accuracy and noise characteristics of such estimates. *Id.* at 71–72 (citing Ex. 1007, 13). Petitioner contends that the proposed modification would have been predictable and obvious to try. *Id.* at 72 (citing Ex. 1005 ¶ 225).

Petitioner also argues that Kramer’s transmitter for its electromagnetic sensor is fixed in an environment. Pet. 73 (citing Ex. 1030, Fig. 2). Petitioner, thus, argues that the proposed combination would have rendered obvious the limitation. *Id.* (citing Ex. 1005 ¶ 230).

Patent Owner responds by referring to arguments for the previous challenge based on Kramer and Chen that (1) Chen is not analogous art, (2) there would have been no motivation to combine Kramer and Chen, and (3) the asserted references fail to teach “selective performance of one of.” Prelim. Resp. 55.

For the reasons above, on the present record, Petitioner shows a reasonable likelihood of prevailing in its challenge to claim 69 based on Kramer and Chen.

IV. CONCLUSION

After considering the evidence and arguments presented in the Petition and the cited evidence, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing in proving that at least one of claims 1–9, 11–29, and 66–69 of the ’632 patent is unpatentable, and thus, we institute an *inter partes* review of all challenged claims on all presented challenges. *SAS*, 138 S. Ct. at 1359–60.

At this stage of the proceeding, the Board has not made a final determination as to the patentability of any challenged claim or any underlying factual and legal issues.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 1–9, 11–29, and 66–69 of U.S. Patent No. 6,922,632 B2 is instituted with respect to all grounds set forth in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4(b), *inter partes* review of U.S. Patent No. 6,922,632 B2

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shall commence on the entry date of this Order, and notice is hereby given of the institution of a trial.

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