Trials@uspto.gov
571-272-7822

Paper 44
Entered: June 5, 2018

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC. and FITBIT, INC.,
Petitioner,

v.

VALENCELL, INC.,
Patent Owner.

Case IPR2017-00321
Patent 8,923,941 B2[1]

Before BRIAN J. McNAMARA, JAMES B. ARPIN, and SHEILA F. McSHANE, *Administrative Patent Judges*.

ARPIN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

[1] Case IPR2017-01556 has been joined with this proceeding.

I. INTRODUCTION

Apple Inc. ("Petitioner") filed a Petition requesting *inter partes* review of claims 14–21 ("the challenged claims") of U.S. Patent No. 8,923,941 B2 (Ex. 1001, "the '941 patent") under 35 U.S.C. §§ 311–319. Paper 2 ("Pet."). Valencell, Inc. ("Patent Owner") filed a Preliminary Response. Paper 6 ("Prelim. Resp."). We instituted the instant *inter partes* review as to the challenged claims.[2] Paper 11 ("Inst. Dec."). Fitbit, Inc. (also "Petitioner") filed a corresponding Petition (IPR2017-01556, Paper 2), accompanied by a Motion for Joinder (IPR2017-01556, Paper 3), challenging claims 14–21 of the '941 patent, and we granted the Motion for Joinder and instituted review of the challenged claims based on the corresponding Petition (IPR2017-01556, Paper 9).

Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 23 ("PO Resp.")), and Petitioner filed a Reply (Paper 30 ("Reply")). In addition, Patent Owner filed a contingent Motion to Amend (Paper 24 ("MTA")), Petitioner filed an Opposition to Patent Owner's contingent Motion to Amend (Paper 31 ("MTA Opp.")), Patent Owner filed a Reply to Petitioner's Opposition to the contingent Motion to Amend (Paper 32 ("MTA Reply")), and Petitioner filed Sur-reply to Patent Owner's Reply to Petitioner's Opposition to the contingent Motion to Amend (Paper 33

[2] We instituted *inter partes* review with respect to each of the claims challenged and on all of the grounds asserted in the Petition, and our Final Decision addresses the patentability of each of the challenged claims on all grounds. *See SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1354 (2018).

("MTA Sur-Reply")). A transcript of the oral hearing held on February 27, 2018, has been entered into the record as Paper 41 ("Tr.").[3]

Although Patent Owner filed objections to evidence submitted with the Petition (Paper 14) and Petitioner filed objections to evidence submitted with Patent Owner's Preliminary Response (Paper 13) and to evidence submitted with the Patent Owner Response (Paper 25), neither party filed a Motion to Exclude. Consequently, these objections are deemed waived. 37 C.F.R. § 42.64(c) ("A motion to exclude evidence must be filed to preserve any objection."). Petitioner also filed a list of alleged misrepresentations of fact and inconsistent statements made by Patent Owner in its Preliminary Response. Paper 10. We considered these listed items in preparation of our Institution Decision (*see* Inst. Dec. 10–11), and Petitioner does not raise the listed, alleged misrepresentations of fact and inconsistent statements in its post-institution filings. Consequently, we do not consider them further here.

This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 14–21 of the '941 patent are unpatentable. We also deny Patent Owner's contingent Motion to Amend.

A. Related Proceedings

According to the parties, the '941 patent is involved in the following civil actions: *Valencell, Inc. v. Apple Inc.*, Case No. 5-16-cv-00010 (E.D.N.C. 2016); *Valencell, Inc. v. Bragi Store, LLC et al.*, Case No. 5-16-

[3] This was a consolidated hearing with the following related case: IPR2017-00319. *See* Tr. 3:2–5.

cv-00895 (E.D.N.C. 2016); and *Valencell, Inc. v. Fitbit, Inc.*, Case No. 5-16-cv-00002 (E.D.N.C. 2016). Pet. 52; Paper 5, 1. Further, the '941 patent is involved in a related petition for *inter partes* review, Case IPR2017-00319, filed by Petitioner on the same day as the instant Petition.

B. The '941 Patent

The '941 patent is entitled "Methods and Apparatus for Generating Data Output Containing Physiological and Motion-Related Information," and was filed February 19, 2014, and issued December 30, 2014. Ex. 1001 at [22], [45], [54]. The '941 patent is a continuation of U.S. Patent Application No. 12/691,388, filed January 21, 2010, now issued as U.S. Patent No. 8,700,111 B2 (*id*. at [63]), and claims priority to four provisional patent applications: U.S. Provisional Patent Application Nos. 61/208,567, filed February 25, 2009; 61/208,574, filed February 25, 2009; 61/212,444, filed April 13, 2009; and 61/274,191, filed August 14, 2009 (*id*. at [60]).

The '941 patent relates generally to physiological monitoring apparatus. Ex. 1001, 1:21–23. Figure 5 of the '941 patent depicts an exemplary embodiment and is reproduced below.

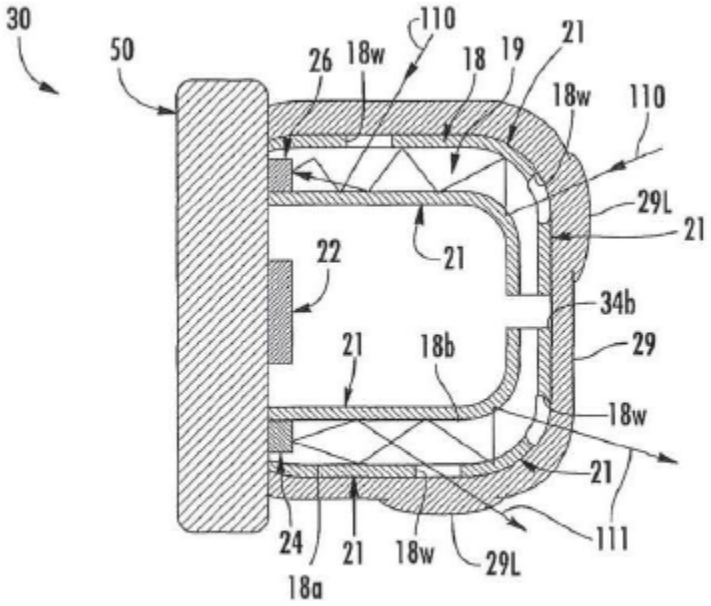


FIG. 5

Figure 5 depicts a side section view of light-guiding earbud 30 for a headset. In particular, earbud 30 includes light guide or cover 18 that serves the function of a housing. *Id*. at 16:16–19. Light guide 18 includes a plurality of windows 18w formed in cladding material 21 on outer surface 18a of cover 18. *Id*. at 16:19–21. Light 111 emitted from light emitter 24 passes through windows 18w and into the wearer's body, and scattered light 110 returning from the wearer's body passes into light guide 18 through windows 18w and is directed to light detector 26. *Id*. at 16:21–24. In other embodiments, earbud housing and light guide 18 may be separate components, for example, as shown in Figure 3, which depicts cover 18 surrounding housing 16. *Id*. at 14:6–10. In addition, light guide 18 of Figure 5 is surrounded by layer 29 of light transmissive material. *Id*. at 16:30–31. One or more lenses 29L are formed in layer 29 and are in optical communication with respective windows 18w in the light guide 18, and lenses 29L are configured to collect returning, scattered light 110 and to

direct scattered light 110 into light guiding region 19 and to light detector 26. *Id*. at 16:31–41. An earbud, such as earbud 30, may integrate a sensor module containing a plurality of sensor elements for measuring physiological information and at least one noise source for measuring noise information and may include a microprocessor that is in electrical communication with the sensor module or modules. *Id*. at 3:46–55, 4:21–25.

In the apparatus described in the '941 patent, photoplethysmography ("PPG") signals may be pre-conditioned by the microprocessor to reduce motion artifacts and signal noise. *Id*. at 4:11–17, 4:25–32, 30:44–48; *see id*. at 32:1–15, 3:47–55. In particular, the physiological information may be filtered to remove signal noise by using various, known signal processing techniques. *See id*. at 3:56–67. Thus, the '941 patent discloses apparatus for removing motion-related noise artifacts, such as subject footstep noise. *See id.* at 3:65–4:5; 31:18–19.

C. Illustrative Claim

Claim 14 is the sole, challenged independent claim of the '941 patent. Each of claims 15–21 depends directly or indirectly from claim 1. Claim 14 is illustrative and is reproduced below with disputed limitations emphasized.

> 14. A wearable device, comprising:
>
> a housing; and
>
> *a chipset enclosed within the housing, the chipset comprising at least one PPG sensor*, at least one motion sensor, and at least one signal processor configured to process signals from the at least one motion sensor and signals from the at least one PPG sensor to reduce motion artifacts from the PPG signals;
>
> wherein the housing comprises at least one window that optically exposes the at least one PPG sensor to a body of a subject wearing the device, and wherein the housing comprises

> non-air light transmissive material in optical communication with the at least one PPG sensor and the window.

Id. at 32:1–15 (emphasis added).

D. Applied References and Declaration

Petitioner relies on the following references and declaration in support of its asserted grounds of unpatentability.

Exhibit	**References and Declaration**
1003	Declaration of Dr. Majid Sarrafzadeh
1016	U.S. Patent Application Publication No. 2009/0105556 A1 to Fricke *et al*., filed September 29, 2008, published April 23, 2009 ("Fricke")
1025	Hyonyoung Han *et al*., *Development of a wearable health monitoring device with motion artifact reduced algorithm*, International Conference on Control, Automation and Systems, IEEE (2007) ("Han")
1027	U.S. Patent Application Publication No. 2004/0186387 A1 to Kosuda et al., published September 23, 2004 ("Kosuda")
1029	Japanese Patent Application Publication No. 2005/270544 A to Maekawa, published October 6, 2005
1030	Certified English-language translation of Japanese Patent Application Publication No. 2005/270544 to Maekawa, published October 6, 2005 ("Maekawa")[4]
1031	U.S. Patent Application Publication No. 2005/059870 A1 to Aceti, published March 17, 2005 ("Aceti")
1032	G. Comtois & Y. Mendelson, *A Comparative Evaluation of Adaptive Noise Cancellation Algorithms for Minimizing Motion Artifacts in a Forehead-Mounted Wearable Pulse Oximeter*, IEEE (2007) ("Comtois")

Pet. v–vii.

As noted above, the '941 patent issued claiming benefit from U.S. provisional patent applications having filing dates as early as

[4] Citations to Maekawa are to this English-language translation.

February 25, 2009. Ex. 1001 at [60]. Each of the applied references has an effective date prior to February 25, 2009. *See* Pet. 8–9.

E. Asserted Grounds of Unpatentability

Petitioner asserted the following grounds of unpatentability:

References	**Basis**	**Challenged Claim(s)**
Kosuda and Maekawa	35 U.S.C. § 103(a)	14, 15, and 21
Kosuda, Maekawa, and Han	35 U.S.C. § 103(a)	18–20
Aceti and Fricke	35 U.S.C. § 103(a)	14–19 and 21
Aceti, Fricke, and Comtois	35 U.S.C. § 103(a)	20

Pet. 7. We instituted *inter partes* review of all of the challenged claims and on all of these asserted grounds.

II. DISCUSSION

A. Claim Interpretation

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b). Under the broadest reasonable interpretation standard, claim terms are given their ordinary and customary meaning, as they would have been understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must be set forth with reasonable clarity, deliberateness, and precision. *See In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Petitioner sought construction of five (5) claim terms in its Petition. Pet. 11–14. Patent Owner challenged some of these constructions in its Preliminary Response and sought construction of the additional claim term

"PPG sensor." Prelim. Resp. 14–17. In the Institution Decision, we proposed constructions for these six (6) terms. Inst. Dec. 7–11. In the Patent Owner Response, Patent Owner contests the preliminary construction of the term "PPG sensor," but does not challenge the constructions of the other terms addressed in the Institution Decision. PO Resp. 7–9; *see* Paper 12, 3 ("The patent owner is cautioned that any arguments for patentability not raised in the response will be deemed waived."). Consequently, for this Decision, we adopt our preliminary constructions of the terms: "body," "headset," "housing," "chipset," and "window," and address the construction of the term "PPG sensor," below.

1. "body" (Claims 14–21)

We determine that the broadest reasonable interpretation of the term "body" is "the body of a subject wearing the device." Inst. Dec. 7–8.

2. "headset" (Claim 17)

We determine that the broadest reasonable interpretation of the term "headset" is "any type of device or earpiece that may be attached to or near the ear of a user, including peripheral devices." *Id.* at 8.

3. "housing" (claims 14–21)

We determine that the broadest reasonable interpretation of the term "housing" is "one or more parts that covers, encloses, supports, or protects; [a] casing." *Id.* at 9.

4. "chipset" (claims 14–21)

We determine that the broadest reasonable interpretation of the term "chipset" is "a collection of one or more chips or integrated circuits." *Id.*

5. "window" (claims 14–21)

We determine that the broadest reasonable interpretation of the term "window" is "an opening through which light can pass." *Id.* at 9–10. We note that the Specification of the '941 patent refers to "windows 18w" and to "openings 18w," from which we conclude that either an "opening" or a "window" with a transparent covering may be the recited "window." *See* Ex. 1001, 16:18–23.

6. "PPG sensor" (claims 14–21)

In the Institution Decision, we adopted Patent Owner's proposed construction of the term "PPG sensor" as the broadest reasonable interpretation of the term. *Id.* at 10–11. In the Patent Owner Response, Patent Owner proposes a slight modification to this interpretation (PO Resp. 9), to which Petitioner does not object (*see* Reply 1–4). Patent Owner now contends that the broadest reasonable interpretation of the term "PPG sensor" is "*an optical sensor* which obtains a plethysmogram that results from blood flow modulations caused by the subject's heartbeat." PO Resp. 9 (emphasis added); *see* Ex. 2005, 1. We agree that the term should include express reference to "an optical sensor," rather than merely to "an optically obtained plethysmogram." Inst. Dec. 10; *see* Ex. 1001, 1:64–2:6. We determine that our previous construction, as modified by Patent Owner, is the broadest reasonable interpretation of this term.

7. Other Claim Terms

Neither party offers specific interpretations of other terms in the challenged claims. *See* Pet. 14 ("All other claim terms should be given their plain and ordinary meaning under the broadest reasonable construction."). Only terms which are in controversy in this proceeding need to be construed, and then only to the extent necessary to resolve the controversy. *See, e.g.*, *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) ("[W]e need only construe terms 'that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))). Consequently, except as noted below, no other claim terms require express interpretation.

B. Obviousness over Kosuda and Maekawa, Alone or in Combination with Han

1. Overview

Petitioner argues that claims 14, 15, and 21 are unpatentable under 35 U.S.C. § 103(a) as obvious over Kosuda and Maekawa, and claims 18–20 are unpatentable as obvious over Kosuda and Maekawa in combination with Han. *See supra* Section I.E. To support its argument, Petitioner provides a mapping of limitations of claims 14, 15, and 21 to structures taught or suggested by Kosuda and Maekawa and claims 18–20 to structures taught or suggested by Kosuda, Maekawa, and Han. Pet. 14–31. Petitioner also cites Dr. Sarrafzadeh's Declaration for support. *See* Ex. 1003 ¶¶ 60–101. Patent Owner limits its response to these arguments to the challenges to independent claim 14. PO Resp. 1 ("Grounds 1 and 2 fail because the proposed combination of [Kosuda] and [Maekawa] suffers from at least two

defects, each of which is fatal to Petitioner's argument of unpatentability of claims 14 and all the claims that depend from it."), 11; *see* Reply 12.

A patent claim is unpatentable under 35 U.S.C. § 103(a) 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;[5] and (4), when in evidence, objective evidence of nonobviousness, i.e., secondary considerations.[6] *Graham v.*

---

[5] Petitioner proposes an assessment of the level of ordinary skill in the art. Pet. 11; *see* Ex. 1003 ¶ 54. Petitioner's declarant, Dr. Sarrafzadeh, and Patent Owner's declarant, Dr. Pollonini, exceeds this assessed level. Ex. 1004; Ex. 2010 ¶¶ 6–11. Patent Owner does not contest Petitioner's assessment or propose an alternative assessment. *See* MTA 11. To the extent necessary, we adopt Petitioner's assessment.

[6] In the instituted proceeding, Patent Owner does not raise arguments or present evidence based on the presence of such objective evidence of nonobviousness. *See In re Applied Materials*, 692 F.3d 1289, 1299 (Fed. Cir. 2012) ("The party seeking the patent bears the burden to overcome the prima facie case of obviousness with evidence of secondary considerations, such as commercial success."); *Medtronic, Inc. v. Nuvasive, Inc.*, Case IPR2014-00087, 2015 WL 1546574, at *11 (PTAB 2015) ("Although it is Patent Owner's burden to introduce evidence supporting such objective indicia, *see In re Huang*, 100 F.3d 135, 139 (Fed. Cir. 1996), the ultimate burden of persuasion never shifts to Patent Owner, *see* 35 U.S.C. § 316(e)."), *aff'd*, *In re Nuvasive, Inc.*, 689 Fed. Appx. 954 (Fed. Cir. 2017); *but see* Prelim. Resp. 4–6. Therefore, this factor does not play into our analysis of Petitioner's challenges to any claim on any ground.

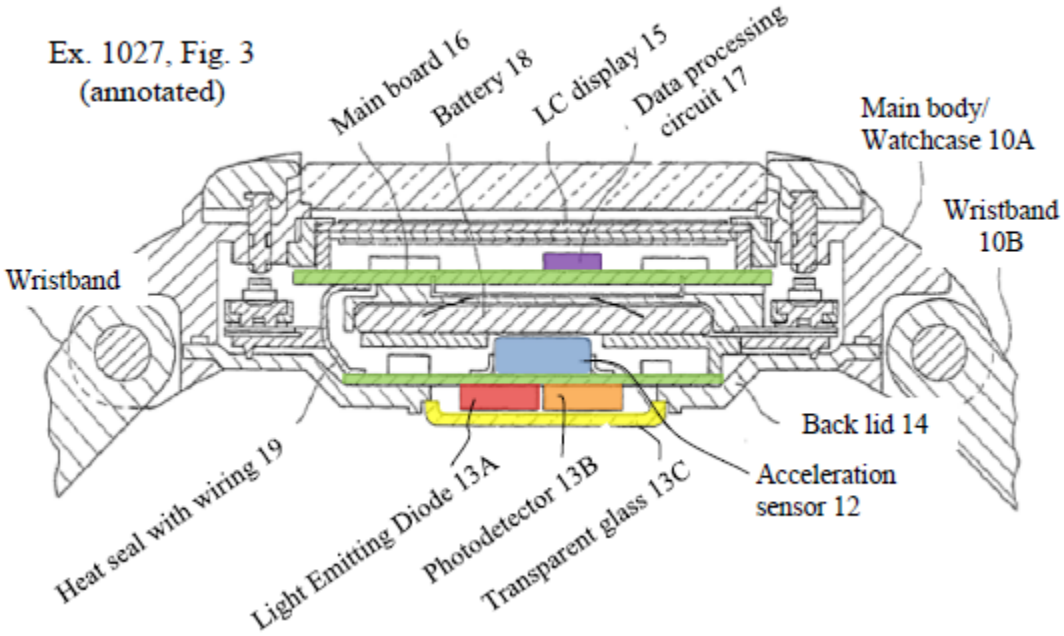
John Deere Co., 383 U.S. 1, 17–18 (1966). Nevertheless, the Supreme Court cautions us against "the temptation to read into the prior art the teachings of the invention in issue." *Graham*, 383 U.S. at 36.

We begin our analysis of these grounds of unpatentability with a review of the applied references.

2. Kosuda (Ex. 1027)

Kosuda's pulse measurement device includes (1) a pulse wave sensor to detect a pulse wave from the wrist, (2) a motion sensor to detect a body motion component, and (3) a signal processing circuit to remove body motion components contained in the pulse wave signal and to calculate a pulse rate of the user. Ex. 1027 ¶ 10, Fig. 2. In particular, the motion sensor may detect body motion along three orthoganal axes. *Id*. ¶ 138, Fig. 5. Thus, the pulse rate may be calculated accurately by proportionally subtracting body motion components detected by a triaxial acceleration sensor from the output of the pulse wave sensor. *Id*.

Kosuda's Figure 3, as annotated by Petitioner, is reproduced below.



Pet. 16. Figure 3 depicts device main body 10A, including back lid 14 and transparent glass 13C, which is held against a subject's wrist (not shown) by wristband 10B. Ex. 1027 ¶ 140. "The transparent glass 13C is fixed by means of a back lid 14 as a component of the device main body 10A." *Id.* ¶ 141. The reverse side of main body 10A includes pulse wave sensor 13 and acceleration (body motion) sensor 12. *Id.* ¶ 140.

Pulse wave sensor 13 may include light emitting diode ("LED") 13A (depicted in red) and photo detector ("PD") 13B (depicted in orange). *Id.* ¶ 141. LED 13A emits light, and PD 13B receives detection light via transparent glass 13C (depicted in yellow), which is fixed to the wrist-side of main body 10A. *Id.* LED 13A, PD 13B, and acceleration sensor 12 (depicted in blue) may be connected to mainboard 16 (depicted in green). *Id.* ¶¶ 142, 143. Further, a central processing unit ("CPU") and other integrated circuit ("IC") circuits (not shown) may be mounted on

mainboard 16 and may comprise processing circuit 17 (depicted in purple). *Id*. ¶ 142.

Kosuda's data processing circuit 17 may utilize adaptive filter 30 to process signals from the acceleration sensor and the pulse wave sensor to reduce motion artifacts in the pulse wave signals. *Id*. ¶¶ 145, 152–158, Fig. 5. Adaptive filter 30 has filter coefficient generating section 31 and synthesizer 32. *Id*. ¶ 154. Filter coefficient generating section 31 applies adaptive filter coefficient h based on data previously output. *Id*. ¶ 155, Fig. 5. By applying the adaptive filter coefficient h to a simulated low-frequency signal and to body motion component detection signals, filter coefficient generating section 31 generates body motion removal data h(x), h(y), and h(z). *Id*. Synthesizer 32 subtracts body motion removal data h(x), h(y), and h(z) from the detected pulse wave data (i.e., pulse wave components and body motion components) and extracts wave components e(n). *Id*.

3. Maekawa (Ex. 1029, Ex. 1030)

Maekawa also teaches a wrist mounted, physiological information measuring device that determines information, such as a pulse rate. Ex. 1030 ¶ 20. Maekawa's Figure 10 is reproduced below.

Fig. 10

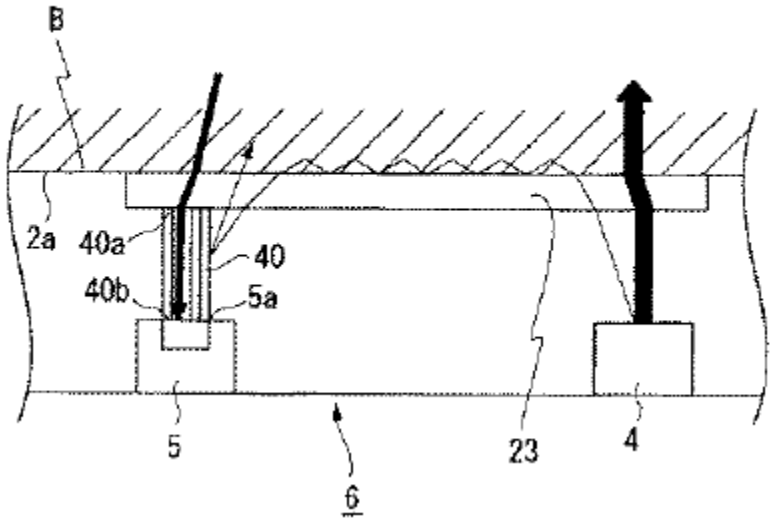


Figure 10 depicts a physiological information measuring device including physiological sensor 6, including LED 4 that emits light toward the wrist, photo diode ("PD") 5 that receives light backscattered from the wrist, and data processor (not shown) that determines a pulse rate based on the amount of light received by sensor 6. *Id*. ¶ 21; *see id*. ¶ 23, Figs. 5 (depicting sensor 6 in housing 2) and 7 (depicting data processor 7). Further, Figure 10 depicts that PD 5 and cover glass 23 are separated, and a bundle of optical fibers 40 extend in the gap between them. *Id*. ¶ 48. One end 40a of optical fibers 40 is adjacent to cover glass 23, and other end 40b is adjacent to light receiving surface 5a of PD 5. *Id*. Optical fibers 40 are arranged, so that light passing along the surface B of the wrist is reflected by the outer circumferential surface of optical fibers 40. *Id*.; *see id*. ¶ 14.

> Light that only passes along the surface of the skin of the living body *does not contain very much physiological information* whereby blocking this light makes it so that most of the light that enters the optical fiber, propagates in the optical fiber, and is lead to the light receiving part is *light that has passed deeply through*

> *the living body under the inner skin, in other words, light that contains a lot of physiological information*.

Id. ¶¶ 15 (emphases added), 48. Thus, light reflected back through the wrist contains more useful physiological information (i.e., light that has penetrated more deeply into the wrist) and is guided to PD 5 through optical fibers 40. *Id*. ¶¶ 14–15, 48. Because light passing along surface B is considered noise, blocking such light improves the pulse signal's signal-to-noise ratio. *Id*. ¶ 47 ("Therefore, when measuring physiological information, light propagating in the cover glass 23 that becomes light noise can be blocked enabling improving the [signal-to-noise ("SN")] ratio for generating a pulse signal."), Fig. 9 (depicting reflective body 23A to preventing light propagating in cover glass 23 from reaching PD 5).

4. Han (Ex. 1025)

Han teaches "a real-time, wearable and motion artifact reduced health monitoring device." Ex. 1025, Abstract, Fig. 1. The wearable device includes a "photoplethysmography (PPG) sensor, 3-axis accelerometer, microprocessor and wireless module." *Id*. Han's PPG sensor may operate in infrared wavelengths. *Id*. at pp. 1582. Motion artifacts, such as those created by finger movements, may cause the PPG sensor to acquire distorted heart beat signals. *Id*., Abstract. Han teaches active noise cancellation, whereby a motion sensor obtains body movement information, and an active noise cancellation algorithm in an adaptive filter removes motion noises. *Id*.

Han's processor conducts pre-processing on raw PPG signals. *Id*. at pp. 1582.

> The raw signal demands a low pass filter for reducing high frequency noise and [a] high pass filter for rejecting a DC component [of the PPG signal] to enhance the AC component.

> . . . The filters are designed as a 0.5–3 Hz band pass filter, and totally fourth order analog active filter and digital filter are used in this signal processing.

Id. Han further teaches that Normalized Least Mean Square ("NLMS") adaptive filters may be used due to their fast processing speeds and low order filter coefficients. *Id*.

Han's Figure 3 is reproduced below.

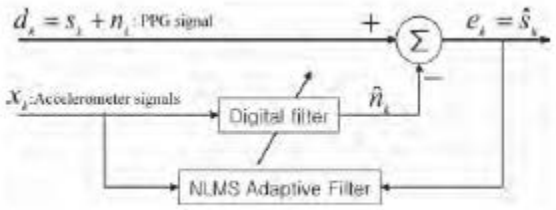


Fig. 3. Block diagram of the active noise cancellation algorithm

Figure 3 depicts

> a block diagram of an active noise cancellation algorithm, which reconstructs a raw pulsation signal (s_k) from the corrupted signal (d_k), using measurable noise signal (x_k). Here, PPG and body motion data correspond to d_k and x_k respectively. This research predominantly used 3-axis accelerometer signals (x_k) for body motion data (n_k).

Id. Such active noise cancellation algorithm techniques may remove motion artifacts due to walking and running. *Id*. at pp. 1584, Table 2.

5. Analysis

a. Claim 14

Petitioner maps the limitations of claim 14 to the teachings of Kosuda. Pet. 20–27. In particular, Petitioner argues that Kosuda teaches a wearable device, such as the wrist-mounted, pulse measurement device 10, depicted in Kosuda's Figures 2 and 3. *Id*. at 20 (citing Ex. 1027, Figs. 2 and 3); *see id*. ¶ 139; Ex. 1003 ¶ 73. The wearable device recited in claim 14, comprises (1) "a housing," and (2) "a chipset enclosed within the housing, the chipset

comprising at least one PPG sensor, at least one motion sensor, and at least one signal processor." Ex. 1001, 32:2–5. Referring to Kosuda's Figure 3, Petitioner argues that Kosuda teaches housing comprising main body 10A including back lid 14, encompassing pulse wave sensor 13, triaxial acceleration sensor 12, and microprocessor unit ("MPU") 24 and data processing circuit 17.[7] Pet. 20–24 (citing Ex. 1027 ¶¶ 137, 138, 140–142, 146); *see* Ex. 1003 ¶¶ 75–82.

Petitioner argues that Kosuda's pulse wave sensor 13 teaches "at least one PPG sensor." Pet. 23; *see supra* Section II.A.6 (modifying construction of "PPG sensor" to describe an "optical sensor"). In particular, Petitioner argues that pulse wave sensor 13 includes the components of a PPG sensor, namely, LED 13A and PD 13B. Pet. 23.

Further, Petitioner argues that Kosuda's acceleration sensor 12 teaches "at least one motion sensor." Pet. 24. In particular, Petitioner argues that "[a]cceleration sensor 12 detects body motion by directly sensing motion of the acceleration sensor itself" and that Kosuda teaches other types of motion sensors, such as angle sensors and blood vessel simulation sensors." *Id*. (citing Ex. 1027 ¶¶ 137, 309, 452, Figs. 66A (angle sensor 122) and 113 (blood vessel simulation sensor 232); *see* Ex. 1003 ¶¶ 81, 82.

In addition, Petitioner argues that Kosuda's MPU 24 and/or data processing circuit 17, teach(es) "at least one signal processor configured to process signals from the at least one motion sensor and signals from the at

[7] As Patent Owner notes, the Institution decision incorrectly referred to "housing 2" and "processor 7." PO Resp. 16 (quoting Inst. Dec. 17). Those typographical errors are corrected here, and Petitioner's mapping of the limitations of claim 14 onto Kosuda is clarified.

least one PPG sensor to reduce motion artifacts from the PPG signals" (Ex. 1001, 32:5–9). Pet 24 (citing Ex. 1027 ¶¶ 135–137, 142, 145, 154–158, Figs. 3–5); *see* Ex. 1003 ¶¶ 83–85. In particular, Kosuda teaches that

> the body motion components originating in the veins are detected by a triaxial acceleration sensor, and the pulse rate is accurately detected based on a signal that is free of the effect of venous blood by subtracting the detected output from the output of the pulse wave sensor in a specific proportion.

Ex. 1027 ¶ 138. Thus, Kosuda teaches that signals from the PPG sensor and the motion sensor are processed to reduce motion artifacts from the PPG signals. Pet. 24; *see* Ex. 1003 ¶¶ 65, 84–85.

Referring to Figure 3 (reproduced above), Kosuda teaches that each of acceleration sensor 12, pulse wave sensor 13, and data processing circuit 17 may be mounted on or physically connected to mainboard 19. Ex. 1027 ¶¶ 144–145, Fig. 3. Thus, Petitioner argues that these components of Kosuda teach "a chipset enclosed within the housing." Pet. 21–23; *see* Ex. 1003 ¶¶ 75– 78; *supra* Section II.A.4. As noted above, "[t]he transparent glass 13C is fixed by means of a back lid 14 as a component of the device main body 10A." Ex. 1027 ¶ 141. Thus, main body 10A, back lid 14, and glass 13C together may form the "housing." Pet. 25 ("Kosuda discloses that the housing (*i.e.*, main body/watchcase 10A) comprises a window (*i.e.*, transparent glass 13C in the opening in back lid 14) that optically exposes the PPG sensor (i.e., pulse wave sensor 13) to a body (*i.e.*, user's arm 11) of a subject wearing the device." (citations omitted)); *see* Reply 1–2.

Finally, Petitioner argues that Kosuda's transparent glass 13C teaches the at least one window in the recited housing. Pet. 25 (citing Ex. 1027 ¶¶ 139–141, Fig. 3); *see* Ex. 1003 ¶ 86; *supra* Section II.A.5. Nevertheless,

Petitioner acknowledges that "Kosuda does not explicitly state that a non-air light transmissive material exists between sensor 13 and transparent glass 13C." Pet. 26. Petitioner argues, however, that "Maekawa teaches placing a non-air light transmissive material (i.e., optical fibers 40) in optical communication with the PPG sensor (i.e., pulse sensor 6) and the window (i.e., cover glass 23)." *Id*. Therefore, Petitioner argues that a person of ordinary skill in the art would have had reason to combine the teachings of Kosuda and Maekawa "to place Maekawa's non-air light transmissive material (such as an optical fiber) in optical communication with Kosuda's PPG sensor (i.e., pulse sensor 13) and window (i.e., transparent glass 13C) *to improve the signal-to-noise ratio of the received pulse signal*." *Id*. at 26–27 (emphasis added); *see* Ex. 1030 ¶¶ 47, 48, Figs. 9 and 10; Ex. 1003 ¶ 89.

As noted above, Maekawa teaches that it is desirable to prevent light propagating in the cover glass or only passing along the surface of the skin from entering the photo diode. *See supra* Section II.B.3. Dr. Sarrafzadeh testifies that a person of ordinary skill in the art would understand that the signal-to-noise ratio would be improved by preventing such light from being received by the Maekawa's photo diode or Kosuda's pulse wave sensor. *See* Ex. 1003 ¶¶ 38, 69–71, 88–90; Ex. 1070, 150:17–153:9. Because Kosuda and Maekawa are directed to physiological monitoring devices and to the extraction of physiological and activity related information from subjects, it is alleged that a person of ordinary skill in the art would have had reason to use a technique known to improve a similar device to improve Kosuda's monitoring device in a similar way. Pet. 27; Reply 4–9; *see KSR*, 550 U.S. at 417 ("For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would

improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill."); *In re Ethicon*, 844 F.3d 1344, 1351 (Fed. Cir. 2017) ("The normal desire of artisans to improve upon what is already generally known can provide the motivation to optimize variables such as the percentage of a known polymer for use in a known device.").

b. Patent Owner's Contentions

Patent Owner contends that Petitioner fails to demonstrate that the combined teachings of Kosuda and Maekawa render the device of challenged claim 14 obvious for two significant reasons. *See* PO Resp. 15–24. First, Patent Owner contends that neither Kosuda nor Maekawa teaches or suggests a chipset within a housing that encloses a PPG sensor. *Id.* at 15–18. Second, Patent Owner contends a person of ordinary skill in the art would not have had reason to combine the teachings of Kosuda and Maekawa to achieve "the housing compris[ing] non-air light transmissive material in optical communication with the at least one PPG sensor and the window." *Id.* at 18–24. For the reasons set forth below, we are not persuaded that Petitioner fails to demonstrate unpatentability in view of either of Patent Owner's contentions.

First, Patent Owner contends that neither Kosuda nor Maekawa teaches or suggests a chipset within a housing that encloses a PPG sensor. *Id.* at 15–18. In particular, Patent Owner contends that Petitioner does not argue that Maekawa teaches or suggests this limitation; thus, Petitioner relies solely on Kosuda to teach or suggest this limitation. *Id.* at 15 (citing Pet. 21–24). More specifically, Patent Owner contends that, although Petitioner asserts that "Kosuda discloses a PPG sensor . . . enclosed within

the housing (i.e., main body watchcase 10A)" (Pet. 23), Petitioner does not identify a "housing," in which a chipset including a PPG sensor is enclosed. PO Resp. 15. Referring to Petitioner's annotated version of Kosuda's Figure 3, reproduced above, Patent Owner contends that Kosuda's main body/watchcase 10 A and back lid 14 do not *enclose* light emitting diode 13A, photodetector 13B, and transparent glass 13C, "which Petitioner argues collectively disclose the claimed PPG sensor." *Id.* at 16 (citing Ex. 2010 ¶ 82). Specifically, Patent Owner's declarant, Dr. Pollonini, states that "because Petitioner argues that Transparent glass 13C is part of the pulse wave sensor, it cannot also be part of the housing which must enclose the pulse wave sensor. Thus, the entire pulse wave sensor, based on Petitioner's argument, cannot be part of a chipset enclosed within a housing." Ex. 2010 ¶ 83. We disagree.

Initially, although neither party offers an interpretation of the word "enclosed," we give the word "enclosed" its plain and ordinary meaning consistent with its usage in the Specification of the '941 patent.[8] Pet. 14; PO Resp. 7–8; *see Translogic*, 504 F.3d at 1257. The verb "to enclose" is defined as "1. to close in on all sides shut in. 2. to surround, as with a fence: *to enclose land*. . . . 4. to contain or hold." RANDOM HOUSE WEBSTER'S COLLEGE DICTIONARY 433 (2nd Random House ed. 1999) (Ex. 3001). This definition of "to enclose" is consistent with the use of that word in the Specification of the '941 patent.

[8] Although Dr. Sarrafzadeh expressed concern regarding a "scientific technical definition" of the word "enclosing," we do not discern that the record suggests that anything beyond the plain and ordinary meaning is indicated here. Ex. 2011, 138:25–139:24; *see* PO Resp. 16.

Figure 6 of the ’941 patent is reproduced below.

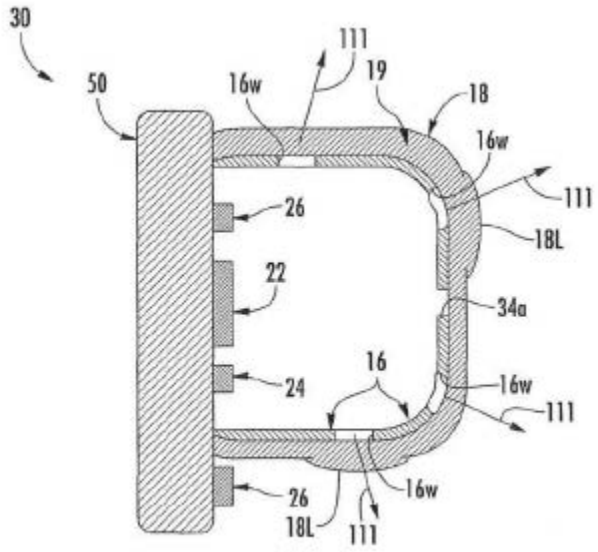


FIG. 6

Ex. 1001, Fig. 6. Figure 6 depicts a side section view of a light-guiding earbud for a headset, according to some embodiments of the claimed invention. *Id.* at 7:16–18. Referring to Figure 6, the Specification explains that “[t]he earbud housing 16 *encloses* the speaker 22, an optical emitter 24 and an optical detector 26 as illustrated. An additional light detector 26 is located on the base 50 but *is not surrounded by* the earbud housing 16.” *Id.* at 16:61–65 (emphases added). Thus, in the context of claim 14, we understand “enclosed within,” as recited in claim 14, to encompass “surrounded by.” *See id.* at 2:35–39 (“In some embodiments, a housing is secured to and overlies the base so as to enclose and protect the speaker, optical emitter and optical detector, as well as other electronic components secured to the base e.g., sensors, processor, transmitter etc.).”); 12:7–12 (Referring to Figure 1, “[t]he headset housing 14 is secured to the base 12 and is configured *to enclose* and protect the various electronic components

mounted to the 10 base (e.g., main circuit board 20 and components secured thereto, etc.) . . ." (emphasis added)).

We are not persuaded that Petitioner argues that light emitting diode 13A, photodetector 13B, *and* transparent glass 13C, *together*, teach the recited, PPG sensor. Instead, Petitioner asserts that "Kosuda discloses a PPG sensor *(i.e., pulse wave sensor 13)* enclosed within the housing (i.e., main body/watchcase 10A)." Pet. 23 (emphasis added); *cf.* PO Resp. 15 (quoted above). Although Kosuda discloses that

> the pulse wave sensor 13 has an LED 13A for emitting light lo detect pulse waves, a PD (Photo Detector) 13B for receiving the detection light reflected by the body, and transparent glass 13C for protecting the LED 13A and the PD 13B, transmitting the light incident on the LED 13A and reflected light obtained via the body, and directing the light onto the PD 13B;

(Ex. 1027 ¶ 141), Petitioner distinguishes *between* sensor 13 *and* transparent glass 13C in its arguments. In particular, Petitioner argues that "Kosuda discloses that the housing (*i.e.*, main body/watchcase 10A) comprises a window (*i.e.*, transparent glass 13C in the opening in back lid 14) that optically exposes the PPG sensor (*i.e.*, pulse wave sensor 13) to a body (i.e., user's arm 11) of a subject wearing the device." Pet. 25; *see id.* at 26 ("Kosuda does not explicitly state that a non-air light transmissive material exists *between* sensor 13 *and* transparent glass 13C." (emphases added)). In other portions of the Petition, Petitioner also refers to the recited, PPG sensor as "pulse wave sensor 13." *See, e.g.*, Pet. 24 (referring to "signals from the PPG sensor (i.e., pulse wave sensor 13)"), 25 (referring to "the PPG sensor (i.e., pulse wave sensor 13)"). Thus, considering the entirety of Petitioner's arguments and the cited text and figures of Kosuda, we find that Petitioner persuasively argues that the recited, PPG sensor is taught by

Kosuda's LED 13A and PD 13B and that those components are *enclosed within* or *surrounded by* a "housing" comprising Kosuda's main body/watchcase 10A and back lid 14, with or without the inclusion of transparent glass 13C. *See* Ex. 1027 ¶ 141 ("The transparent glass 13C is fixed by means of a back lid 14 *as a component of the device main body 10A*." (emphasis added)); *see also* Ex. 2011, 137:12–15 ("I believe a person of ordinary skill in the art would have understood Kosuda's main body watch 10A including, of course, the back lid 14 to satisfy the claimed housing."), 138:7–12 ("I'm not claiming that transparent panel 13C is part of the housing, that's correct."). Therefore, we are persuaded that Petitioner demonstrates that the combined teachings of Kosuda and Maekawa teach or suggest "a chipset enclosed within the housing, the chipset comprising at least one PPG sensor."

Second, Patent Owner contends that Petitioner fails to provide sufficient reason to combine the teachings of Kosuda and Maekawa. PO Resp. 18–24. In particular, Patent Owner contends that (1) "Maekawa's disclosure (and Dr. Sarrafzadeh's adoption of it) where light passing only superficially along the surface of the wrist does not contain 'useful physiological information' is incorrect" (*id.* at 20–21); (2) "[l]ight entering [Maekawa's glass 23] from certain angles would be transmitted entirely within the glass, and some of that light may exit into the optical cables" (*id.* at 21–23); (3) "using Maekawa's 'fiber optic cables' in Kosuda's device would not reduce motion artifacts in Kosuda's pulse wave sensor" (*id.* at 23–24); and (4) "a [person of ordinary skill in the art ("POSA")] would not have looked to the solution offered in Maekawa because there is a much simpler

way of solving Kosuda's purported signal-to-noise problem" (*id*. at 24). We disagree.

First, although Petitioner argues that "[l]ight that only passes along the surface of the wrist does not contain useful physiological information" (Pet. 19 (citing Ex. 1030 ¶¶ 14, 15, 48)), Petitioner explains that:

> By blocking this surface light, the light *that contains more useful physiological information* (*i.e.*, light that has penetrated more deeply into the wrist) is led to the PD 5 through optical fibers 40. Ex. 1030, ¶¶ 0014-0015, 0048; Ex. 1003, ¶¶ 69–71. Because light propagating along the surface of the skin would be considered noise, blocking such light noise improves the signal-to-noise ratio of the pulse signal. Ex. 1030, ¶¶ 0047-0048; Ex. 1003, ¶ 71.

Pet. 19–20 (emphasis added). Notably, Maekawa discloses that:

> Light that only passes along the surface of the skin of the living body *does not contain very much physiological information* whereby blocking this light makes it so that most of the light that enters the optical fiber, propagates in the optical fiber, and is lead to the light receiving part is light that has passed deeply through the living body under the inner skin, *in other words, light that contains a lot of physiological information*.

Ex. 1030 ¶ 15 (emphases added). Thus, light that passes along the surface of the skin may contain some, but certainly contains less, physiological information than light that passes more deeply through the skin. Reply 5–6.

Second, although Patent Owner asserts that "[l]ight entering [Maekawa's glass 23] from certain angles would be transmitted entirely within the glass, and some of that light may exit into the optical cables," Maekawa clearly teaches that this is undesirable. PO Resp. 21. Referring to its Figure 9, Maekawa teaches that reflective surface 23a within cover glass 23 deflects light propagating within cover glass 23 and prevents that propagating light from reaching PD 5. Ex. 1030 ¶ 47; *see* Reply 6.

Referring to its Figure 10, Maekawa's bundle of optical fibers 40 limits propagating light from reaching PD5, even if it does not prevent all propagating light from reaching PD5. Ex. 1030 ¶ 48; *see* Reply 6–7. Petitioner concludes that "even assuming that light traveling within Kosuda's transparent glass was a problem, it was a problem recognized in the prior art to which there were known solutions as taught by Maekawa and admitted to by [Patent Owner]." Reply 7 (citing PO Resp. 21–23). Thus, we agree with Petitioner that a person of ordinary skill in the art would have had reason to combine the teachings of Kosuda and Maekawa even if the combination did not eliminate all undesirable light from reaching the sensor. *Id.*

Third, despite Patent Owner's contention that "using Maekawa's 'fiber optic cables' in Kosuda's device would not reduce *motion artifacts* in Kosuda's pulse wave sensor" (PO Resp. 23–24 (emphasis added)), Petitioner does not rely on Maekawa's fiber optic cables for this purpose (Reply 7). *See* Ex. 2010 ¶ 91. Instead, Petitioner argues that "it would have been obvious to a POSA to place Maekawa's non-air light transmissive material (such as an optical fiber) in optical communication with Kosuda's PPG sensor (*i.e.*, pulse sensor 13) and window (*i.e.*, transparent glass 13C) *to improve the signal-to-noise ratio of the received pulse signal*." Pet. 26–27 (emphasis added, citing Ex. 1003 ¶ 89). Petitioner notes that Kosuda's motion sensor, not Maekawa's bundle of fiber optic cables, is intended to reduce motion artifacts. Reply 7–8.

Finally, Patent Owner's contention that there exists "a much simpler way of solving Kosuda's purported signal-to-noise problem" (PO Resp. 24) is not determinative of whether a person of ordinary skill in the art would

have had reason to combine the teachings of Kosuda and Maekawa in the manner proffered by Petitioner. Initially, we note that although Patent Owner has suggested an alternative solution to the signal-to-noise problem, neither Patent Owner nor its declarant provides support for their contention that the alternative solution is superior to that taught by the combination of the teachings of Kosuda and Maekawa. *See* PO Resp. 24; Ex. 2010 ¶ 90. But even if it had, as Petitioner notes, "the law does not require that a particular combination be the preferred, or the most desirable, combination described in the prior art in order to provide motivation for the claimed invention." Reply 8; *see In re Fulton*, 391 F.3d 1195, 1200 (Fed. Cir. 2004) ("The question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination, *not whether there is something in the prior art as a whole to suggest that the combination is the most desirable combination available*." (emphasis added)). Thus, the existence of potentially superior alternatives does not negate the combination of teachings proposed by Petitioner.

Accordingly, we are persuaded that Petitioner demonstrates sufficiently that a person of ordinary skill in the art would have had reason for combining the teachings of Kosuda and Maekawa to achieve the device recited in claim 14 of the '941 patent.

c. Claims 15 and 21

Petitioner argues that claims 15 and 21 also are rendered obvious over the combined teachings of Kosuda and Maekawa and provides a mapping reading of the additional limitations of these dependent claims on the combined teachings of Kosuda and Maekawa, as follows:

Claim	Limitation	Applied Teachings
15	"wherein the non-air light transmissive material comprises at least one light guide in optical communication with the at least one PPG sensor and the window"	Maekawa teaches or suggests the addition of a non-air light transmissive material (such as a bundle of optical fibers 40) in optical communication with photo diode 5 and cover glass 23. Ex. 1030 ¶ 48; *see* Pet. 26. Kosuda teaches that light is directed to the back of the wearer's wrist and returned to a detector via the transparent glass. Pet. 27 (citing Ex. 1027[9] ¶¶ 310, 315, 445, 449); *see* Ex. 1003 ¶¶ 91, 92.
21	"wherein the *at least one motion sensor comprises* at least one of the following: *an optical sensor*, *an inertial sensor*, an electrically conductive sensor, *a capacitive sensor*, an inductive sensor, *an accelerometer*, and a blocked channel sensor" (emphases added)	Kosuda teaches that the motion sensor may comprise at least one of an optical sensor (Ex. 1027 ¶ 356), an inertial sensor (*id.* ¶ 351), a capacitive sensor (*id.* ¶ 316), and an accelerometer (*id.* ¶ 140). Pet. 28; *see* Ex. 1003 ¶¶ 93, 94.

Pet. 27–28; *see* Ex. 1003 ¶¶ 91–94.

Patent Owner does not contest this mapping, but, instead, contends that Petitioner fails to demonstrate the combined teachings of Kosuda and Maekawa teach or suggest all of the limitations of the base claim, claim 14, and/or fails to provide a sufficient reason to combine the teachings of the Kosuda and Maekawa to achieve the device recited in claim 14. PO Resp. 1; Reply 12; *see supra* Section II.B.5. For the reasons set forth above, we are

[9] Petitioner incorrectly cites to "Ex. 1030," instead of "Ex. 1027." Pet. 27.

persuaded that Petitioner has demonstrated that the combined teachings of Kosuda and Maekawa teach or suggest all of the limitations of claim 14, as well as those of claims 15 and 21, and provides sufficient reason to have combined the teachings of Kosuda and Maekawa. Pet. 20–28. Thus, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence claims 15 and 21 are unpatentable under 35 U.S.C. § 103(a) as rendered obvious by the combined teachings of Kosuda and Maekawa.

d. Claims 18–20

Petitioner argues that claims 18–20 are rendered obvious over the combined teachings of Kosuda, Maekawa, and Han. *See supra* Section I.E. Claim 18 depends from claim 14 and recites that "at least one processor is configured to reduce motion artifacts by removing frequency bands from the signals that are outside of a range of interest using at least one band-pass filter to produce preconditioned signals." Ex. 1001, 32:24–28. Claim 19 depends from claim 18 and recites that any one of a plurality of types of filtering may be applied to filter the preconditioned signals in the device of claim 18. *Id*. at 32:29–33. Finally, claim 20 depends from claim 14 and recites that "the subject motion artifacts comprises subject footstep-related motion artifacts." *Id*. at 32:34–35.

Petitioner relies on the combined teachings of Kosuda and Maekawa to render the base claim, claim 14, of claims 18–20 unpatentable, and Petitioner specifically identifies the limitations of claims 18–20 that are missing from the combined teachings of Kosuda and Maekawa.[10] Pet. 28–

[10] In its Preliminary Response, Patent Owner contended that Petitioner fails to demonstrate which limitations of each claims are missing from one or

29 ("Though Kosuda does not expressly mention removing footstep-related motion or disclose that the frequency bands are removed using a band-pass filter to produce pre-conditioned signals, such techniques were well known in the art."); *see* Ex. 1003 ¶ 96. Petitioner provides a mapping of the additional limitations of these dependent claims onto Han, as follows:

Claim	**Limitation**	**Han's teaching**
18	"wherein the at least one processor is configured to reduce motion artifacts by removing frequency bands from the signals that are outside of a range of interest using at least one band-pass filter to produce preconditioned signals"	Han teaches that "[t]he raw signal demands a low pass filter for reducing high frequency noise and high pass filter for rejecting a DC component to enhance the AC component. As filters, second order active analog high and low pass filters (Sallen-Key Filter) are used. Filtering signals are amplified to enhance and acquire discriminable signals by a thousand times. The last part is digital signal processing. High order filtering has good performance *to extract wanted signal*, but more number of components are required to increase filtering order. Therefore, digital filtering is employed to satisfy both circuit size and filtering performance. The filters are designed as a 0.5 – 3 Hz band pass filter,

more applied reference(s) and supplied by another reference. Prelim. Resp. 36–39. Patent Owner does not maintain this contention in its Patent Owner Response. Paper 12, 3.

		and totally fourth order analog active filter and digital filter are used in this signal processing." Pet. 30 (citing Ex. 1025, pp. 1582 (emphasis added)); *see* Ex. 1003 ¶ 100.
19	"wherein the at least one processor is configured to filter the preconditioned signals via at least one of the following: FIR (Finite Impulse Response) filtering, IIR (Infinite Impulse Response) filtering, adaptive filtering. phase filtering, and frequency filtering"	Han teaches "an active noise cancellation algorithm to filter the preconditioned signals via a Normalized Least Mean Square (NLMS) *adaptive filtering*." Pet. 30–31 (emphasis added, citing Ex. 1025, pp. 1582, Fig. 3); *see* Ex. 1003 ¶ 100.
20	"wherein the subject motion artifacts comprises subject footstep-related motion artifacts"	In Figure 2, Han teaches that motion artifacts may include running or walking. Ex. 1025, pp. 1584, Table 2, Fig. 3; *see* Pet. 30; Ex. 1003 ¶ 100.

Pet. 28–31 (citing Ex. 1025, pp. 1581–82). Moreover, Petitioner identifies a reason why a person of ordinary skill in the art would have combined the teachings of Kosuda, Maekawa, and Han to achieve the device recited in claims 18–20. Pet. 31; *see* Ex. 1003 ¶ 101.

Patent Owner does not contest this mapping, but, instead, contends that Petitioner fails to demonstrate the combined teachings of Kosuda and Maekawa teach or suggest all of the limitations of the base claim, claim 14, or a reason to combine the teachings of the Kosuda and Maekawa to achieve the device recited in claim 14. PO Resp. 1; Reply 12; *see supra* Section II.B.5. For the reasons set forth above, we are persuaded that Petitioner has demonstrated that the combined teachings of Kosuda and Maekawa teach or suggest all of the limitations of claim 14, and provides sufficient reason to

have combined the teachings of Kosuda and Maekawa. Pet. 20–27. Further, we are persuaded that Petitioner demonstrates where Han teaches the additional limitations of the dependent claims (Pet. 29–31 (citing Ex. 1003 ¶¶ 97–100)), and, despite the similarities between the Petitioner's arguments and Dr. Sarrafzadeh's testimony, we credit Dr. Sarrafzadeh's testimony regarding the combined teachings (*see* Ex. 1003 ¶¶ 1–14, 23). Thus, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence claims 18–20 are unpatentable under 35 U.S.C. § 103(a) as rendered obvious by the combined teachings of Kosuda, Maekawa, and Han.

e. Summary

For the reasons set forth above, we are persuaded that Petitioner demonstrates by a preponderance of the evidence that claims 14, 15, and 18–21 of the '941 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over Kosuda and Maekawa, alone or in combination with Han.

C. Obviousness over Aceti and Fricke, Alone or in Combination with Comtois

1. Overview

Petitioner argues that claims 14–21 are unpatentable under 35 U.S.C. § 103(a) as obvious over Aceti and Fricke, alone or in combination with Comtois. *See supra* Section I.E. To support its argument, Petitioner provides a mapping of limitations of claims 14–21 to structures taught or suggested by Aceti and Fricke or by Aceti, Fricke, and Comtois. Pet. 31–50. Petitioner also cites Dr. Sarrafzadeh's Declaration for support. *See* Ex. 1003 ¶¶ 102–143. Patent Owner limits its response to these arguments to the challenges to independent claim 14. PO Resp. 2, 25 ("As with the combination of Kosuda and Maekawa for Grounds 1 and 2, Petitioner has

failed make out a *prima facie* case that claim 14 and its dependent claims are obvious over Aceti and Fricke. Thus, Grounds 3 and 4 also fail."); *see* Reply 12.

We begin our analysis of these grounds of unpatentability with a review of the applied references.

2. Aceti (Ex. 1031)

Aceti teaches a pulse oximetry sensor (i.e., a PPG sensor) including an optical emitter and optical detector for sensing physiological information. Ex. 1031 ¶ 27. Aceti's Figure 1 is reproduced below.

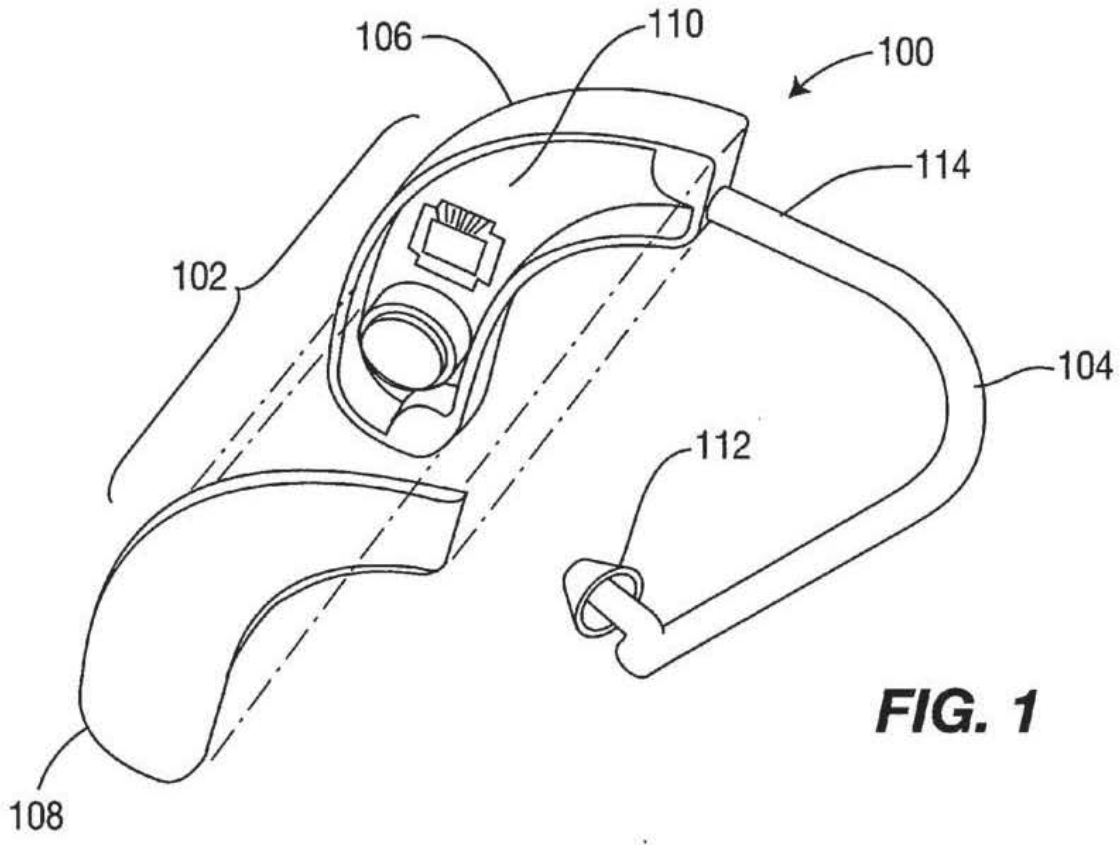


Figure 1 depicts a partially exploded view of an exemplary monitoring device in accordance with Aceti's disclosure. *Id.* ¶ 7. Monitoring device 100 includes processor portion 102 and conductor portion 104. *Id.* ¶ 16. In

an exemplary embodiment, conductor portion 104 may be removably coupled to processor portion 102 and may be disposable. *Id.* Processor portion 102 may include housing 106 with cover 108, which may contain electrical and/or electronic components 110. *Id.* ¶ 17. Additionally, electrical and/or electronic components 110 may be found within conductor portion 104. *Id.* Conductor portion 104 includes first end 112 configured for insertion at least partially within the auditory canal of the wearer and second end 114 coupled to processor portion 102. *Id.*

Referring to Aceti's Figure 3, Aceti teaches components 110 may include pulse oximetry sensor 336, accelerometer 340, and processor 314, and signal processing circuitry 342, to determine pulse rate. *Id*. ¶ 27. Aceti notes that pulse oximetry was a well-known application of photoplethysmography, and, in Figure 3, Aceti teaches that such a PPG sensor may emit light in the red (660 nm) and infrared (805 nm) wavelengths. *Id*., Fig. 3 (LED 330 (660 nm) and LED 332 (805 nm)); *see* Ex. 1034 ¶ 38 (660 nm and 805 nm wavelengths were known to be used in PPG sensors); Ex. 1003 ¶¶ 32, 33.

Aceti's Figure 4 is reproduced below.

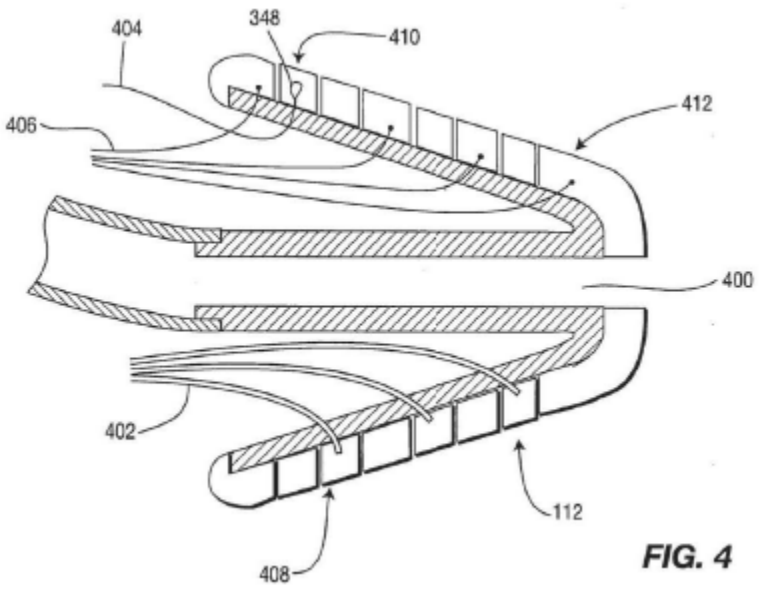


FIG. 4

Figure 4 depicts a section of first end 112 of conductor portion 104 for insertion into the wearer's auditory canal. Ex. 1031 ¶¶ 22, 33. Fiber optic cables 402 terminate in optically transparent elastomer 408 of first end 112 to allow the communication of light between fiber optic cable 402 and the auditory canal wall. *Id*. ¶ 33.

3. Fricke (Ex. 1016)

Fricke describes a method for obtaining physiological parameters and reducing artifacts by removing frequency bands from the signals that are outside of a range of interest using a band-pass filter. Ex. 1016 ¶ 53. Fricke's Figure 3 is reproduced below.

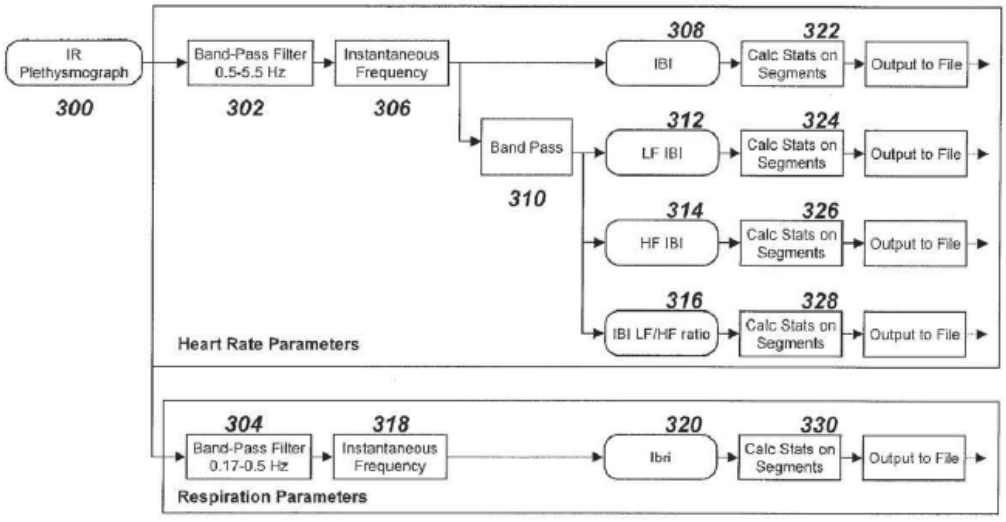


Fig. 3

Fricke's Figure 3 depicts band-pass filtering by band-pass filters 302 and 304. *Id*. Fricke explains that, once band-pass filtering is performed on IR plethysmograph parameters signals 300, additional filtering may be performed on the pre-conditioned (i.e., filtered) signals by, for example, instantaneous frequency computation component 306 or 318. *Id*. ¶¶ 53–55, 67–78, 92. Additional filtering may include Hilbert transform (IIR, FIR) filtering, Least Mean Square ("LMS") adaptive filtering (IIR), and Kalman filtering (IIR). *Id*. ¶¶ 54, 69, 92.

4. Comtois (Ex. 1032)

Comtois recognized that a significant factor limiting the accuracy of pulse oximetry is poor signal-to-noise ratio because PPG signals, from which SpO_2 and heart rate ("HR") measurements are derived, are compromised by movement artifacts. Ex. 1032, Abstract. Comtois teaches that "processing motion-corrupted PPG signals by least mean squares (LMS) and recursive least squares (RLS) algorithms can be effective to reduce

SpO_2 and HR errors during jogging, but the degree of improvement depends on filter order." *Id*.

Comtois's Figure 2 depicts the analysis of data acquired during jogging experiments and shows that adaptive noise cancellation ("ANC") implemented using LMS and RLS algorithms may improve the accuracy of a pulse oximeter. *Id*. at 1530. Thus, Comtois explains that the performance effectiveness of wearable physiological monitoring devices may be improved by applying algorithms to reduce limitations imposed by footstep-related motion (e.g., jogging) artifacts. *Id*. at 1531.

5. Analysis

a. Claim 14

Petitioner provides a mapping of the limitations of claim 14 on the teachings of Aceti. Pet. 38–42. In particular, Petitioner argues that Aceti teaches a wearable device, such as device 100, depicted in Aceti's Figure 2. *Id*. at 38 (citing Ex. 1031 ¶¶ 16–19, Fig. 2; *see* Ex. 1003 ¶ 111. The wearable device recited in claim 14 comprises (1) "a housing," and (2) "a chipset enclosed within the housing, the chipset comprising at least one PPG sensor, at least one motion sensor, and at least one signal processor." Ex. 1001, 32:2–5. Referring to Aceti's Figure 2, Petitioner further argues that Aceti teaches housing 106 of portion 102 or first end 112 of conductor portion 104 encompassing a set of electric and/or electronic components 110, including pulse oximetry sensor 302, accelerometer 306, pulse oximetry circuitry 336, signal processing circuitry 342, and processor 314. Pet. 38–41 (citing Ex. 1031 ¶¶ 17, 20, Fig. 1 and 3); *see* Ex. 1003 ¶ 113. Petitioner argues that a person of ordinary skill in the art "would have understood that Aceti's housing 106 (with cover 108) and conductor portion

104 collectively function as a casing that covers, encloses, supports, and protects electrical and/or electronic components 110, and would thus have considered processor portion 102, including housing 106 and cover 108, and conductor portion 104 a 'housing.'" Pet. 38 (citing Ex. 1003 ¶ 112); Reply 10–11; *see supra* Section II.A.3. Aceti teaches that device 100 includes processor portion 102 and conductor portion 104 that includes first end 112, configured for insertion in wearer's auditory canal and having optically transparent elastomer 408. Ex. 1031 ¶¶ 16, 33; *see* Ex. 1003 ¶ 125.

Referring to Aceti's Figure 3, Petitioner argues that Aceti's pulse oximetry sensor 302, which includes 660 nm LED 330, 805 nm LED 332, and photo diode 334, is a PPG sensor. Ex. 1031 ¶ 27; *see* Ex. 1003 ¶¶ 26–33, 104; Ex. 1034 ¶ 38 (describing a typical PPG sensor, in which "two different wavelengths of light (e.g. 660 and 805 nm) are applied to one side of a finger and the received intensity is detected on the opposite side after experiencing some absorption by the intervening vascular tissues"). Moreover, Aceti explains that its device may include one or more of the disclosed sensors. *See* Ex. 1031 ¶ 20. In addition, referring to Figure 4 (reproduced above), light emitted from LEDs 330 and 332 may be conducted via fiber optic cables 402 to optically transparent elastomer 408 and into the wearer's tissue. Ex. 1031 ¶¶ 27, 33; *see* Ex. 1003 ¶ 125. Similarly, light returning from the wearer's tissue passes through optically transparent elastomer 408 and is conducted to photo diode 334 via fiber optic cables 402. Ex. 1031 ¶¶ 27, 33; *see* Ex. 1003 ¶ 125. Consequently, Aceti teaches that "the housing comprises at least one window that optically exposes the at least one PPG sensor to a body of a subject wearing the device, and wherein the housing comprises non-air light transmissive

material in optical communication with the at least one PPG sensor and the window." Pet. 43–44.

As noted above, Aceti teaches that electric and/or electronic components 110 include processor 314 in housing 106. *See* Ex. 1031 ¶¶ 17, 22. Further, Aceti teaches that processor 314 "is configured to process signals from the sensors, present information (e.g., via the presentation device 312), and communicate information (e.g., via the data input/output circuitry 322/324 and the transceiver 320)." *Id*. ¶ 21. Petitioner acknowledges that "Aceti does not expressly disclose that the processor is configured to reduce motion artifacts." Pet. 41. Nevertheless, Petitioner argues that "processing signals from a motion sensor to reduce motion artifacts from a PPG sensor was an old and well-known technique at the time of the alleged invention" (*id*. (citing Ex. 1003 ¶ 121)) and that "Fricke's processor (*i.e.*, signal processing unit 114) is configured to remove motion artifacts from signals (*i.e.*, detector signal 112) produced by an optical detector (*i.e.*, photodetector 110) in response to signals produced by the motion sensor (*i.e.*, accelerometer 130) to improve the signal-to-noise ratio" (*id*. (citing Ex. 1016 ¶¶ 7, 44, 67–69); *see* Ex. 1003 ¶ 122). Thus, Fricke teaches the limitations of claim 14 missing from Aceti.

Petitioner further argues that a person of ordinary skill in the art would have had reason to combine the teachings of Aceti and Fricke "to add motion reduction signal processing like that of Fricke to Aceti's device." *Id*. at 41–42; *see* Ex. 1003 ¶¶ 122–124. Specifically, because the problem of motion artifacts in PPG signals was known (*see* Ex. 1003 ¶ 121) and because Aceti and Fricke are directed to the processing of PPG signals (*see* Ex. 1031 ¶ 27; Ex. 1016, Fig. 3), according to Petitioner, a person of ordinary skill in

the art would have had reason to use a known technique, such as that taught by Fricke, to improve a similar device to improve Aceti's monitoring device in a similar way. *Id*. at 42–43 (citing Ex. 1003 ¶¶ 123–124); *see KSR*, 550 U.S. at 417; *Ethicon*, 844 F.3d at 1351.

b. Patent Owner's Contentions

Patent Owner contends that Petitioner fails to demonstrate that the combined teachings of Aceti and Fricke render the device of challenged claim 14 obvious. In particular, Patent Owner contends that the combined teachings of Aceti and Fricke fail to teach or suggest all of the limitations of claim 14. PO Resp. 25–33. For the reasons discussed below, we disagree.

Patent Owner acknowledges that Aceti teaches a PPG sensor and motion sensor, but that it does not teach a processor that is configured to reduce motion effects. *Id*. at 27 (citing Ex. 1031 ¶¶ 27, 33). Patent Owner further acknowledges that Fricke teaches "the use of an accelerometer to sense motion and use this information to process the PPG signals to remove motion-related artifacts." *Id.* at 29 (citing Ex. 1016 ¶¶ 44, 67–69). Thus, as Petitioner argues, the combined teachings of Aceti and Fricke teach or suggest the "chipset," recited in claim 14. Pet. 38–42. Nevertheless, Patent Owner contends that the combined teachings of Aceti and Fricke fail to teach or suggest "a window that optically exposes a PPG sensor to the body of a subject *and* a chipset in the *same* housing." PO Resp. 29.

Although Patent Owner does not dispute our construction of the term "housing" (*see supra* Section II.A.3.) which includes "one or more parts that covers, encloses, supports, or protects," Patent Owner contends that the recitations of claim 14 require that the "chipset," the "at least one window," and the "non-air light transmissive material" must be within the *same*

"housing" (*id.* at 29–30). Petitioner relies on Aceti to teach or suggest this arrangement (Pet. 38–40, 43–44), but Patent Owner contends Aceti teaches that these components are contained in processing portion 102 and/or conductor portion 104 and that these portions are *different* housings. PO Resp. 30–31.

In particular, Patent Owner contends that these portions are different housings because (1) conductor portion 104 is removably coupled to processing portion 102 (PO Resp. 31 (citing Ex. 1031 ¶ 16)), (2) each part of the alleged housing does not perform each of the recited functions (*id.* (citing Ex. 2010 ¶ 96)), and (3) the parts of the alleged housing may be made from different materials (*id.* at 32–33 (citing Ex. 2010 ¶¶ 97, 98)). We do not find these contentions persuasive.

First, Patent Owner's contention that conductor portion 104 can only be removably coupled to processor portion 102 is incorrect. As noted above, Aceti discloses that "conductor portion 104 is removably coupled to the processor portion 102 and is considered disposable" only in an *exemplary* embodiment. Ex. 1031 ¶ 16. Thus, Aceti is understood to teach embodiments, in which conductor portion 104 is not removably coupled to processing portion 102. Consequently, we are not persuaded by Patent Owner's argument that Aceti's device *requires* that conductor portion 104 and processor portion 102 are removably coupled. Moreover, Patent Owner's declarant testified that the Specification of the '941 patent does not limit the disclosed device's housing to removable or fixed components. Ex. 1070, 133:14–134:19. We credit this testimony. Therefore, even if conductor portion 104 is removable from processor portion 102, that is not

sufficient to distinguish Aceti's housing teachings from the housing recited in claim 14.

Second, Patent Owner contends that, "[w]hile the Board's construction permits the housing to be comprised of 'one or more parts,' those parts must cover, enclose, support, or protect the claimed components." PO Resp. 31. This incorrectly suggests that *each* part of the housing must perform *each* of the recited functions of the housing. Patent Owner's contention shows a misunderstanding of our construction of the term "housing." We construed the term "housing" to mean "one or more parts that covers, encloses, supports, or protects; [a] casing." *See supra* Section II.A.3. Thus, the one or more parts comprising the housing, *alone or together*, covers, encloses, supports, or protects the housed items; and, to the extent permitted by the claim language, different parts comprising a housing may perform different functions. As Petitioner argues, "[a] POSA would have understood that Aceti's housing 106 (with cover 108) and conductor portion 104 *collectively function* as a casing that covers, encloses, supports, and protects electrical and/or electronic components 110, and would thus have considered housing 106 and conductor portion 104 a 'housing.'" Pet. 38 (emphasis added, citing Ex. 1003 ¶ 112); *see* Reply 10–11. Patent Owner's declarant testifies that different parts may form the housing. Ex. 1070, 131:11–133:13. Again, we credit this testimony. Therefore, just as different parts of the body of an automobile enclose the engine, the passenger compartment, and the trunk; the "housing" comprising Aceti's processor portion 102 and conducting portion 104 enclose the pulse oximetry sensor 302, accelerometer 306, pulse oximetry circuitry 336, signal processing circuitry 342, and processor 314, i.e., the "chipset"; fiber optic

cables 402 and 406, i.e., the "non-air light transmissive material"; and optically transparent elastomer 408, i.e., the "windows."

Third, Patent Owner contends that, because "first end 112 is configured for comfort, biocompatibility, durability, and ease of manufacture," a person of ordinary skill in the art "would have considered elastomer 408 to comprise *a different housing or to sit atop the housing comprised of housing 106 and conductor 104*." PO Resp. 32 (emphasis added, citing Ex. 2010 ¶¶ 97, 98). Nevertheless, because different parts of the housing may perform different functions, those parts may be made of materials tailored to their function. Reply 11–12. Patent Owner's declarant testified that the parts of a housing need not be made from the same material. Ex. 1070, 159:19–160:2. Once again, we credit this testimony. Returning to our automobile body analogy, an automobile body may comprise parts made from steel, aluminum, and polymers, depending upon their function, but *together* they form the automobile body. Although the parts of the housing may be made from different materials, we are not persuaded that this prevents the parts to collectively serve as a housing.

Accordingly, we are persuaded that Petitioner demonstrates by a preponderance of the evidence that the combined teachings of Aceti and Fricke teach or suggest all of the limitations of claim 14 and demonstrates sufficiently that a person of ordinary skill in the art would have had reason for combining the teachings of Aceti and Fricke to achieve the device recited in claim 14 of the '941 patent.

c. Claims 15–19 and 21

Petitioner argues that claims 15–19 and 21 also are rendered obvious over the combined teachings of Aceti and Fricke and provides a mapping of

the reading of the additional limitations of these dependent claims on the combined teachings of Aceti and Fricke, as follows:

Claim	Limitation	Applied Teachings
15	"wherein the non-air light transmissive material comprises at least one light guide in optical communication with the at least one PPG sensor and the window"	Aceti teaches that connector portion 104 includes fiber optic cables 402 in optical communication with pulse oximeter 302, including photodetector diode 334, and optically transparent elastomer 408. Ex. 1031 ¶¶ 27, 33, Fig. 4; *see* Pet. 44 (citing Ex. 1003 ¶ 127).
16	"wherein the wearable device is an earbud"	Referring to its Figure 2, Aceti discloses that exemplary monitoring device 100 may be inserted into the auditory canal of a wearer. Ex. 1031 ¶ 19. Petitioner argues that a person of ordinary skill in the art would understand this to teach an earbud." Pet. 44 (citing Ex. 1003 ¶ 128).
17	"wherein the wearable device is a headset"	Referring to its Figure 2, Aceti discloses that exemplary monitoring device 100 may be positioned relative to ear 202 on head 204 of a wearer. Ex. 1031 ¶ 19. Petitioner argues that a person of ordinary skill in the art would understand this to teach a "headset." Pet. 44 (citing Ex. 1003 ¶ 128).
18	"wherein the at least one processor is configured to reduce motion artifacts by removing frequency bands	Referring to its Figure 3, Fricke discloses using band-pass filters 302 and 304 to reduce motion artifacts and produce a

	from the signals that are outside of a range of interest using at least one band-pass filter to produce preconditioned signals"	preconditioned signal. Ex. 1016 ¶ 53. Thus, Petitioner argues that Fricke teaches removing frequency bands from signals that are outside a range of interest using band-pass filtering. Pet. 45 (citing Ex. 1003 ¶¶ 108, 130).
19	"wherein the at least one processor is configured to filter the preconditioned signals via at least one of the following: FIR (Finite Impulse Response) filtering, IIR (Infinite Impulse Response) filtering, *adaptive filtering. phase filtering, and frequency filtering*" (emphasis added)	Fricke teaches that, after band-pass filtering is performed, additional filtering may be performed on the band-pass filtered signals by, for example, instantaneous frequency computation component 306 or 318. Ex. 1016 ¶¶ 55, 92. Such additional filtering may include low-band filtering, and high-pass filtering, Hilbert transform, LMS adaptive filtering, Kalman filtering, and matched filtering. *Id.* Thus, Fricke teaches at least adaptive filtering, phase filtering, and frequency filtering. Pet. 45–46 (citing Ex. 1003 ¶¶ 109, 110, 130–134).
21	"wherein the *at least one motion sensor comprises* at least one of the following: an optical sensor, an inertial sensor, an electrically conductive sensor, a capacitive sensor, an inductive sensor, *an accelerometer*, and a blocked channel sensor" (emphases added)	Aceti discloses that the motion sensor comprises at least one accelerometer. Ex. 1031 ¶ 29, Fig. 3; *see* Pet. 47 (citing Ex. 1003 ¶ 137).

Pet. 44–47 (citing Ex. 1003 ¶¶ 127–137).

Patent Owner does not contest this mapping, but, instead, contends that Petitioner fails to demonstrate the combined teachings of Aceti and Fricke teach or suggest all of the limitations of the base claim, claim 14. PO Resp. 2; Reply 12; *see supra* Section II.C.5. For the reasons set forth above, we are persuaded that Petitioner has demonstrated that the combined teachings of Aceti and Fricke teach or suggest all of the limitations of claim 14, as well as those of claims 15–19 and 21, and provides sufficient reason to have combined the teachings of Aceti and Fricke. Pet. 38–44. Thus, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence claims 15–19 and 21 are unpatentable under 35 U.S.C. § 103(a) as rendered obvious by the combined teachings of Aceti and Fricke.

d. Claim 20

Petitioner argues that claim 20 is rendered obvious over the combined teachings of Aceti, Fricke, and Comtois and provides a mapping of the additional limitations of this dependent claim on the combined teachings of Aceti, Fricke, and Comtois. Pet. 47–50 (citing Ex. 1003 ¶¶ 138–143). In particular, claim 20 recites that "the subject motion artifacts comprises subject footstep-related motion artifacts" (Ex. 1001, 32:34–35) and that, although "Aceti and Fricke do not expressly mention removing footstep-related motion artifacts" (Pet. 47), Comtois teaches processing PPG signals to remove such artifacts (Ex. 1032, Abstract, 1530, Fig. 2). *See* Ex. 1003 ¶¶ 141–142. Further, Petitioner argues that, because Fricke and Comtois teach similar processing techniques to remove artifacts, a person of ordinary skill in the art would have had reason to combine their teachings to achieve the device as recited in claim 20. Pet. 50 (citing Ex. 1003 ¶ 143).

Patent Owner does not contest this mapping, but, instead, contends that Petitioner fails to demonstrate an adequate reason to have combined the teachings of Aceti and Fricke to achieve the device recited in the base claim, claim 14, of challenged claim 20. PO Resp. 2; Reply 12; *see supra* Section II.C.5. For the reasons set forth above, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence claim 20 is unpatentable under 35 U.S.C. § 103(a) as rendered obvious by the combined teachings of Aceti, Fricke, and Comtois.

e. Summary

For the reasons set forth above, we are persuaded that Petitioner demonstrates by a preponderance of the evidence that claims 14–21 of the '941 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over Aceti and Fricke, alone or in combination with Comtois.

D. Unpatentability of Challenged Claims

In consideration of the above, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claims 14–21 of the '941 patent are unpatentable based on the challenges asserted in the Petition. Specifically Petitioner has demonstrated by a preponderance of the evidence that:

References	**Basis**	**Challenged Claim(s)**	**Determination**
Kosuda and Maekawa	35 U.S.C. § 103(a)	14, 15, and 21	Unpatentable
Kosuda, Maekawa, and Han	35 U.S.C. § 103(a)	18–20	Unpatentable
Aceti and Fricke	35 U.S.C. § 103(a)	14–19 and 21	Unpatentable
Aceti, Fricke, and Comtois	35 U.S.C. § 103(a)	20	Unpatentable

III. MOTION TO AMEND

In an *inter partes* review, amended claims are not added to a patent as of right, but rather must be proposed as a part of a motion to amend. 35 U.S.C. § 316(d). We must assess the patentability of the proposed substitute claims "without placing the burden of persuasion on the patent owner." *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017). Thus, we determine whether the preponderance of the evidence based on the entirety of the record shows that the substitute claims are unpatentable. Patent Owner's proposed substitute claims still must meet the statutory requirements of 35 U.S.C. § 316(d) and the regulatory requirements of 37 C.F.R. § 42.121. *See* "Guidance on Motions to Amend in view of *Aqua Products*" (Nov. 21, 2017).[11] Accordingly, Patent Owner must demonstrate (1) the amendment responds to a ground of unpatentability involved in the review; (2) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter; (3) the amendment proposes a reasonable number of substitute claims; and (4) the original disclosure sets forth written description support for each proposed claim. *See* 35 U.S.C. § 316(d)(2) and (3); 37 C.F.R. § 42.121.

A. Proposed Substitute Claims

Patent Owner filed a contingent motion to substitute independent claim 22 for claim 14, if found unpatentable; to substitute dependent claim 26 for claim 18, if found unpatentable; and to substitute claims altering the

[11] The guidance memorandum is publicly available at https://www.uspto.gov/sites/default/files/documents/guidance_on_motions_to_amend_11_2017.pdf

dependencies of claims 15–17, 19, and 21 from claim 14 to claim 22 and the dependency of claim 27 from claim 18 to claim 26, if the claims from which they depend are found unpatentable. MTA 23–25 (App'x A). In particular, Patent Owner proposes to limit claim 14 by reciting that the

> at least one signal processor [is] configured to process signals from the at least one motion sensor and signals from the at least one PPG sensor to reduce motion artifacts from the PPG signals and <u>to extract physiological and motion parameters</u>;
>
> <u>wherein the at least one signal processor configured to process data to be output, wherein the output data comprises physiological information and motion related information, and wherein the output data is parsed out such that an application-specific interface (API) can utilize the physiological information and motion-related information for an application</u>;

and to limit claim 18 by also reciting that the at least one processor is configured "<u>to generate the parsed output data by executing one or more processing methods to provide information that is fed into a multiplexed output serial data string of motion-related and physiological information</u>." MTA 23–25 (App'x A) (added limitations underlined).

Because the sole substitute independent claim, claim 22, includes additional limitations that were not part of the challenged claims and includes all of the limitations of challenged claim 14, we are persuaded that the substitute claims do "not enlarge the scope of the claims of the patent." 35 U.S.C. § 316(d)(3); *see* 37 C.F.R. § 42.121(a)(2)(ii). Moreover, because Patent Owner proposes only one substitute claim for each of the challenged claims, we are persuaded that Patent Owner has proposed a reasonable number of substitute claims. 37 C.F.R. § 42.121(a)(3) ("The presumption is that only one substitute claim would be needed to replace each challenged claim").

B. Responsiveness to a Ground of Institution

Our Rules provide that "[a] motion to amend may be denied where: (i) The amendment does not respond to a ground of unpatentability involved in the trial." 37 C.F.R. § 42.121(a)(2)(i). Patent Owner makes the general statement that "[t]he references asserted in this *Inter Partes* Review, and all other references known to [Patent Owner], fail to anticipate or render the substitute claims obvious. *See Nike, Inc. v. Adidas AG*, 812 F.3d 1326, 1350-51 (Fed. Cir. 2016)." MTA 2. Nevertheless, Patent Owner does not explain how the substitute claims are distinguishable over the combinations of references upon which we instituted review or, in fact, even mention Kosuda, Maekawa, Han, Aceti, Fricke, or Comtois in its Motion to Amend. *See id.* at ii, iv.

Petitioner contends that Patent Owner's Motion to Amend is not responsive to any ground of unpatentability involved in the review because the Motion to Amend does not discuss the Kosuda, Maekawa, Aceti, or Fricke. MTA Opp. 4–5 (citing *Aqua Prod.*, 872 F.3d at 1341 (Reyna J. concurring)); *see supra* Section I.E. Although the Motion to Amend includes a heading entitled "The Claim Amendments Overcome the Asserted Grounds of [Un]Patentability," the Motion to Amend contains only the most conclusory statements in this regard and provides no analysis or evidence in support of this assertion. MTA 11–12. Instead, Patent Owner identifies and attempts to distinguish the substitute claims over other references. *Id.* at 12–20. Although we do not place the burden of persuasion on the Patent Owner, Patent Owner's silence provides no information as to how the proposed claim amendments distinguish over the applied references in the challenges on which we instituted *inter partes* review. Thus, the

significance of the amendments in the substitute claims in the context of the challenges presented in the Petition is somewhat unclear.

In its Reply to Petitioner's Opposition to Motion to Amend, Patent Owner contends that as long as the substitute claims are responsive to a ground of unpatentability involved in the review, the requirements of our Rules have been satisfied. MTA Reply 12 (quoting 37 C.F.R. § 42.121(a)(2)). Patent Owner further contends that "[t]he Patent Trial and Appeal Board in *Idle Free* clarified this requirement stating, '[a] proposed substitute claim is not responsive to an alleged ground of unpatentability of a challenged claim if it does not either include or narrow each feature of the challenged claim being replaced.'" *Id.* at 12 (quoting *Idle Free Sys., Inc. v. Bergstrom, Inc.*, Case IPR2012-00027, slip op. at 5 (PTAB June 11, 2013) (Paper 26) ("*Idle Free*")[12]). The fact that the substitute claim is narrowing is a necessary, but not a sufficient, condition for distinguishing the substitute claims over a ground of unpatentability involved in the review. *See* MTA Sur-Reply 1 (citing *Blackberry Corp. v. MobileMedia Ideas LLC*, Case IPR2013-00016, slip op. at 15–18 (PTAB Feb. 25, 2014) (Paper 32)). Nevertheless, Patent Owner explains in its Reply to Petitioner's Opposition to Motion to Amend how it believes these substitute claims are distinguishable over the combined teachings of Kosuda and Maekawa, alone or in combination with Han, and of Aceti and Fricke, alone or in combination with Comtois. MTA Reply 7–10; *see id.* at 7 n.2. Thus, although Patent Owner did not address these grounds in its Motion to

[12] Although *Idle Free* was designated as "informative" at the time of the briefing in this case, *Idle Free* was de-designated as "informative" on June 1, 2018.

Amend, we find that Patent Owner has adequately explained how the proposed, substitute claims respond to the grounds of unpatentability involved in the review. *See Western Digital Corp. v. SPEX Tech., Inc.*, IPR2018-00082, slip op. at 5–7 (PTAB Apr. 25, 2018) (Paper 13) (informative)[13] ("*Western Digital*") ("Thus, in considering the motion, we review the entirety of the record to determine whether a patent owner's amendments respond to a ground of unpatentability involved in the trial.").

C. Written Description Support

Our Rules further require that "[a] motion to amend claims must . . . set forth: (1) The support in the original disclosure of the patent for each claim that is added or amended; and (2) The support in an earlier-filed disclosure for each claim for which benefit of the filing date of the earlier filed disclosure is sought." 37 C.F.R. § 42.121(b). Patent Owner contends that the substitute claims are supported by the Specification of the '941 patent application (Ex. 2116 (the "'941 Application")); its parent application, U.S. Patent Application No. 12/691,388, now U.S. Patent No. 8,700,111 B2 (filed on Jan. 21, 2010, the "'111 Application") (Ex. 2108); and U.S. Provisional Application No. 61/274,191 (filed on Aug. 14, 2009, the "191 Prov. Application") (Ex. 2109), from which the '941 patent claims earliest priority. MTA 4. In support of its contention, Patent Owner

[13] This order was designated as "informative" on June 1, 2018. "An informative opinion is not binding authority," but may identify "Board norms on recurring issues," "guidance on issues of first impression," and/or "guidance on Board rules and practices." PTAB SOP 2, rev. 9 (Sec. IV). Consequently, neither *Idle Free* nor *Western Digital*, or the de-designation of one as informative or the designation of the other, is determinative of the outcome of this case.

provides a claim chart juxtaposing the recitations of substitute claims 22 and 26 with lists of citations from the '941 Application, the '111 Application, and the 191 Prov. Application, which allegedly provide "Exemplary Support." *Id.* at 4–7. Patent Owner provides no argument or further explanation in the Motion to Amend of how the cited text provides written support for the proposed, substitute claims.

Petitioner argues that Patent Owner's claim charts, including bare citations to applications in the priority chain of the '941 patent, without further argument or explanation, fails to satisfy the requirement that Patent Owner identify written description support for the substitute claims under 37 C.F.R. § 42.121(b). MTA Opp. 1–2. As the Board has previously determined, "the motion should account for the claimed subject matter as a whole, i.e., the *entire* proposed substitute claim, when showing where there is sufficient written description support for each claim feature." MTA Sur-Reply 2–3 (quoting *Facebook, Inc. v. B.E. Tech., LLC.*, Case IPR2014-00052, slip op. at 27 (PTAB Mar. 31, 2015) (Paper 45); *aff'd*, *B.E. Tech., L.L.C. v. Google, Inc.*, No. 2015-1827, 2016 WL 6803057, at *7 (Fed. Cir. Nov. 17, 2016) (citing *Respironics, Inc. v. Zoll Med. Corp.*, Case IPR2013-00322, slip op. at 24 (PTAB Sept. 17, 2014) (Paper 46) ("Zoll's string citations amount to little more than an invitation to us (and to Respironics, and to the public) to peruse the cited evidence and piece together a coherent argument for them. This we will not do; it is the province of advocacy.")[14],

[14] *See Stampa v. Jackson*, 78 USPQ2d 1567, 1571 (BPAI 2005) (quoting *Ernst Haas Studio, Inc. v. Palm Press, Inc.*, 164 F.3d 110, 111–12 (2d Cir. 1999) ("Appellant's Brief is at best an invitation to the court to scour the record, research any legal theory that comes to mind, and serve generally as an advocate for appellant. We decline the invitation.")).

vacated and remanded on other grounds, 656 Fed. Appx. 531, 534 (Fed. Cir. 2016)).

In its Reply to Petitioner's Opposition to the Motion to Amend, Patent Owner chose not to explain the relevance of the citations set forth in its claim chart, but, instead, to contend that the bare listings of citations were adequate to satisfy the requirement in our Rules that Patent Owner establish written description support for the substitute claims. MTA Reply 10. Moreover, Patent Owner characterizes its amendments to claims 14 and 22 as not presenting "extensive modifications" and its showing of support as containing multiple, string citations, rather than a single, string citation. *Id.* at 11. Patent Owner also cites decisions in which Board panels have accepted tables of citations as an adequate showing of written description support for substitute claims. *Id.* at 10. Thus, Patent Owner maintains that its attempt to show written description support is distinguishable from the unsuccessful attempts described in the decisions cited by Petitioner. *Id.* at 11; *see* MTA Sur-Reply 2–3.

Our Rules do not state that a claim chart in the motion to amend listing bare citations is or is not adequate to show written description support in a motion to amend. *See* 37 C.F.R. § 42.121(b).[15] Nevertheless, Petitioner objects primarily to the *form* by which Patent Owner attempts to show

[15] In *Western Digital*, the panel states that "[t]he motion to amend itself, not the claim listing . . . , must set forth the written description support. In addition, the motion must set forth written description support for each proposed substitute claim as a whole, and not just the features added by the amendment." *Western Digital* at 8 (citation omitted). Because the claim listing does not count toward page limits, the panel further states in the "*Claim Listing*" section of the order: "All arguments and evidence in support of the motion to amend shall be in the motion itself." *Id.* (Sec. 6).

written description support, rather than to the *showing* itself. MTA Opp. 1–2; MTA Sur-Reply 2–3. Here, we find that Patent Owner has made a sufficient *and substantially unrebutted* showing of written description support for the substitute claims.

D. Obviousness Analysis

1. Overview

Patent Owner asserts that each of the substitute claims is patentable over "the references asserted in this *Inter Partes* Review, and all other references known to [Patent Owner]." MTA 2. In particular, Patent Owner asserts that the substitute claims are patentable over U.S. Patent Application Publication No. 2008/0200774 A1 to Luo (Ex. 2126); U.S. Patent No. 6,513,532 B2 to Mault *et al.* (Ex. 2136); U.S. Patent Application Publication No. 2008/0133699 A1 to Craw *et al.* (Ex. 2127 ("Craw")); U.S. Patent Application Publication No. 2003/0181798 A1 to Al-Ali (Ex. 2137); and R.G. Lee *et al.*, "A Mobile Care System With Alert Mechanism," IEEE Transactions on Information Technology in Biomedicine, Vol. 11, Issue 5, September 2007 (Ex. 2138), alone or in combination with other references. MTA 13. Petitioner does not contest these assertions, but, instead, argues that the claims are rendered obvious over Kosuda, Maekawa, and Gupta, alone or in combination with Han, or over Aceti, Fricke, and Craw, alone or in combination with Comtois. MTA Opp. 12–25. Therefore, we address only Petitioner's challenges to the substitute claims below. *See Aqua Prods.*, 872 F.3d at 1327–28 (the patent owner does not bear the burden of persuasion with respect to patentability); *Western Digital* at 3–4.

2. Claim Construction

Patent Owner acknowledges that we apply the broadest reasonable interpretation to the terms of the substitute claims and states that "no additional claim terms need construction beyond the terms previously construed by the Board in its Decision to Institute." MTA 11; *see supra* Section II.A. Although Patent Owner relies in part on the addition of the term "application-specific interface (API)" to distinguish the substitute claims over the identified references (MTA 8–10, 12–19), Patent Owner does not construe this term (*id.* at 10–11; *see* MTA Opp. 2–3). Although Patent Owner contends that we construed the term "application-specific interface (API)" in the related proceeding, IPR2017-00319, we did not. *See* MTA Reply 1; Tr. 34:19–25.

In the related proceeding, Petitioner argued that there was a typographical error in the term "application-*specific* interface (API)" and that this term should be read as "application *programming* interface (API)."[16] IPR2017-00319, Paper 2, 14–15; *see* Tr. 18:11–18. Patent Owner proposed no alternative construction in that proceeding, but objected to Petitioner's proposed construction. IPR2017-00319, Paper 6, 13. We rejected Petitioner's proposed construction for three reasons. First, because the term was used consistently in the claims and the Specification of the '941 patent, we were not persuaded that Petitioner had shown that the use of a known abbreviation, "API," demonstrated that the term contained a

[16] Petitioner argued that, unlike "application-specific interface (API)," "application programming interface (API)" has a well-known meaning and "API" is a common abbreviation for the well-known term. *See* MICROSOFT COMPUTER DICTIONARY, 33 (5th ed. 2002) (Ex. 3002).

typographical error. IPR2017-00319, Paper 10, 8–10. Second, we were not persuaded that we should prefer extrinsic evidence, which allegedly supported Petitioner's proposed construction, over intrinsic evidence, which did not. *Id.* at 10–11. Third, we determined that Petitioner's proposed construction for the term was inconsistent with the explanation of the meaning of the term in the Specification of the '941 patent. *Id.* at 11–12. Thus, although we rejected Petitioner's proposed construction, we determined that it was not necessary for us to construe the term ourselves in order to deny institution of Petitioner's challenges to claim 3 of the '941 patent. *Id.* at 12; *see* IPR2017-00319, Paper 13, 2 ("the Board did not provide an actual definition for 'application specific interface (API)' in the Institution Decision"); IPR2017-00319, Paper 15, 5–6. ("[W]e were not persuaded by Petitioner's proposed construction; and, because Petitioner's arguments with respect to the unpatentability of claim 3 are based on that construction, we were not persuaded that Petitioner had shown a reasonable likelihood of prevailing in showing the unpatentability of claim 3 on the grounds asserted."). Thus, because we found Petitioner's proposed construction of the term "application-specific interface (API)" to be deficient in IPR2017-00319, we determined that Petitioner's challenges to claim 3 based on that deficient construction could not succeed. At the time, it was not necessary for us to construe this term which appeared only in a claim upon which we did not institute review, and we did not construe this term. *See SAS Inst.*, 138 S. Ct. at 1354.

In context of the substitute claims presented in the Motion to Amend, we now must consider the construction of the term "application-specific interface (API)." Although Patent Owner has provided us with arguments

and evidence regarding the construction of this term, Patent Owner does not state what this term means or even what it believes that we construed this term to mean. MTA 7–11.

> The Specification of the '941 patent states that:
>
> The multiplexed data outputs 604 may be a serial data string of activity and physiological information 700 (FIG. 18) parsed out specifically *such that an application-specific interface (API) can utilize the data as required for a particular application*. The applications may use this data to generate high-level assessments, such as overall fitness or overall health. Furthermore, the individual data elements of the data string can be used to facilitate better assessments of other individual data elements of the data string.

Ex. 1001, 26:15–23 (emphasis added, referring to Fig. 17); *see* MTA 8–9. The Specification of the '941 patent gives examples of these "particular applications," e.g., a "Blood Flow" application for determining first and second derivatives of each blood pulse and an application to determine "blood volume over each blood pulse." Ex. 1001, 26:23–31. Referring to the Abstract of the '941 patent, Patent Owner contends that "[o]nce the data string is obtained, it is parsed such that an application specific interface can use both sets of data to generate statistical relationships between the physiological parameters and the physical activity parameters." MTA 8. Specifically, the Abstract of the '941 patent states that "[t]he serial data string is parsed out such that an *application-specific interface* can utilize the physiological information and motion-related information for an application that generates statistical relationships between subject physiological parameters and subject physical activity parameters in the physiological information and motion-related information." Ex. 1001, [57] (emphasis

added). None of Patent Owner's arguments or evidence, however, amounts to a construction of this term.

Petitioner argues that Patent Owner does not present any specific construction of the term "application-specific interface (API)." MTA Opp. 2–3. We agree. Moreover, Petitioner argues that Patent Owner and its declarant have taken inconsistent positions regarding the meaning of this term. *Id.* Again, we agree.

In IPR2017-00319, Petitioner argued that the term "application-specific interface (API)" in claim 3 of the '941 patent should be construed as "application programming interface (API)." IPR2017-00319, Paper 2, 14–15. Petitioner explained that "[a]n API specifies how components should interact with each other. In practice, an API is often a library that includes specifications for routines, data structures, object classes, and variables. APIs are thus characterized by their broad applicability to different applications—and not 'application specific' as such." *Id.* at 14 (citations omitted); *see* MICROSOFT COMPUTER DICTIONARY at 33 (defining "application programming interface" as "[a] set of routines used by an application program to direct the performance of procedures by the computer's operating system") (Ex. 3002). As noted above, we rejected this construction as inconsistent with the Specification of the '941 patent, which describes "an application-specific interface (API) can utilize the data as required for a particular application." Ex. 1001, 26:17–19; *see* MTA Opp. 2–3. Nevertheless, Patent Owner now contends that Figure 17 of the '941 patent "teaches how to create a serial data string by pulling multiple metrics from the sensors by outside *Application Programming Interfaces ('APIs')*." PO Resp. 4 (emphasis added); Tr. 20:15–21; *see* Ex. 2010 ¶ 40;

Ex. 1070, 125:3–128:24; *but see* Tr. 34:4–18. We find this Patent Owner contention, as well as the cited testimony of its declarant, to be inconsistent with the Specification of the '941 patent. Moreover, despite its rejection of Patent Owner's arguments and evidence regarding the construction of this term, Petitioner offers essentially the same, previously rejected, construction of this term. MTA Opp. 8–9; *see* Ex. 1072 ¶¶ 30–35.

After considering the parties' arguments and the cited evidence, especially, the Specification of the '941 patent and the ordinary meaning of the word "interface" in this field,[17] *in the context of substitute claim 22*, we construe the term "application-specific interface (API)" to mean "an interface which enables a particular application to utilize data obtained from hardware, such as the at least one motion sensor and the at least one PPG sensor." Because substitute claims 23–29 depend from independent, substitute claim 22, this construction also applies to those claims. In light of this construction, we now consider Petitioner's challenges to the substitute claims.

3. Obviousness Over Kosuda, Maekawa, and Gupta, Alone or in Combination with Han

Petitioner argues that claim 22, 23, and 26–29 are unpatentable under 35 U.S.C. § 103(a) as obvious over Kosuda, Maekawa, and Gupta, alone or in combination with Han. MTA Opp. 12–16. To support its argument, Petitioner provides a mapping of the limitations of claims 22 and 26 to

[17] A relevant definition of "interface" is "[s]oftware that enables a program to work with the user (the user interface, which can be a command-line interface, menu-driven interface, or a graphical user interface), with another program such as the operating system, or with the computer's hardware." MICROSOFT COMPUTER DICTIONARY at 279–80 (Ex. 3002).

structures taught or suggested by Kosuda, Maekawa, and Gupta and by Kosuda, Maekawa, Gupta, and Han, respectively. *Id.* Petitioner also cites Dr. Sarrafzadeh's Declaration for support. *See* Ex. 1072 ¶¶ 53–90. Patent Owner limits is response to these arguments to the challenges to independent claim 22. MTA Reply 7–8.

We begin our analysis of these grounds of unpatentability with a review of the Gupta.

a. Gupta (Ex. 1045)

Gupta is entitled "Design of a Low-cost Physiological Parameter Measuring and Monitoring Device" and teaches a monitoring device used to measure physiological parameters, such as motion (e.g., fall impact) and heart rate, of a human subject. Ex. 1045, Abstract. Gupta's Figure 1 is reproduced below.

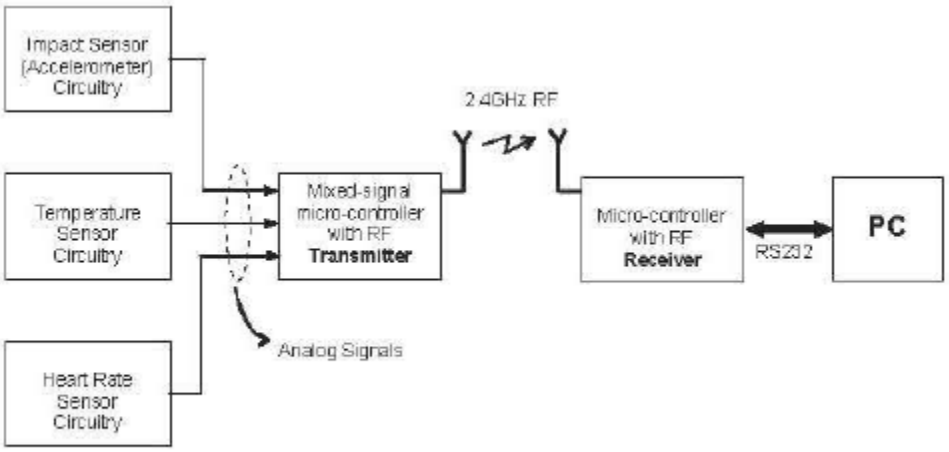


Fig. 1. Functional block diagram of the system hardware

Figure 1 depicts a physiological parameter measurement and monitoring system. *Id.* at 2; Ex. 1072, ¶48. The system includes of three sensors: a temperature sensor, a heart rate sensor, and an impact sensor. Ex. 1045, 2. Each of the sensor circuitries used in this system generates analog voltages

which are fed as Analog-to-Digital converter ("ADC") inputs to the microcontroller. *Id.* The ADC inputs are time-multiplexed and sampled at different rates, then encoded by the microcontroller to generate a packet of heart rate, skin temperature, and impact information. *Id.* at 2, 4; *see* Ex. 1072 ¶ 51.

Gupta's Figure 5 is reproduced below.

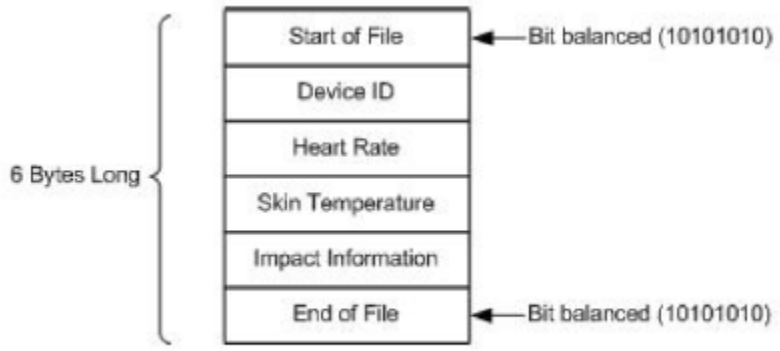


Fig. 5. Data packet composition

Figure 5 depicts the composition of a data packet. Data packets are sent to the receiver, which is connected to a personal computer ("PC") and which is constantly receiving data packets. Ex. 1045, 4; *see* Ex. 1072 ¶ 52. "A program, running on the PC, receives the packetized information from [a] serial port, decodes the packet and then displays this information on the PC monitor." Ex. 1045, 4. When the readings from the patient exceed a threshold, an alarm is issued. *Id.*; *see* Ex. 1072 ¶ 52.

b. Claim 22

We determine above, that the combined teachings of Kosuda and Maekawa teach or suggest all of the limitations of original claim 14. *See supra* Section II.B.5. Claim 22 includes all of the limitations of claim 14 and adds certain additional limitations. In the Petition, Petitioner argues that

Kosuda teaches MPU 24/signal processing circuit 17 is configured to process signals from triaxial acceleration sensor 12, i.e., at least one motion sensor, and from pulse wave sensor 13, i.e., at least one PPG sensor, in order to reduce motion artifacts from the PPG signals. *See* Pet. 24.

MPU 24/signal processing circuit 17 performs a type of frequency analysis on the residual data, extracts the harmonic components of the pulse wave, and calculates the pulse rate from the frequency. Ex. 1027 ¶¶ 151–152. Thus, MPU 24/signal processing circuit 17 is configured to extract pulse rate, i.e., a physiological parameter, from its pulse wave signal, i.e., a PPG signal. Ex. 1072 ¶¶ 64–67.

Nevertheless, Petitioner acknowledges that although MPU 24/signal processing circuit 17 monitors the motion signal from the motion sensor to reduce motion artifacts, Kosuda does not teach that the MPU 24/signal processing circuit 17 is configured to extract a particular motion parameter. MTA Opp. 13. Moreover, although Kosuda teaches that MPU 24/signal processing circuit 17 is configured to process data as output, and that this output data comprises physiological information, Petitioner acknowledges Kosuda does not teach that the output data includes motion-related information or that the output data is parsed[18] out, such that an application-specific interface (API) can utilize the physiological information and motion-related information for a particular application. *Id.* (citing Ex. 1072 ¶ 68).

[18] The verb "to parse" means "[t]o break input into smaller chunks so that a program can act upon the information." MICROSOFT COMPUTER DICTIONARY at 392 (Ex. 3002); *see* Tr. 37:12–17.

Like Kosuda, Gupta teaches a wrist-worn pulse monitoring device that includes a heart rate sensor, i.e., a PPG sensor; a temperature sensor; and an accelerometer, i.e., a motion sensor, to monitor impacts. Ex. 1045, 2; *see* Ex. 1072 ¶ 69 (Gupta's monitoring device also uses photoplethysmography to measure heart rate). Further, "Gupta's processor is configured to process signals from the motion sensor to determine a fall detection parameter (i.e., a motion parameter) for transmission to a remote computer." MTA Opp. 13–14 (citing Ex. 1045, 2; Ex. 1072 ¶¶ 69–71).

Petitioner argues that

> Gupta's system receives the pulse signal and accelerometer data from the sensors in a time-division multiplexed manner, and processes the data to provide a data packet (serial data string) of heart rate and impact (motion) information. Ex. 1045, pp. 2–4, FIG. 5; Ex. 1072, ¶70. The data is output to a receiving unit. Ex. 1072, ¶70. The data is arranged such that an application specific interface can decode the packet and a particular application can display the information from the packet. *Id.* The application program may also raise an alarm when the readings exceed a threshold. *Id.*

MTA Opp. 14.

Patent Owner contends that Petitioner relies on Gupta to teach that "the data includes motion-related information or that the output data is parsed out such that an application-specific interface (API) can utilize the physiological information and motion-related information for an application," which teachings are missing from Kosuda. MTA Reply 7 (citing MTA Opp. 13). Patent Owner acknowledges that Gupta teaches that its system receives the pulse signal and accelerometer data from the sensors in a time-division, multiplexed manner (Ex. 1045, 2–4) and processes the data to provide a data packet, i.e., a serial data string, of heart rate and

impact information (*id.*, Fig. 5 (reproduced above)). Patent Owner contends, however, that Petitioner improperly concludes that, because Gupta system creates a data package, the data packet arranges data "such that an application specific interface can decode the packet and a particular application can display the information from the packet." MTA Opp. 14. We agree that to the extent that Gupta teaches a packetized data, it is logical to assume that Gupta further teaches an application that can decode the packet. *See* Ex. 1072 ¶ 71.

> Petitioner further argues that
>
> > a person of ordinary skill in the art would have found it obvious to configure the device of Kosuda to add the functionality of impact detection (a motion-related parameter) and transmission to remote devices, in the same way as Gupta (i.e., by configuring Kosuda's processor to process signals from an accelerometer using Gupta's impact detection algorithm, to output a serial data string of physiological information and motion-related information parsed out such that an specific application interface is able to utilize the physiological information and motion-related information for a particular application).

Id. at 15 (citing Ex. 1072 ¶ 72). Specifically, Petitioner asserts that combining Gupta's known processing techniques with Kosuda's known device, would have involved nothing more than using known techniques to improve a known device. *Id.* Thus, Petitioner argues that a person of ordinary skill in the art would have recognized that Gupta's processor outputs physiological information and motion-related information parsed out in a specific data format, such that a specific application interface is able to utilize the physiological information and motion-related information for an application. Ex. 1072 ¶ 71.

In order to demonstrate obviousness, Petitioner must show that a person of ordinary skill in the art would have had reason to combine the teachings of Kosuda, Maekawa, and Gupta to achieve the device recited in the substitute claim. It is not sufficient that the techniques of Kosuda and those of Gupta were known. This is no more than an assertion that they *could* have been combined in the manner proposed by Petitioner. Petitioner's declarant, Dr. Anthony, provides no more reason to have combined the teachings of Kosuda and Gupta than that argued in the Opposition to the Motion to Amend. Ex. 1072 ¶ 72; *see id.* ¶ 90 (In combining the teachings of Kosuda, Gupta, Maekawa, and Han, Dr. Anthony relies on the reasons discussed above to combine the teachings of Kosuda and Han.). Despite the fact that Kosuda and Gupta relate to wrist worn monitoring devices, we find Dr. Anthony's testimony conclusory and insufficient to demonstrate a reason to combine the teachings of the Kosuda and Gupta in the manner proposed. *See* 37 C.F.R. § 42.65(a).

We are not persuaded that Petitioner has shown a reason to combine the teachings of these references, other than hindsight improperly gleaned from substitute claim 22. Consequently, because Petitioner's challenge to substitute, independent claim 22 is deficient, we also are not persuaded that Petitioner prevails in its challenges to claims 23 and 26–29.

4. Obviousness Over Aceti, Fricke, and Craw, Alone or in Combination with Comtois

Petitioner argues that claim 22–29 are unpatentable under 35 U.S.C. § 103(a) as obvious over Aceti, Fricke, and Craw, alone or in combination with Comtois. MTA Opp. 16–25. To support its argument, Petitioner provides a mapping of the limitations of claims 22 and 26 to structures

taught or suggested by Aceti, Fricke, and Craw and by Aceti, Fricke, Craw, and Comtois, respectively. *Id.* Petitioner also cites Dr. Sarrafzadeh's Declaration for support. *See* Ex. 1072 ¶¶ 91–151. Patent Owner limits its response to these arguments to the challenges to independent claim 22. MTA Reply 8–10.

We begin our analysis of these grounds of unpatentability with a review of Craw.

a. Craw (Ex. 2127)

Craw teaches methods for communicating medical information between network devices. Ex. 2127 ¶ 2; *see id.* ¶ 13, Fig. 9A (displaying physiological information based definitions derived from data dictionaries). The health care computing environment includes a variety of medical monitoring and analysis devices that process physiological data, including heart rate and respiration rate, and communicate that physiological data via a network. *Id.* ¶ 4. For example, Craw teaches "a system for interoperability of medical devices on a network and particularly measurements of non-invasive blood pressure ('NIBP'), but it is understood that this example is merely illustrative and other uses and fields of use are contemplated." *Id.* ¶ 51.

Craw teaches serializing data for transmission using a classification scheme to enable extraction of physiological parameters by a recipient device, such as for displaying information. *See id.* ¶¶ 200–216. "Serialization may be thought of as a process for taking an instance of software structure or class and turning the attributes/members of the class into transferable data encoding." *Id.* ¶ 235. Craw further teaches the use of string tables to provide an interface that may be used by software to manage

and access strings of data. *Id.* ¶ 255. A data dictionary may be used with a string table as an interface for managing, extracting, and displaying information from binary information streams. *Id.* ¶ 256, Fig. 7G. Thus, Craw's system may include a protocol for the serializing and deserializing byte streams of information. *Id.* ¶ 15. Accordingly, physiological information may be communicated via known serial communications channels. *Id.* ¶¶ 68–70.

b. Claim 22

We determined above, that the combined teachings of Aceti and Fricke teach or suggest all of the limitations of original claim 14. *See supra* Section II.C.5. Claim 22 includes all of the limitations of claim 14 and adds certain additional limitations.

Substitute claim 22 recites that "at least one signal processor [is] configured to process signals from the at least one motion sensor and signals from the at least one PPG sensor to reduce motion artifacts from the PPG signals and to extract physiological and motion parameters." MTA 23 (App'x A). Petitioner argues that Aceti discloses pulse oximetry circuitry 336, signal processing circuitry 342, and processor 314. MTA Opp. 19–20 (citing Ex. 1031 ¶ 27, Fig. 3). Aceti further teaches that pulse oximetry circuitry 336 monitors PPG signals to determine physiological parameters, i.e., pulse rate and/or blood oxygenation levels. *Id.* Aceti explains that signal processing circuitry 342 may process signals from accelerometer 306 to extract a variety of different types of motion-related parameters, including ovulation monitoring, fall detection, inclination and activity, wakefulness, patient movement, sleep apnea, and the like. *Id.* (citing Ex. 1031 ¶¶ 53–55; Ex. 1072 ¶ 114).

Substitute claim 22 also recites that "the at least one signal processor configured to process data to be output, wherein the output data comprises physiological information and motion related information." MTA 23 (App'x A). Petitioner argues that Aceti teaches this added limitation, as well. MTA Opp. 20. In particular, Aceti teaches processing elements within processor portion 102 to determine physiological information, such as heart rate, and motion related information, such as physical activity. Ex. 1031 ¶¶ 18, 27, 29, 46–49, Fig. 9. This determined information may be output via output circuitry 324. *Id.* ¶¶ 21–22, 46–47. Thus, Petitioner asserts that Aceti teaches that signal data is processed by at least one signal processor to generate output data including both physiological information and motion-related information. MTA Opp. 20 (citing Ex. 1072 ¶ 119).

Substitute claim 22 further recites that "the output data is parsed out such that an application-specific interface (API) can utilize the physiological information and motion-related information for an application." MTA 23 (App'x A). Petitioner argues that Aceti teaches that "one or more remote devices 800 (FIG. 8) may be deployed as one or more nodes (e.g., rooms) within a facility (e.g., home, hospital, care facility)" (Ex. 1031 ¶ 49) and that "[e]ach node 800 within the facility can receive, from the monitoring device 100, emergency alerts, physiological characteristics and/or physiological parameters for processing and/or routing to a central processing device 804" (*id.* ¶¶ 46, 49, 53). MTA Opp. 20–21. Petitioner further argues that Aceti teaches that numerous applications can use these physiological parameters, including physiological information and motion-related information. *Id.* at 21 (citing Ex. 1072 ¶ 120).

Petitioner acknowledges that, although Aceti teaches that processor 314 is configured to communicate data, including physiological information and motion-related information, via the data input/output circuitry 322/324 and transceiver 320, Aceti does not teach or suggest that "the output data is parsed out such that an application-specific interface (API) can utilize the physiological information and motion-related information for an application." *Id.* at 21. Nevertheless, Petitioner maintains that "Craw's data structure and classification scheme is directed to the problem of inoperability and seamless transmission of physiological data between varied computing environments." *Id.* (citing Ex. 2127 ¶ 123). In particular, Craw teaches use of a serial data format, e.g., "string data," to enable extraction of multiple physiological parameters and motion-related information for display of the extracted information. Ex. 2127 ¶¶ 200–216, Fig. 7H; *see* Ex. 1072 ¶ 123.

Petitioner argues that a person of ordinary skill in the art would have had reason to combine the teachings of Aceti and Craw because the logical scheme of serializing data output, as taught by Craw, would allow for transmission of a variety of parameters, such as heart rate, respiration rate, activity state, activity strength, and activity duration, and subsequent extraction, i.e., deserialization, of those parameters from the serial data by an application specific interface of an external receiving device for further processing and display. MTA Opp. 21 (citing Ex. 1072 ¶¶ 123–125). Referring to Aceti's Figure 8, we note that Aceti teaches a system including monitoring device 100 and a plurality of remote devices 800 and that:

> The monitoring device 100 may attach an identification code to each communication with the remote devices 800 so that a particular monitoring device 100 is distinguishable from other

> monitoring devices. *In addition, each remote device 800 may attach a unique monitoring code to communications communicated from the monitoring device 100 through the remote devices 800 to a central processing device 804 in order to provide an indication of the remote device 800 through which the monitored information was received.*

Ex. 1031 ¶ 40 (emphasis added). Thus, Aceti teaches or suggests transmission of information in data packets. Consequently, Petitioner argues that modifying Aceti's processing techniques with a data formatting techniques taught be Craw would have amounted to use of a known processing technique to improve a similar device in the same way. *Id.* at 22–23 (citing Ex. 1072 ¶¶ 120–126). We agree.

Patent Owner contends that Petitioner has failed to demonstrate that Craw teaches parsing output data, such that an application-specific interface (API) can utilize the physiological information and motion-related information for an application. MTA Reply 9. Specifically, Patent Owner contends that Craw's use of serial data packets does not teach parsing out data for use of an application-specific interface (API). *Id.* We disagree.

Given our understanding of the word "parsing," Craw's use of serial data packets teaches or suggests the recited parsing. Moreover, Craw relates to the communication of information to various medical devices (Ex. 2127, [57], ¶ 2) and Craw explains that:

> The design of each medical device, or any other machine performing health assessment, is dependent upon the particular subset or subsets of physiological data that the medical device or other machine processes and communicates. *The design of the software residing on the medical devices is also dependent upon the subset or subsets of physiological data or clinical outcomes that the medical device processes and communicates.*

Id. ¶ 5 (emphasis added). Thus, we are persuaded that Craw teaches or suggests that "the output data is parsed out such that an application-specific interface (API) can utilize the physiological information and motion-related information for an application," as recited in claim 22.

We are persuaded that Petitioner has shown by a preponderance of the evidence that substitute claim 22 is rendered obvious by the combined teachings of Aceti, Fricke, and Craw. Each of substitute claims 23–25, 28, and 29 depends directly from independent claim 22 and their recited limitations correspond to challenged claims 15–17, 20, and 21. Because we determined above that the limitations of those challenged claims were taught or suggested by the combined teachings of Aceti and Fricke, alone or in combination with those of Comtois, we also are persuaded that substitute claims 23–25, 28, and 29 are rendered obvious over the combined teachings of Aceti, Fricke, and Craw, alone or in combination with those of Comtois. *See supra* Section II.C.5.

c. Claim 26

> Substitute claim 26 recites that, in the device of substitute claim 22, the at least one processor is configured to (i) reduce motion artifacts by removing frequency bands from the signals that are outside of a range of interest using at least one band-pass filter to produce preconditioned signals and (ii) to generate the parsed output data by executing one or more processing methods to provide information that is fed into a multiplexed output serial data string of motion-related and physiological information.

MTA 24 (App'x A). Petitioner argues that the combined teachings of Aceti's monitoring device, Fricke's motion artifact reduction methods, and Craw's data formatting scheme teach or suggest the limitation added to this substitute claim. MTA Opp. 23. Moreover, Petitioner argues that a person

of ordinary skill in the art, in view of Aceti's teaching regarding the transmission to multiple remote devices 800 and the extraction of different parameters from the transmitted data (Ex. 1031 ¶ 140), would have had reason to combine Craw's teachings regarding serial data formatting "such that Aceti's pulse rate, blood-oxygen content, etc., could be extracted from the physiological information, and such that subject physical activity parameters could be extracted from the motion-related information." *See* Ex. 1072 ¶¶ 140–144. Patent Owner does not contest this combination or its alleged teachings. MTA Reply 10.

We are persuaded that Petitioner has shown by a preponderance of the evidence that substitute claim 26 is rendered obvious by the combined teachings of Aceti, Fricke, and Craw. Substitute claim 27 depends directly from claim 26 and its recited limitations correspond to challenged claim 19. Because we determined above that the limitations of this challenged claim were taught or suggested by the combined teachings of Aceti and Fricke, we also are persuaded that substitute claim 27 is rendered obvious over the combined teachings of Aceti, Fricke, and Craw.

5. Summary

In consideration of all the evidence discussed above, we *deny* Patent Owner's Motion to Amend.

IV. PROCEDURAL ISSUES

Patent Owner objects to the use of *inter partes* reviews as unconstitutional based, at least, upon the reasons presented in the petition for certiorari that was granted in *Oil States Energy Services, LLC v. Greene's Energy Group, LLC*. PO Resp. 33–34; *see* Reply 12. On April 24, 2018, the U.S. Supreme Court upheld the constitutionality of *inter partes* review; thus,

Patent Owner's arguments are moot. *Oil States Energy Servcs. LLC v. Greene's Energy Grp., LLC*, 138 S.Ct. 1365, 1370 (2018).

V. CONCLUSION

For the foregoing reasons and on this record, we are persuaded that Petitioner establishes by a preponderance of the evidence that claims 14, 15, and 18–21 of the '941 patent are unpatentable as obvious over Kosuda and Maekawa, alone or in combination with Han, and that claims 14–21 of the '941 patent over Aceti and Fricke, alone or in combination with Comtois. Further, for the foregoing reasons and on this record, we are not persuaded that Patent Owner is entitled to grant of its Motion to Amend with respect to substitute claims 22–29.

VI. ORDER

In consideration of the foregoing, it is

ORDERED that claims 14–21 of the '941 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Amend is *denied*; and

FURTHER ORDERED, that because this is a final written decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

For PETITIONER

Michelle K. Holoubek
Michael D. Specht
Richard M. Bemben
STERNE, KESSLER, GOLDSTEIN & FOX
holoubek-PTAB@skgf.com
mspecht-PTAB@skgf.com
rbemben-PTAB@skgf.com
PTAB@skgf.com

Harper Batts
Jeremy Taylor
BAKER BOTTS LLP
harper.batts@bakerbotts.com
jeremy.taylor@bakerbotts.com

For PATENT OWNER

Justin B. Kimble
Nicholas C Kliewer
BRAGALONE CONROY PC
JKimble-IPR@bcpc-law.com
nkliewer@bcpc-law.com