

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SONY ELECTRONICS INC.,
Petitioner,

v.

JAWBONE INNOVATIONS, LLC,
Patent Owner.

IPR2023-01352
Patent 7,246,058 B2

Before GEORGIANNA W. BRADEN, NORMAN BEAMER, and
JASON M. REPKO, *Administrative Patent Judges*.

BRADEN, *Administrative Patent Judge*.

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

I. INTRODUCTION

Meta Platforms, Inc. (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 1–5 in U.S. Patent No. 7,246,058 B2 (Exhibit 1001, “the ’058 patent”) under 35 U.S.C. §§ 311–319. Paper 1 (“Pet.”). Jawbone Innovations, LLC (“Patent Owner”) filed a Preliminary Response. Paper 6 (“Prelim. Resp.”).

Under 37 C.F.R. § 42.4(a), we have authority to determine whether to institute an *inter partes* review. We may institute an *inter partes* review only if “the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a) (2018). The “reasonable likelihood” standard is “a higher standard than mere notice pleading” but “lower than the ‘preponderance’ standard to prevail in a final written decision.” *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 13 (PTAB Dec. 20, 2019) (precedential).

Based on the current record and for the reasons explained below, Petitioner has shown that there is a reasonable likelihood that it would prevail with respect to at least one of the challenged claims. Thus, we institute an *inter partes* review of claims 1–5 in the ’058 patent on all challenges included in the Petition.

II. BACKGROUND

A. Real Parties in Interest

Petitioner identifies Meta Platforms, Inc. as the real party in interest. Pet. 82. Patent Owner identifies itself as the real party in interest. Paper 5, 2. The parties do not raise any issue about real parties in interest.

B. Related Matters

The parties both identify the following multiple district court cases involving the '058 patent as well as related IPR proceedings: IPR2022-00623; IPR2023-00222; IPR2023-01021, IPR2023-01110, and IPR2023-01119. Pet. 82–85; Paper 5, 2–3. Each of the related IPR proceedings, except IPR2023-01110 and IPR2023-01119, has been terminated due to settlement. *See* IPR2022-00623, Paper 31; IPR2023-00222, Paper 13.

C. The '058 Patent (Exhibit 1001)

The '058 patent, titled “Detecting Voiced and Unvoiced Speech Using Both Acoustic and Nonacoustic Sensors,” issued on July 17, 2007, from an application filed on May 30, 2002. Ex. 1001, codes (22), (45), (54). The patent claims priority to the following applications: (1) eleven provisional applications filed between May 30, 2001, and March 27, 2002; (2) a nonprovisional application filed on July 12, 2001; and (3) a nonprovisional application filed on November 21, 2001. *Id.* at 1:7–14, code (60).

1. Written Description

The '058 patent discloses systems and methods for “detecting voiced and unvoiced speech in acoustic signals having varying levels of background noise.” *Id.* at code (57).

The '058 patent's Figures 1 and 2 (reproduced below) depict embodiments of block diagrams of speech-detection systems 100 and 200:

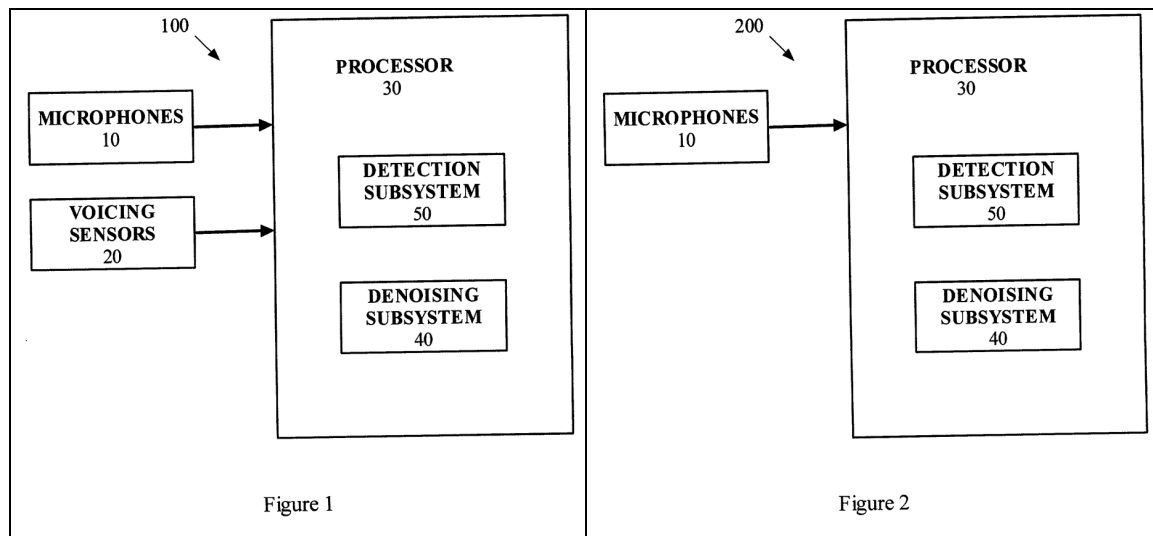


Figure 1 (above on the left) illustrates “a Non-Acoustic Sensor Voiced Speech Activity Detection (NAVSAD) system” 100, and Figure 2 (above on the right) illustrates “a Pathfinder Speech Activity Detection (PSAD) system” 200. Ex. 1001, 1:52–55, 2:20–24, 2:30–31, 2:41–42, Figs. 1–2. “The PSAD can operate independently or as a backup to the NAVSAD, detecting voiced speech if the NAVSAD fails.” *Id.* at 2:48–49; *see id.* at 8:62–63, 9:44–45.

As Figures 1 and 2 show, both NAVSAD system 100 and PSAD system 200 include microphones 10 coupled to processor 30. Ex. 1001, 2:31–32, 2:42–43, Figs. 1–2. NAVSAD system 100 also includes voicing sensors 20, i.e., nonacoustic sensors, coupled to processor 30. *Id.* at 2:31–34, Fig. 1. Processor 30 controls subsystems including denoising subsystem 40 and detection subsystem 50, e.g., a detection algorithm. *Id.* at 2:34–37, 2:43–45; *see id.* at 2:50–60.

The '058 patent explains that unvoiced speech detection should be:

- (1) “insensitive” in high-noise situations because unvoiced speech is “easily washed out by the noise” and “unlikely to affect the voiced speech denoising”; and
- (2) “highly sensitive” in low-noise situations because the “speech information is most important in the presence of little to no noise.”

Ex. 1001, 3:17–27; *see id.* at 5:65–6:1.

The '058 patent also explains that NAVSAD system 100 includes a nonacoustic sensor “to enable detection of voiced speech in any environment” by detecting “human tissue motion associated with speech.” Ex. 1001, 3:13–15, 3:55–63. As an example of a nonacoustic sensor, the patent identifies a General Electromagnetic Movement Sensor (GEMS), i.e., “a radio frequency device (2.4 GHz) that allows the detection of moving human tissue dielectric interfaces.” *Id.* at 3:57–60, 3:64–66. “The GEMS includes an RF interferometer that uses homodyne mixing to detect small phase shifts associated with target motion.” *Id.* at 3:63–4:1.

“The NAVSAD and PSAD systems include an array algorithm for speech detection that uses the difference in frequency content between two microphones to calculate a relationship between the signals of the two microphones.” Ex. 1001, 3:29–32.

The '058 patent's Figure 4 (reproduced below) depicts a flow diagram of a detection algorithm for detecting voiced and unvoiced speech:

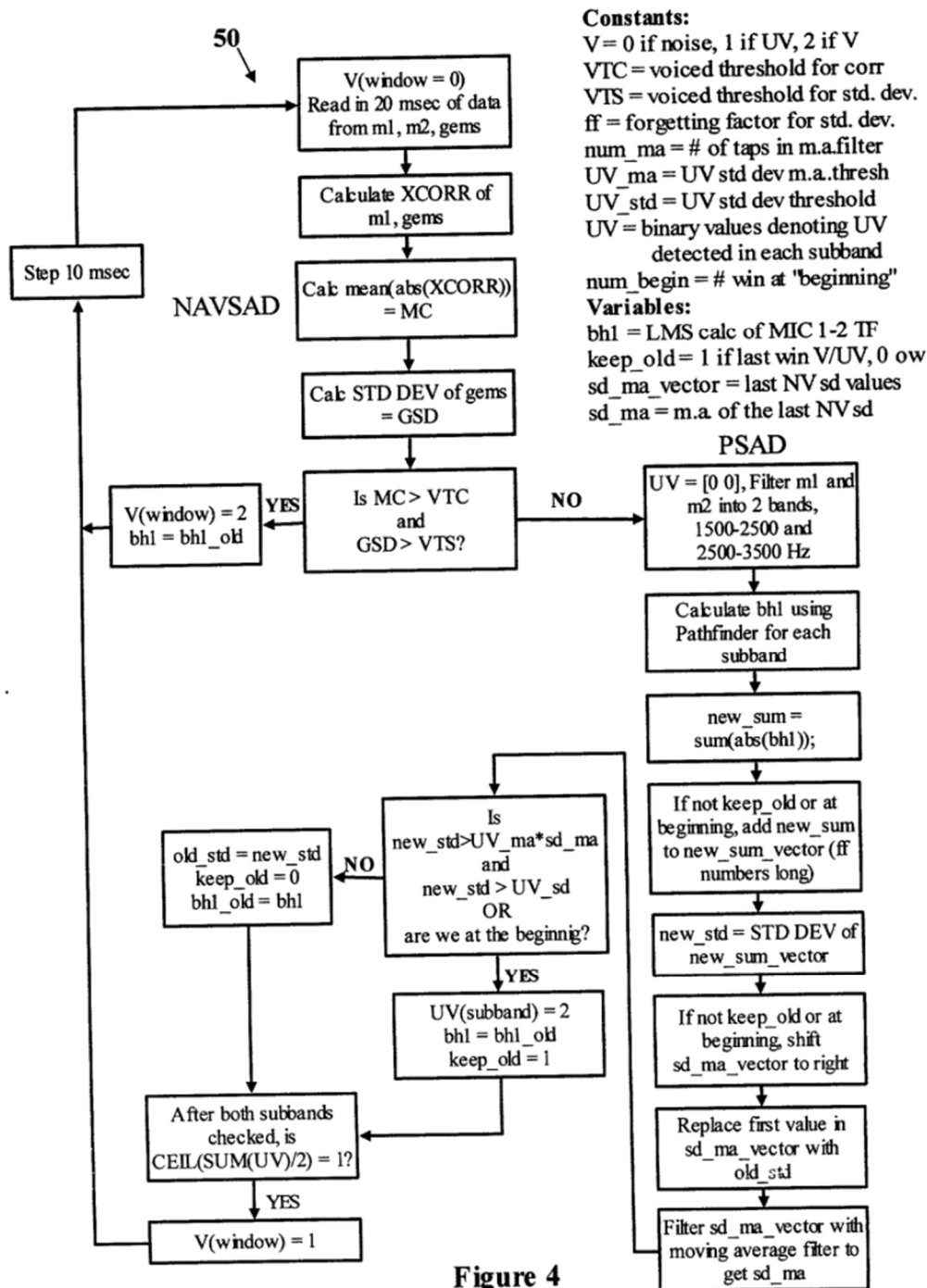


Figure 4 illustrates detection algorithm 50 for detecting voiced and unvoiced speech in “environments containing varying amounts of background

acoustic noise.” Ex. 1001, 1:58–60, 4:14–16, 4:42–44, Fig. 4. NAVSAD system 100 and PSAD system 200 may “include the detection algorithm 50 as the detection subsystem 50.” *Id.* at 4:16–18.

A system with detection algorithm 50 records data from a first microphone (“m1” in Figure 4), a second microphone (“m2” in Figure 4), and a nonacoustic sensor (“gems” in Figure 4) during a time window, e.g., 20 milliseconds. Ex. 1001, 4:18–26, Fig. 4; *see id.* at code (57). The system determines the energy of the signals from the first microphone, the second microphone, and the nonacoustic sensor over the time window. *Id.* at 4:64–5:3.

The system generates “difference parameters between the acoustic signals received at each of the two microphones.” Ex. 1001, code (57); *see id.* at 7:52–8:48. “The difference parameters are representative of the relative difference in signal gain between portions of the received acoustic signals.” *Id.* at code (57). The system compares the difference parameters to various thresholds to distinguish speech from noise. *Id.*

The system also determines the cross correlation (XCORR) between the acoustic signal from the first microphone and the signal from the nonacoustic sensor to “further differentiate sensor noise from tissue motion.” Ex. 1001, 4:64–5:3, 5:11–12, Fig. 4; *see id.* at 5:26–44. “The sensor detects human tissue motion associated with the closure of the vocal folds, so the acoustic signal produced by the closure of the folds is highly correlated with the closures.” *Id.* at 5:26–29. Hence, “sensor data that correlates highly with the acoustic signal is declared as speech, and sensor data that does not correlate well is termed noise.” *Id.* at 5:29–31.

2. Illustrative Claim

Petitioner challenges independent system claim 1, independent method claim 2, and claims 3–5 that depend directly from claim 2. Pet. 1, 17–75.

Claim 1 exemplifies the challenged claims and reads as follows (with formatting added for clarity):

1. A system for detecting voiced and unvoiced speech in acoustic signals having varying levels of background noise, comprising:

at least two microphones that receive the acoustic signals;

at least one voicing sensor that receives physiological information associated with human voicing activity; and

at least one processor coupled among the microphones and the voicing sensor,

wherein the at least one processor;

generates cross correlation data between the physiological information and an acoustic signal received at one of the two microphones;

identifies information of the acoustic signals as voiced speech when the cross correlation data corresponding to a portion of the acoustic signal received at the one receiver exceeds a correlation threshold;

generates difference parameters between the acoustic signals received at each of the two receivers, wherein the difference parameters are representative of the relative difference in signal gain between portions of the received acoustic signals;

identifies information of the acoustic signals as unvoiced speech when the difference parameters exceed a gain threshold; and

identifies information of the acoustic signals as noise when the difference parameters are less than the gain threshold.

Ex. 1001, 11:8–35.

D. Evidence of Record

For its challenges, Petitioner relies on the following references:

Name	Reference	Exhibit
Meisel	US 4,718,096, issued Jan. 5, 1988	1005
Kaneda	US 5,208,864, issued May 4, 1993 (based on an application filed March 8, 1990)	1006
Freidin	US 6,148,313, issued Nov. 14, 2000	1007
Sakoe	US 4,239,936, issued Dec. 16, 1980	1008
Lyons	Richard G. Lyons, <i>Understanding Digital Signal Processing</i> (1997)	1012

Pet. 1–2.

Petitioner asserts that each reference qualifies as prior art under § 102(b). Pet. 1–2; *see* 35 U.S.C. § 102(a), (b), (e) (2006).¹

At this stage of the proceeding, Patent Owner does not dispute that each reference qualifies as prior art. *See, e.g.*, Prelim. Resp. 3–6.

E. The Asserted Challenges to Patentability

Petitioner asserts the following challenges to patentability:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 2, 4, 5	103(a)	Meisel, Kaneda, Freidin

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284 (2011), amended 35 U.S.C. § 102 and § 103 effective March 16, 2013. Because the filing date of the challenged claims predates the AIA’s amendments to § 102 and § 103, this decision refers to the pre-AIA versions of § 102 and § 103.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
3	103(a)	Meisel, Kaneda, Freidin, Lyons
4	103(a)	Meisel, Kaneda, Freidin, Sakoe

Pet. 2.

F. Testimonial Evidence

To support its challenges, Petitioner relies on the declaration of Richard M. Anderson, Ph.D. (Exhibit 1003). Dr. Anderson states, “I am a professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology (‘Georgia Tech’) in Atlanta, Georgia.” Ex. 1003 ¶ 8. Dr. Anderson also states, “I received my Ph.D. in Electrical and Computer Engineering from Georgia Tech, and I received my B.S. and M.S. in Electrical Engineering from Brigham Young University. Prior to my time at Georgia Tech, I worked in the field of speech and audio signal processing designing and implementing signal processing methods for hearing aids at Sonic Innovations 1993-1994.” *Id.* Additionally, he explains that “I have been retained [by] Google LLC (‘Google’ or ‘Petitioner’) as an independent expert consultant in this proceeding before the United States Patent and Trademark Office.”² *Id.* ¶ 1.

² Dr. Anderson was retained as an independent expert by non-party Google LLC for IPR proceeding IPR2023-00623, which challenged the ’058 patent based on the same prior art as asserted in the present Petition. We remind the parties of their obligation under Rule 42.51(b)(1)(ii), which allows for cross examination of affidavit testimony as routine discovery. *See John’s Lone Star Distrib., Inc. v. Thermolife Int’l, Inc.*, Case No. IPR2014–01201 (PTAB May 13, 2015) (Paper 31) (petitioner submitted affidavit testimony from a witness triggering cross-examination under 37 C.F.R. § 42.51(b)(1), and because petitioner did not make that witness available for cross-examination, the Board expunged the testimony.); *IBG LLC et al. v. Trading Technologies Internationale, Inc.*, Case No. CBM2015-00179 (PTAB

Petitioner also relies on the declaration of Lauren Gluckman (Exhibit 1027) created originally on behalf of non-party Google LLC for IPR proceeding IPR2023-00623. Ms. Gluckman states, “I earned a Master of Science in Library Science (‘MLS’) from the Rutgers University in 1993, and a Bachelor of Arts in Political Science from Rutgers University in 1991. I have worked as a librarian for over twenty-five years. I have been employed in the Research & Information Services Department at Finnegan Henderson since August 2021.” *Id.* ¶ 4. Ms. Gluckman discusses “standard library practices regarding receipt, cataloging, and shelving of materials” as relevant to Lyons. *Id.* ¶¶ 6–19.

III. PATENTABILITY ANALYSIS

A. Legal Principles: Obviousness

A patent may not be obtained “if the differences between the subject matter sought to be patented 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.” 35 U.S.C. § 103(a) (2006). An obviousness analysis involves underlying factual inquiries including (1) the scope and content of the prior art; (2) differences between the claimed invention and the prior art; (3) the level of ordinary skill in the art; and (4) where in evidence, objective indicia of nonobviousness, such as commercial success, long-felt but unsolved needs,

Apr. 15, 2016) Paper 39, 3 (The Board determined that it was the petitioner’s responsibility to produce the witness for cross-examination, because that deposition was the sole evidence that a reference was prior art.).

and failure of others.³ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18, 35–36 (1966); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1047–48 (Fed. Cir. 2016) (en banc). When evaluating a combination of references, an obviousness analysis should address “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007).

We analyze the obviousness issues according to these principles.

B. Level of Ordinary Skill in the Art

Factors pertinent to determining the level of ordinary skill in the art include (1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) prior-art solutions to those problems; (4) the rapidity with which innovations are made; (5) the sophistication of the technology; and (6) the educational level of workers active in the field. *Envtl. Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 696–97 (Fed. Cir. 1983). Not all factors may exist in every case, and one or more of these or other factors may predominate in a particular case. *Id.* These factors are not exhaustive, but merely a guide to determining the level of ordinary skill in the art. *Daiichi Sankyo Co. v. Apotex, Inc.*, 501 F.3d 1254, 1256 (Fed. Cir. 2007). Moreover, the prior art itself may reflect an appropriate skill level. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

Petitioner asserts that a person of ordinary skill in the art at the time of the alleged invention “would have had a minimum of a bachelor’s degree in computer engineering, computer science, electrical engineering, mechanical engineering, or a similar field, and approximately three years

³ The record does not include evidence concerning objective indicia of nonobviousness.

of industry or academic experience in a field related to acoustics, speech recognition, speech detection, or signal processing.” Pet. 7. Petitioner also asserts that “[w]ork experience can substitute for formal education and additional formal education can substitute for work experience.” *Id.* Dr. Anderson’s testimony supports Petitioner’s assertions. *See* Ex. 1003 ¶¶ 14–16.

For purposes of the Preliminary Response, Patent Owner “utilizes Petitioner’s proposed level of skill in the art.” Prelim. Resp. 7 (quoting Pet. 7).

Based on the current record and for purposes of analysis, we accept Petitioner’s description of an ordinarily skilled artisan as it is consistent with the level of skill shown in the ’058 patent and the asserted prior art.

C. Claim Construction

We construe claim terms “using the same claim construction standard” that district courts use to construe claim terms in civil actions under 35 U.S.C. § 282(b). *See* 37 C.F.R. § 42.100(b) (2022). Under that standard, claim terms “are given their ordinary and customary meaning, which is the meaning the term would have to a person of ordinary skill in the art at the time of the invention.” *Power Integrations, Inc. v. Fairchild Semiconductor Int’l, Inc.*, 904 F.3d 965, 971 (Fed. Cir. 2018) (citing *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc)). The meaning of claim terms may be determined by “look[ing] principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

Petitioner contends that “no claim terms require construction to resolve the obviousness challenges.” Pet. 7.

Patent Owner “believes that claim construction is not required to resolve any issues.” Prelim. Resp. 7.

Patent Owner’s arguments, however, depend on the meaning of “voicing sensor,” “voicing activity,” and “physiological information.” See Prelim. Resp. 8–11. We address those arguments in Section III.E.1.c. For the reasons discussed in that section, we preliminarily determine that “voicing sensor” encompasses acoustic microphones. See *infra* § III.E.1.c. Likewise, we preliminarily determine that “physiological information associated with human voicing activity,” as recited in claim 1, encompasses information associated with “vibration of the vocal chords.” See *id.* During trial, the parties are invited to discuss the meaning of these terms further.

On the current record, no other terms are in controversy. “[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.” *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); see *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

D. Overview of Asserted Prior Art of Record

1. Overview of Meisel (Exhibit 1005)

Meisel is a U.S. Patent that was filed in 1986 and issued in 1988. Ex. 1005, code (22), (45). It relates to a speech-recognition system with microphones on a speaker’s mouth, nose, and throat. *Id.* at code (57). The system identifies certain types of speech using the differences between the amplitudes of the microphone signals. *Id.* at 2:11–53, 4:35–39. For example, a throat microphone detects vibration of the vocal cords—i.e.,

“voicing.” *Id.* at 2:33–35. By comparing the signals between the throat microphone and a mouth microphone, the system can distinguish voiced stop consonants, such as *b*, *d*, and *g*, from unvoiced stop consonants, such as *p*, *t*, and *k*. *Id.* at 2:36–46.

According to at least one embodiment, Meisel’s speech recognition system includes at least one processor, such as signal pre-processor (2) and speech recognition subsystem (3). *Id.* at 4:27–34. Meisel discloses that the signals from the microphones are sent to the signal pre-processor (2), which compares and detects imbalances (differences) in signal amplitudes between any two microphones. *Id.* at 4:35–42. Meisel’s signal pre-processor (2) uses amplitude detector/comparator/integrator units (ADCI) to distinguish between voiced and unvoiced speech using the differences in the two signals, as shown in Figure 14 (reproduced below). *Id.* at 4:11–13.

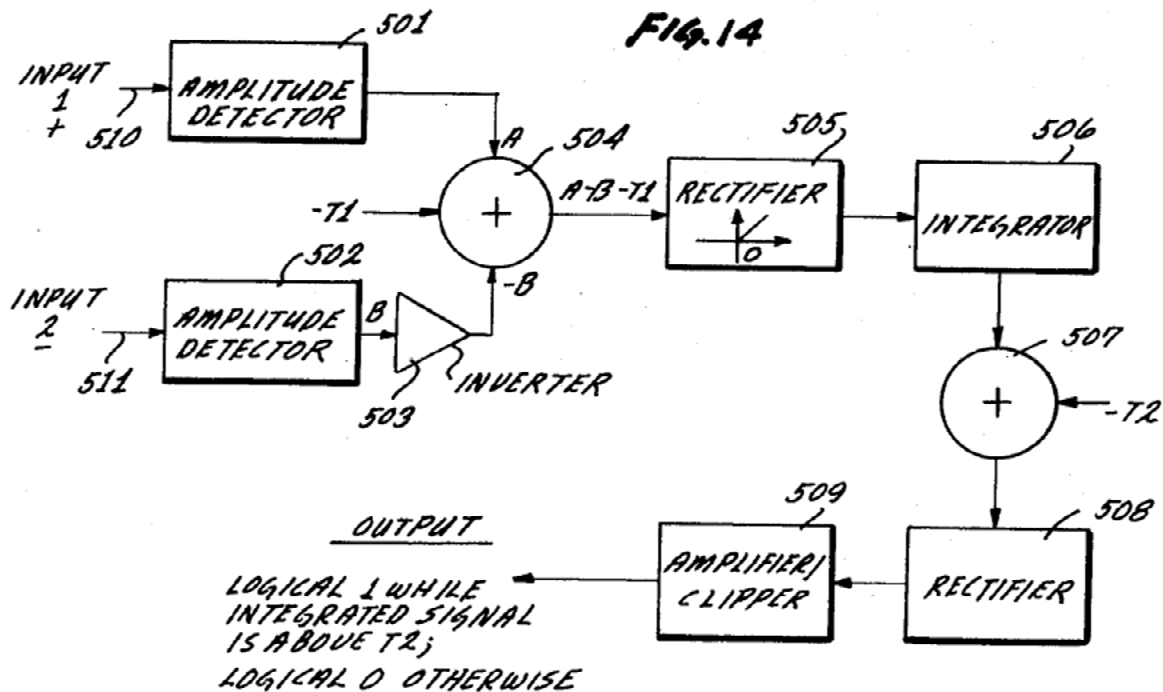


Figure 4 illustrates the details of an amplitude detector/comparator/integrator unit (ADCI). *Id.* at 4:11–13. According to Meisel, the two inputs to ADCU

unit 44 are respectively introduced to amplitude detectors 501 and 502. These two detectors rectify and filter the input signal so as to follow the envelope of the speech signal. In one embodiment, Meisel's signal pre-processor (2) calculates a difference between two input signals (A-B) and compares that difference to a predetermined threshold (T1). *Id.* at 9:12–29. The signal pre-processor (2) further processes this information using an integrator (506), which integrates signals over a period of time, and compares the output data to a second predetermined threshold (T2). *Id.* at 9:38–42.

Meisel discloses that signal pre-processor (2) compares the signals from the first mouth microphone (18) and the throat microphone (20) to distinguish voiced from unvoiced stop consonants and fricatives. *Id.* at 2:31–48. As one example, Meisel states that its speech detection system measures the difference in signal amplitudes (gains) between the received signals for the side mouth microphone (18) and the front mouth microphone (32). *Id.* at 9:38–50, 10:4–11.

2. Overview of Freidin (Exhibit 1007)

Freidin is a U.S. Patent that was filed in 1998 and issued in 2000. Ex. 1007, code (22), (45). It discloses a programmable digital correlator device and associated correlation method. *Id.* at code (57). According to Freidin, “[c]orrelators have been widely used in signal processing to measure the degree of correspondence between a data sequence and a predetermined pattern or reference sequence,” and “[c]orrelation is used in a number of applications including speech recognition.” *Id.* at 1:11–24.

4. *Overview of Sakoe (Exhibit 1008)*

Sakoe is a U.S. Patent that was filed in 1978 and issued in 1980. Ex. 1008, code (22), (45). It discloses a speech-recognition system adaptable to noisy environments. *Id.* at 1:59–62. The system recognizes speech and measures the intensity of ambient noise. *Id.* at 1:63–2:2.

5. *Overview of Lyons (Exhibit 1012)*

Lyons is a book titled “Understanding Digital Signal Processing,” by Richard G. Lyons, published no later than 1997 by Addison-Wesley Publishing Co. Ex. 1012, i–iv⁴. Lyons discloses digital signal-processing techniques for a wide variety of technical fields, including speech recognition. *See* Ex. 1012, 1, 21, 47, 127–28, 155–56, 217–18, 295, 317–18, 441–42.

Lyons explains that “unwanted fluctuations in a measured value are called *noise*.” Ex. 1012, 319 (emphasis in original). Lyons discloses using “statistical measures known as the mean [or average], variance, and standard deviation” for quantitative analyses. *Id.* at 319–20; *see id.* at 476–84. Lyons explains that if “the sequence $x(n)$ represents a time series of signal samples,” then:

- (1) “ x_{ave} specifies the constant, or DC, value of the signal”;
- (2) “the standard deviation σ reflects the amount of the fluctuating, or AC, component of the signal”; and
- (3) “the variance σ^2 is an indication of the power in the fluctuating component.”

⁴ Except for the page numbers i–xvi that Petitioner applied to the cover page and the introductory matter in Exhibit 1012 (Lyons), we follow Petitioner’s practice and cite to the page numbers that appear in the book rather than the page numbers that Petitioner applied to the exhibit.

Id. at 320.

For a time series of signal samples $x(n)$, Lyons discloses the following equations for the standard deviation σ and the variance σ^2 :

$\sigma = \sqrt{\frac{1}{N} \sum_{n=1}^N [x(n) - x_{\text{ave}}]^2}$	$\sigma^2 = \frac{1}{N} \sum_{n=1}^N [x(n) - x_{\text{ave}}]^2$
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The equation above on the right for the variance σ^2 shows the variance σ^2 calculated as the sum of the squared difference between each signal $x(n)$ and the average x_{ave} divided by the number signals N . Ex. 1012, 320, 478.

The equation above on the left for the standard deviation σ shows the standard deviation σ calculated as the positive square root of the variance σ^2 .

Id. at 320, 479.

6. *Overview of Kaneda (Exhibit 1006)*

Kaneda is a U.S. patent titled “Method of Detecting Acoustic Signal,” filed on March 8, 1990, and issued on May 4, 1993. Ex. 1006, codes (11), (22), (45), (54). Kaneda states the “invention relates to a method of detecting an acoustic signal, and a method of detecting a period of a desired acoustic signal in a signal including noise and the desired acoustic signal.”

Id. at 1:5–9; *see id.* at code (57).

Kaneda’s Figures 2(a)–2(b) (reproduced below) depict microphone arrangements for detecting speech in the presence of noise where two

microphones are located to cause a signal-to-noise ratio (S/N ratio) difference between the outputs from the two microphones:

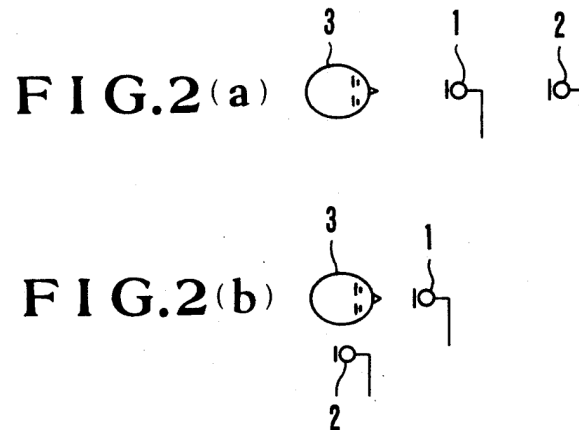


Figure 2(a) (the upper figure above) illustrates “a first microphone 1” located “near a speaker 3” and “a second microphone 2” located “away from the speaker 3.” Ex. 1006, 1:55–58, Fig. 2(a). Figure 2(b) (the lower figure above) illustrates “the first microphone 1” located “in front of the speaker 3” and “the second microphone 2” located “near the side of the speaker 3.” *Id.* at 1:58–61, Fig. 2(b).

In each microphone arrangement, “the speech power level of the output from the first microphone is higher than that from the second microphone.” Ex. 1006, 1:61–63. Additionally, “assuming that noise is generated in a remote location, the noise power levels of the outputs from these microphones are almost equal to each other.” *Id.* at 1:64–66. Hence, “an S/N ratio difference in outputs of the two microphones occurs.” *Id.* at 1:66–68.

Kaneda's Figures 3(a)–3(c) (reproduced below) help explain how the microphone arrangements in Figures 2(a)–2(b) operate:

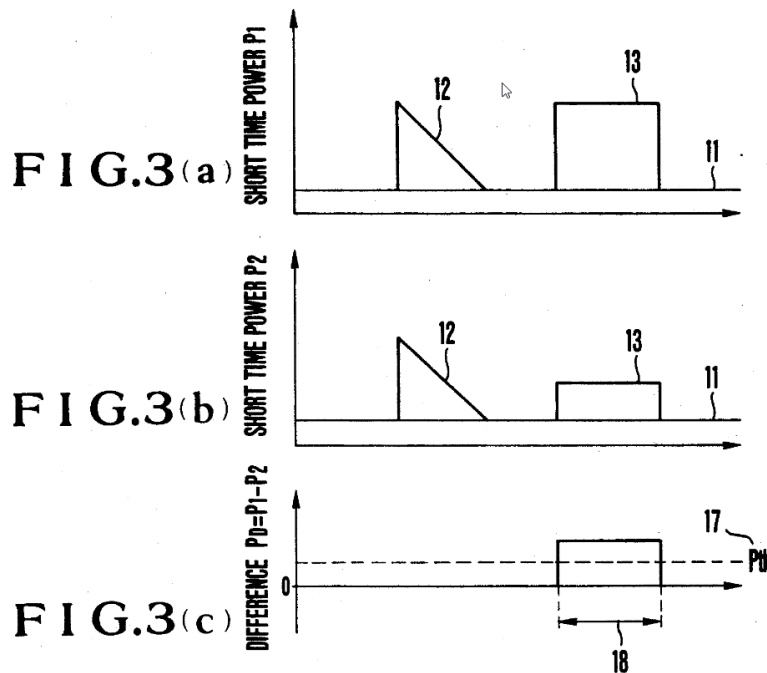


Figure 3(a) (the upper figure above) “shows a time change in power P1 of the output from the first microphone.” Ex. 1006, 2:3–4, Fig. 3(a). Figure 3(b) (the middle figure above) “shows a time change in power P2 of the output from the second microphone.” *Id.* at 2:5–6, Fig. 3(b). Figure 3(c) (the lower figure above) shows a time change in the power difference PD between the powers P1 and P2 ($PD = P1 - P2$) in Figures 3(a) and 3(b). *Id.* at 2:12–15, Fig. 3(c).

Figures 3(a) and 3(b) each show stationary noise 11, unstationary noise 12, and speech 13. Ex. 1006, 2:6–8, Figs. 3(a)–3(b). With the two microphones arranged as illustrated in Figure 2(a) or 2(b), the noise power levels are the same in Figures 3(a) and 3(b), but the speech power level in Figure 3(b) “is lower than that in” Figure 3(a). *Id.* at 2:8–12, Figs. 3(a)–3(b).

As Figure 3(c) shows, “[w]hen the power difference PD is larger than a given threshold value Pth17, a corresponding time period 18 is detected as a speech period.” Ex. 1006, 2:15–18, Fig. 3(c). Hence, “the unstationary noise period having a high power is not detected as a speech period.” *Id.* at 2:19–21.

E. Alleged Obviousness over Meisel, Kaneda, and Freidin: Claims 1–5

Petitioner contends that claims 1–5 are unpatentable under § 103(a) as obvious over the teachings of Meisel, Kaneda, and Freidin. *See* Pet. 2, 18–43. Patent Owner disputes Petitioner’s contentions. *See* Prelim. Resp. 8–12. As explained below, Petitioner establishes sufficiently for purposes of institution that the combined disclosures in Meisel, Kaneda, and Freidin teach or suggest the subject matter in claims 1–5.

1. Analysis of Independent Claim 1

a) Preamble

Claim 1 recites “[a] system for detecting voiced and unvoiced speech in acoustic signals having varying levels of background noise.” Ex. 1001, 11:8–9.

Petitioner contends that Meisel teaches claim 1’s preamble because Meisel discloses a system that compares “the signal from the throat microphone [20] to that of the mouth microphone [18]” to “distinguish, for example, voiced from unvoiced stop consonants” and “voiced fricatives (v, z, and th) from unvoiced fricatives (f, s, and sh).” Pet 18 (citing Ex. 1005, 2:31–53). Petitioner argues that a person of ordinary skill in the art at the critical time would have understood “that distinguishing voiced from unvoiced stop consonants and voiced from unvoiced fricatives are examples of distinguishing voiced from unvoiced speech.” *Id.* (citing Ex. 1003 ¶ 40;

Ex. 1005, 2:35–45 (“By comparing the signal from the throat microphone to that of the mouth microphone, one can distinguish, for example, voiced from unvoiced stop consonants,” e.g. “unvoiced stops (p, t, and k)” where “the vocal cords do not vibrate” from “voiced stops (b, d, and g)” where “the vocal cords vibrate during the closure.”)). *Id.* Petitioner then argues that Meisel further discloses that the sounds received from the nose and mouth microphones are acoustic signals. *Id.* (citing Ex. 1003 ¶ 41; Ex. 1005, claim 6).

At this stage of the proceeding, Patent Owner makes no arguments specific to claim 1’s preamble. *See, e.g.*, Prelim. Resp. 6–13. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

Generally, a preamble does not limit a claim. *Allen Eng’g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1346 (Fed. Cir. 2002). We need not decide whether claim 1’s preamble limits the claim because Petitioner establishes sufficiently for purposes of institution that Meisel teaches claim 1’s preamble. *See* Pet. 18–19; Ex. 1003 ¶¶ 39–42.

b) At Least Two Microphones

Claim 1 recites “at least two microphones that receive the acoustic signals.” Ex. 1001, 11:11.

Petitioner contends that the combined disclosures in Meisel and Kaneda teach claim 1’s “two microphones” limitation. *See* Pet. 20–21 (citing Ex. 1003 ¶ 46). Specifically, Petitioner asserts that Meisel discloses a nose microphone (16) that detects acoustic sounds emanating from the speaker’s nose and two mouth microphones (18, 32) that detect acoustic sounds

emanating from the speaker's mouth. *Id.* (citing Ex. 1005, Fig. 5, code (57), 5:29–36).

At this stage of the proceeding, Patent Owner does not dispute that Meisel discloses a two-microphone system. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

Based on the current record and for the reasons advanced by Petitioner and supported by Dr. Anderson's testimony, Petitioner establishes sufficiently for purposes of institution that the disclosures in Meisel teaches claim 1's "two microphones" limitation. *See* Pet. 20–21; Ex. 1003 ¶ 46; Ex. 1005, Fig. 5, Abstract, 2:11–17, 5:29–36, 8:49–59.

c) At Least One Voicing Sensor

Claim 1 recites "at least one voicing sensor that receives physiological information associated with human voicing activity." Ex. 1001, 11:12–13.

Petitioner contends that Meisel teaches claim 1's "voicing sensor" limitation because Meisel discloses an "acoustic throat microphone (20), the same as the '058 patent, which detects vocal cord vibrations associated with voicing activity (e.g., voiced speech) through sounds emanating from the speaker's throat (physiological information)." Pet. 22 (citing Ex. 1005, 2:31–35; Ex. 1003 ¶ 47). According to Petitioner, Meisel explains that "[t]he throat microphone, if used, detects the vibration of the vocal cords, or 'voicing,'" and "the [throat] microphone 20 is disposed to detect vibration of the vocal cords through sounds emanating from the throat of a speaker." Ex. 1005, 2:31–35, 5:29–36. Petitioner argues that a person of ordinary skill in the art "would have recognized that detecting 'vibration of the vocal

cords’ is receiving physiological information about ‘voicing’ activity of the speaker.” *Id.* (citing Ex. 1003 ¶ 49; Ex. 1005, 2:33–35).

Patent Owner disagrees. Prelim. Resp. 8. Patent Owner contends Meisel uses a “push-to-talk” button, not a throat microphone, to detect voicing activity. *Id.* (citing Ex. 1005, 11:8–15, Fig. 13). Patent Owner argues that Meisel relies on this button to “delineate the beginning and end of a spoken word,” and the button does not qualify as “physiological information associated with human voicing activity.” *Id.* at 8–9.

Patent Owner then asserts that “Meisel’s throat microphone further does not disclose this limitation because it does not receive physiological information” and only detects “sounds emanating from the throat of a speaker.” Prelim. Resp. 9 (citing Ex. 1005, 5:29–36). Patent Owner argues that Meisel’s throat microphone can only receive acoustic signals propagating through the air because it is separated from the speaker’s throat. *Id.* at 10 (citing Ex. 1005, 5:29–46, Figs. 3, 5, 7).

At this stage and on this record, we are not persuaded by Patent Owner’s arguments. First, we disagree that Meisel uses a “push-to-talk” button to the exclusion of a throat microphone. *See* Prelim. Resp. 8–9 (citing Ex. 1005, 11:8–15, Fig. 13). The “push-to-talk” button or switch 34 identified by Patent Owner is a button used to detect voicing activities, but only is depressed “during the time that the words being spoken by the speaker are intended to be reproduced in a printed or typewritten form.” *See* Ex. 1005, 3:40–53, 6:24–29, Figs. 3, 5, 13. The use of a button to indicate when spoken word should be converted to written text does not detract from the fact that Meisel discloses and uses a throat microphone that detects vibration from the vocal cords. *See* Ex. 1005, 2:31–48.

Second, we are not persuaded that the physiological information recited in claim 1 excludes information reflected in acoustic signals. Claim 1 does not recite whether the voicing sensor is acoustic or non-acoustic. *See* Ex. 1001, 11:8–35. Notably, claim 2’s limitations are similar to those in claim 1, but claim 5, which depends from claim 2, recites the “voicing sensor includes at least one detector selected from a group including . . . *acoustic* throat microphones.” *See id.* at 12:1–5, 30–33 (emphasis added). That is, claims 2 and 5 suggest that neither the term “physiological” nor the term “voicing sensor” excludes acoustic microphones.

On the current record, we preliminarily determine that the ’058 patent also supports this reading. For example, the ’058 patent discloses a “nonacoustic sensor” but explains that other embodiments “may use any sensor that is able to detect human tissue motion associated with speech and is unaffected by environmental acoustic noise.” *Id.* at 3:60–63. The ’058 patent also discloses that some embodiments are “acoustic-only.” *Id.* at 3:10–4:13, 4:42–57, *cited in* Prelim. Resp. 10. Thus, we determine, at this stage, the term “voicing sensor” encompasses acoustic microphones. *See* Pet. 21 (citing Ex. 1001, 3:61–63; Ex. 1005, 1:10–15, 2:31–35).

Patent Owner argues that “Meisel’s throat microphone is not a ‘voicing sensor’ because it does not sense voicing activity.” Prelim. Resp. 9. According to Patent Owner, Meisel’s microphone only detects certain consonants—i.e., whether a particular sound is a voiced or unvoiced consonant. *Id.* (citing Ex. 1005, 2:23–45). At this stage and on this record, we are not persuaded by Patent Owner that claim 1 excludes microphones that detect only certain consonants. *See id.* Patent Owner’s implicit

construction here requires detection of all voicing activity, but the claim merely requires receiving physiological information. *See id.* Apart from being “associated with human voicing activity,” the claim does not place further restrictions on the type or range of voicing activity that the physiological information is associated with.

The current record better supports Petitioner’s assertion that Meisel’s microphone 20 receives the recited “physiological information” for at least the reason that it “detects vocal cord vibrations associated with voicing activity (e.g., voiced speech) through sounds emanating from the speaker’s throat (physiological information).” Pet. 22. In fact, Meisel refers to human physiology in describing the type of information that the microphone detects: “the vibration of the vocal cords.” Ex. 1005, 2:31–35; *see also id.* at 5:29–36 (stating “microphone 20 is disposed to detect vibration of the vocal cords through sounds emanating from the throat of a speaker”). Thus, at this stage and on this record, we preliminarily determine that information associated with “vibration of the vocal chords” is “physiological information associated with human voicing activity,” as recited in claim 1. *See* Pet. 22–23. Thus, Petitioner sufficiently shows at this stage of the proceeding that Meisel discloses the voicing sensor recited in claim 1.

d) At Least One Processor

Claim 1 recites “at least one processor coupled among the microphones and the voicing sensor.” Ex. 1001, 11:15–16.

Petitioner contends that Meisel teaches claim 1’s “processor” limitation because Meisel discloses that all of its microphones, including the nose microphone (16) and two mouth microphones (18, 32), and the voicing sensor (throat microphone (20)) are all connected, or coupled, to the same

signal preprocessor (2) and then to the speech recognition subsystem (3).
Pet. 27 (citing Ex. 1005, Fig. 1, 4:27–34).

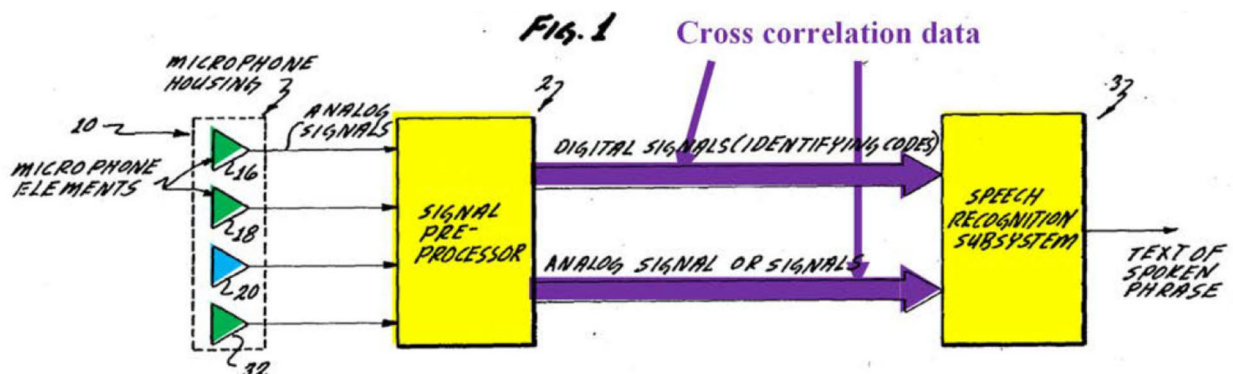
At this stage of the proceeding, Patent Owner makes no arguments specific to claim 1’s “processor” limitation. *See, e.g.*, Prelim. Resp. 8–24. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on the current record and for the reasons advanced by Petitioner and supported by Dr. Anderson’s testimony, Petitioner establishes sufficiently for purposes of institution that Meisel teaches claim 1’s “processor” limitation. *See* Pet. 27; Ex. 1005, Fig. 1, 4:27–34.

e) Processor Generates Cross Correlation Data

Claim 1 specifies that the processor “generates cross correlation data between the physiological information and an acoustic signal received at one of the two microphones.” Ex. 1001, 11:18–20.

Petitioner contends that Meisel in combination with Freidin renders obvious the “cross correlation data” limitation. *See* Pet. 26–37. To support its contentions, Petitioner provides annotations to Meisel’s Figure 1, reproduced below. *Id.* at 26.



Petitioner asserts that Meisel’s Figure 1, above, shows correlating information from microphone element 18, on the side of the mouth, with

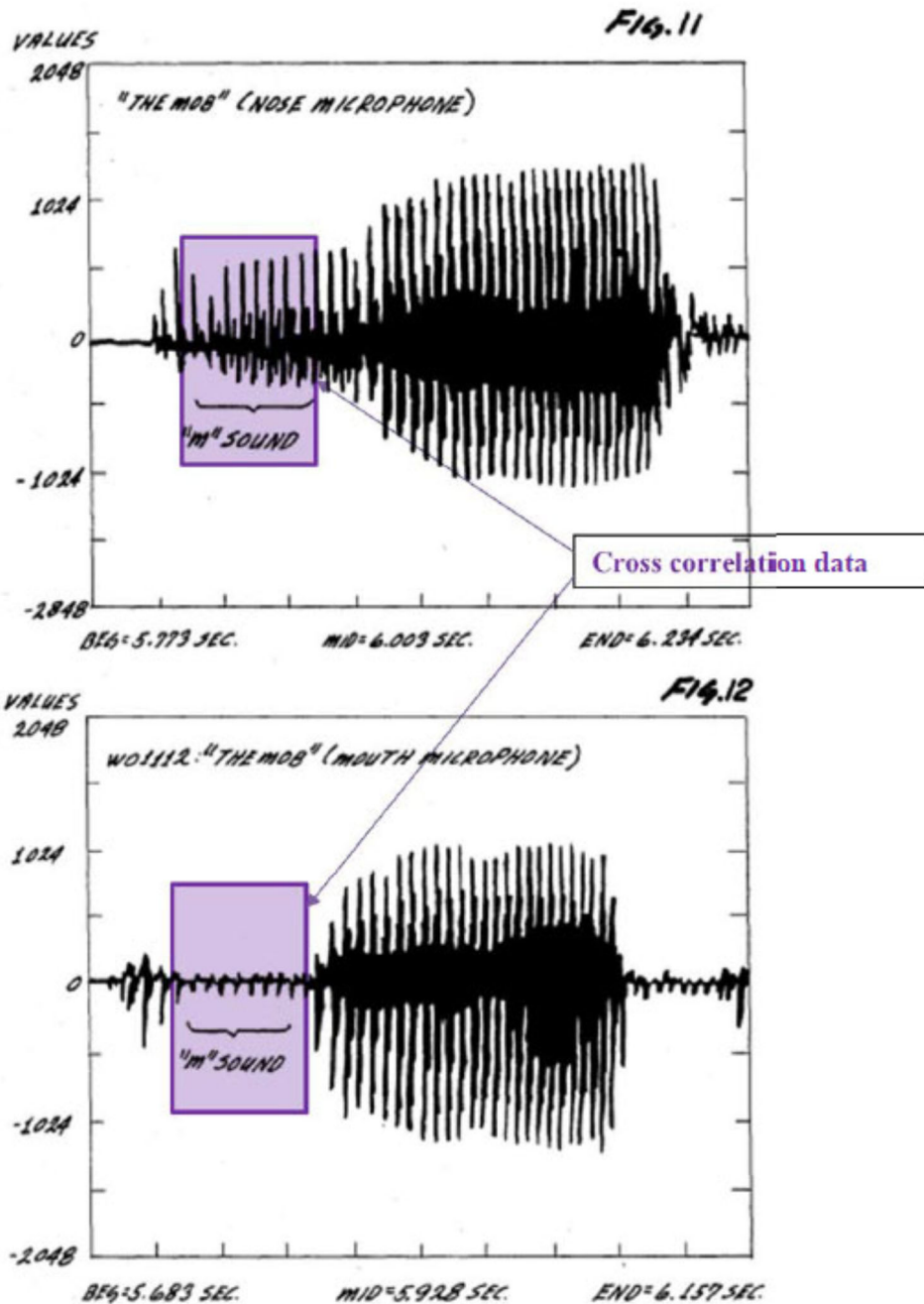
physiological information from microphone 32, on the throat. *Id.* at 26–27. The system sends analog signals from microphone elements 16, 18, 20, and 32 to signal preprocessor 2. *Id.* at 26 (citing Ex. 1005, 4:35–42). The system compares these signals and determines the differences or imbalances between their amplitudes. *Id.* These imbalances are coded as a pattern and sent to speech recognition subsystem 3. *Id.* at 27 (citing 4:35–44; Ex. 1003 ¶ 54).

Patent Owner contends Petitioner has not shown that Meisel generates the recited cross correlation data. Prelim. Resp. 16–18. According to Patent Owner, Meisel does not disclose receiving physiological information and uses a push-to-talk button. *Id.* at 17. Patent Owner argues that Petitioner’s assertions regarding Meisel’s imbalances being cross correlation data are only supported by the Anderson Declaration, which simply repeats Petitioner’s statements. *Id.* at 18.

At this stage of the proceeding, we are not persuaded by Patent Owner’s arguments. First, as discussed previously, we disagree that Meisel uses a “push-to-talk” button to the exclusion of not a throat microphone. *See* Ex. 1005, 11:9–14. The “push-to-talk” button or switch 34 identified by Patent Owner is not button used to detect voicing activities. Rather, according to Meisel, switch 34 is depressed “during the time that the words being spoken by the speaker are intended to be reproduced in a printed or typewritten form.” *See* Ex. 1005, 3:40–53, 6:24–29, Figs. 3, 5, 13.

Second, based on this preliminary record, Petitioner sufficiently explains why Meisel’s imbalances are a type of cross correlation: According to Petitioner, a person of ordinary skill in the art “would understand that a pattern of imbalances is a type of cross correlation data because it contains,

or is based on, a correlation between signal amplitudes of the acoustic microphones (e.g., side mouth microphone 18) and the throat microphone 20.” Pet. 27 (citing Ex. 1003 ¶ 55). In addition to citing Dr. Anderson’s Declaration, Petitioner asserts that Meisel’s Figures 11 and 12, shown below, demonstrate a correlation. *Id.* at 29.



Figures 11 and 12, above, are graphs of waveform and are shown with Petitioner's annotations indicating what it contends is the cross correlation data. Pet. 28 (citing Ex. 1005, 8:24–59, Figs. 11–12). According to the Petition, these figures show that signals from nose microphone 16 and mouth microphones 18 and 32⁵ are correlated to determine whether a part is nasal. *Id.* at 28–29. At this stage, we determine Meisel supports this position for at least the reason that Meisel compares these different signals and generates an output representing the result of that comparison. Pet. 27 (citing Ex. 1005, 4:35–44).

Patent Owner's argument does not appear to be based on a specific claim construction that would exclude Meisel's comparison. *See* Prelim. Resp. 7, 17–19. Nor does Patent Owner support its argument with sufficient relevant discussion of cross correlation from the challenged patent. *See id.* To the contrary, Dr. Anderson testifies that “[c]ross correlation functions were so conventional that the '058 patent identifies the built-in conventional XCORR function rather than explaining cross correlation.” Ex. 1003, 46 n.1 (citing Ex. 1001, 4:64–53); *see also id.* ¶ 66 (describing XCORR). As noted by Dr. Anderson, the '058 patent discloses that “the cross-correlation (XCORR) between the acoustic signal from microphone 1 and the sensor data” is optional. *See* Ex. 1001, 5:1–6. The '058 patent describes instances when XCORR is useful and when it is not:

The XCORR can also be useful when the sensor signal is distorted or modulated in some fashion. For example, there are

⁵ Petitioner asserts that the cross correlation process associated with Figures 11 and 12 also applies to the signals from the throat microphone and the side-mouth microphone. Pet. 28 (citing Ex. 1005, 8:24–59, 9:60–66, Fig. 13).

sensor locations (such as the jaw or back of the neck) where speech production can be detected but where the signal may have incorrect or distorted time-based information. That is, they may not have well defined features in time that will match with the acoustic waveform. However, XCORR is more susceptible to errors from acoustic noise, and in high (<0 dB SNR) environments is almost useless. Therefore, it should not be the sole source of voicing information.

Id. at 5:15–25. The patent compares the XCORR values to a threshold. *Id.* at 5:39–45. Notably, the patent expressly defines some terms, but “crosscorrelation” is not listed among them. *See, e.g., id.* at 10:30–40. During trial, Patent Owner is invited to discuss these and other passages from the patent to the extent that it believes there is a special definition for crosscorrelation that would exclude Meisel’s comparisons.

Patent Owner also argues that it would not have been obvious to modify Meisel to include Freidin’s crosscorrelation. Prelim. Resp.19 (citing Pet. 30–36). According to Patent Owner,

The purpose of the throat microphone in Meisel is to differentiate voiced sounds from unvoiced sounds. Meisel, 2:31-48. If its push-to talk button is pressed, Meisel outputs a 1 from the ADCI 58 when a sound is voiced (as opposed to unvoiced), in which case the throat microphone amplitude is greater than the side mouth microphone amplitude. Meisel, 10:9-11. Meisel does not state or identify a need to determine a period where both a mouth microphone and throat microphone have high amplitudes, and no such need exists in view of its push-to-talk button.

Neither Dr. Anderson nor Petitioner identify such a need. Instead, they simply state that voiced speech types correlate when signals at the throat and a signal microphone are high. Pet. at 32; Ex. 1003, ¶ 62.

Id.

At this stage of the proceeding, we are not persuaded by Patent Owner because this argument appears to ignore the fact that the “push-to-talk” button or switch 34 identified by Patent Owner is not a button used to detect voicing activities to the exclusion of a throat microphone. Ex. 1005, 11:9–14. Rather, according to Meisel, switch 34 is depressed “during the time that the words being spoken by the speaker are intended to be reproduced in a printed or typewritten form.” *See* Ex. 1005, 3:40–53, 6:24–29, Figs. 3, 5, 13. Second, Patent Owner appears to ignore Petitioner’s reliance on Freidin. *See* Pet. 31–37 (citing Ex. 1003 ¶¶ 61–66). For example, Petitioner asserts that, “to allow for [a] more accurate characterization of Meisel’s speech,” it would have been obvious to use Freidin’s cross correlation “to identify sounds at the throat and mouth microphones as their respective voiced or unvoiced type based on whether the throat microphone has a high signal amplitude, rather than rejecting them as noise.” *See* Pet. 30; *see also id.* at 41 (explaining that Freidin provides additional accuracy and expands to correlating other speech types).

Petitioner asserts that a person of ordinary skill in the art would have found it obvious to use Freidin’s correlator to identify voiced speech when the difference is small:

A POSITA would have found it obvious to apply Freidin’s correlator to the input signals from Meisel’s side mouth microphone (18) and throat microphone (20) to calculate a correlation value (cross correlation data) between the two input signals to identify voiced speech when the signals are both present at both microphones (e.g., the difference would be small because a signal is present both at the throat and mouth microphones).

Id. at 30–31.

Patent Owner further argues that Petitioner has not provided sufficient reasons to combine Meisel and Freidin. Prelim. Resp. 21. Patent Owner argues, for instance, that Petitioner simply argues that both references exist, without explaining why the combination would be more accurate. *Id.* (citing Pet. 32). Patent Owner argues that “Petitioner identifies no teaching in Meisel suggesting that Meisel’s disclosure is lacking in accuracy; nor does Petitioner provide any argument that one of skill in the art would have perceived a lack of accuracy within Meisel.” *Id.* In Patent Owner’s view, “Petitioner’s suggestion that Meisel could somehow benefit from Freidin tacitly assumes that a POSITA would stop using Meisel’s push-to-talk button in favor of Meisel’s throat microphone, without any justification whatsoever.” *Id.*

We are unpersuaded by Patent Owner’s arguments. Rather, at this stage, we are persuaded that Petitioner sufficiently supports its assertion that Freidin’s cross correlation would improve the accuracy of Meisel’s identification. Pet. 31–32. The Petition explains that, unlike Meisel, Freidin describes how to use the cross correlation data:

While Meisel and Freidin both correlate between signals, Freidin describes the cross correlation function to produce the cross correlation data and explains how to use that cross correlation data to compare it with threshold y_{TH} to identify a result, such as Meisel’s voiced speech.

Pet. 40–41.⁶ Petitioner asserts that Meisel’s ADCI unit compares the signals from the throat and side-mouth microphones. *Id.* at 29. If the output is

⁶ This explanation is placed in the section addressing limitation [1e] directed to identifying information of the signals as voiced speech. *See* Pet. 36. Although the explanation is in a separate section, it is part of Petitioner’s

nonzero, signal processor 2 determines that voiced speech is present. *Id.* (citing Ex. 1005, 9:12–22). Dr. Anderson’s testimony supports Petitioner’s position and explains that accuracy of this depends on ADCI’s calculation:

A POSITA also would have been motivated to use cross correlation, as disclosed in Freidin, to identify voiced speech types because such voiced speech types correlate when the signals at the throat microphone and signal microphone (e.g., mouth microphone) are high and the differences of the ADCI calculation may therefore be small. Thus, a POSITA would have been motivated to use Freidin’s cross correlation calculation to improve the accuracy of voiced and unvoiced speech identification already performed by Meisel.

Ex. 1003 ¶ 62, *discussed in* Pet. 31–32. Petitioner explains that Freidin’s cross correlation can be used when the signal is present at both microphones, and can expand to correlating voiced-speech types other than just voiced stops. Pet. 40–41 (citing Ex. 1007 ¶ 73).

At this stage and on this record, Petitioner has sufficiently shown that the Meisel-Freidin combination teaches or suggests a processor that “generates cross correlation data between the physiological information and an acoustic signal received at one of the two microphones,” and we determine that Petitioner’s articulated reasoning for combining the references has rational underpinning and is sufficiently supported by the cited evidence.

reason why Meisel and Freidin would have been combined, which is relevant to Patent Owner’s argument. *Id.*

*f) Processor Identifies Information of the Acoustic Signals
as Voiced Speech*

Claim 1 specifies that the processor “identifies information of the acoustic signals as voiced speech when the cross correlation data corresponding to a portion of the acoustic signal received at the one receiver exceeds a correlation threshold.” Ex. 1001, 11:21–24.

Petitioner asserts that a skilled artisan “would have been motivated to combine Meisel’s speech processing system with Freidin’s correlator to compare the correlation value (cross correlation data, *supra* § V.A.4.e)⁷ to a correlation threshold to identify the speech type as voiced speech in Meisel.” Pet. 40.

Patent Owner argues that Meisel will not identify voiced speech when the correlation data exceeds a threshold, and Freidin does not remedy Meisel’s deficiency. Prelim. Resp. 22–23. According to Patent Owner, “Meisel makes a simple comparison between the throat and mouth microphones without checking whether anything exceeds a threshold.” *Id.* at 22. Patent Owner then argues that “Freidin teaches multiplying an input data sample by corresponding reference values and comparing that product to a threshold,” but does not teach identifying voiced speech. *Id.* at 23.

We are unpersuaded by Patent Owner’s argument at this stage of the proceeding because Petitioner proposes using Freidin’s cross correlation calculation to improve the accuracy of Meisel’s voiced- and unvoiced-speech identification. Pet. 37–40. Specifically, Petitioner notes that both

⁷ Section V.A.4.e of the Petition analyzes the recited “cross correlation data between the physiological information and an acoustic signal received at one of the two microphones.” *See* Pet. 26.

references use cross correlation. *Id.* at 38–39; *see also supra* § III.E.1.e (discussing the Freidin’s cross correlation). Patent Owner’s argument does not address how Petitioner relies on the collective teachings of Meisel and Freidin to arrive at the claimed limitation, and we disagree with Patent Owner’s argument for the reasons discussed in III.E.1.e. *See Prelim. Resp.* 22–23

Based on the current record and for the reasons advanced by Petitioner and supported by Dr. Anderson’s testimony, we are persuaded Petitioner has sufficiently shown that the Meisel-Freidin combination teaches or suggests a processor that “identifies information of the acoustic signals as voiced speech when the cross correlation data corresponding to a portion of the acoustic signal received at the one receiver exceeds a correlation threshold.” *See Pet.* 37–40. At this stage, we preliminarily determine that Petitioner’s articulated reasoning for combining the references has rational underpinning and is sufficiently supported by the cited evidence for institution. *See Pet.* 40; *see supra* § III.E.1.e.

g) Processor Generates Difference Parameters

Claim 1 specifies that the processor “generates difference parameters between the acoustic signals received at each of the two receivers, wherein the difference parameters are representative of the relative difference in signal gain between portions of the received acoustic signals.” *Ex.* 1001, 11:25–29.

Petitioner contends that the disclosure in Meisel teaches claim 1’s “difference parameters” limitation. *See Pet.* 43–49. Specifically, Petitioner asserts that Meisel “generates difference parameters between the acoustic signals received at each of the two receivers (e.g., microphones 16, 18),

wherein the difference parameters are representative of the relative difference in signal gain between portions of the received acoustic signals. Ex. 1003 ¶ 76. According to Petitioner, different microphones in Meisel (e.g., nose microphone (16) and mouth microphone (18)) generate different signal amplitudes for the received signals, and the signal pre-processor (2) compares those signals to determine “instant imbalances in the relative amplitude of each microphone.” Pet. 43 (citing Ex. 1005, 4:35–39). Petitioner argues that Meisel’s “imbalances” refer to differences in the signal amplitudes received at different microphones, which a person of ordinary skill in the art would have recognized as the signal gain. *Id.* at 44 (citing Ex. 1003 ¶ 77).

Meisel further discloses that the difference parameters are representative of the relative difference in signal gain between portions of the received acoustic signals. Pet. 45 (citing Ex. 1003 ¶ 79). According to Petitioner, a person of ordinary skill in the art would have understood that amplitude signals are representative of the signal gain for each microphone, and the difference in gain is used to determine, e.g., voiced speech. *Id.* at 46 (citing Ex. 1003 ¶ 79). Petitioner argues that Meisel’s summing unit (504), which acts as a comparator, generates difference parameters by inverting the amplitude of the second microphone signal (e.g., the nose microphone (16)), and summing the inverted signal with the amplitude of the first acoustic signal. *Id.* (citing Ex. 1005, 9:12–22). Petitioner then argues a person of ordinary skill in the art would have understood that the acoustic signals from the first mouth microphone (18) can be compared with those of the second mouth microphone (32) to determine a difference in their signal gains and

generate difference parameters between the two mouth microphones. *Id.* at 49 (citing Ex. 1003 ¶ 82).

At this stage of the proceeding, Patent Owner makes no arguments specific to claim 1's "difference parameters" limitation. *See, e.g.*, Prelim. Resp. 6–13. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on the current record and for the reasons advanced by Petitioner and supported by Dr. Anderson's testimony, Petitioner establishes sufficiently for purposes of institution that the disclosure in Meisel teach or at least suggests claim 1's "difference parameters" limitation. *See* Pet. 43–49; Ex. 1003 ¶¶ 76–82.

*h) Processor Identifies Information of the
Acoustic Signals as Unvoiced Speech*

Claim 1 specifies that the processor "identifies information of the acoustic signals as unvoiced speech when the difference parameters exceed a gain threshold." Ex. 1001, 11:30–32.

Petitioner contends that the disclosure in Meisel teaches claim 1's "identifies unvoiced speech" limitation. *See* Pet. 50–56. Specifically, Petitioner cites to Figure 13 of Meisel and asserts that a person of ordinary skill in the art would have recognized that Meisel's disclosure of the throat microphone (20) would also increase the accuracy of speech recognition when combined or compared with various speech types (e.g., fricative/plosive identification) to distinguish voiced and unvoiced speech. *Id.* at 53–54 (citing Ex. 1005, 9:38–50, 10:7–11; Ex. 1003 ¶ 87). According to Petitioner, Meisel performs generating the difference parameters and comparing the difference parameters to a gain threshold in two steps and that

a person of ordinary skill in the art would have understood “it was less expensive and easier to calculate the A-B and -T1 steps separately when using logic circuits and also negligible in processing time when using digital signal processing.” *Id.* at 56 (citing Ex. 1003 ¶ 88).

At this stage of the proceeding, Patent Owner makes no arguments specific to claim 1’s “identifies unvoiced speech” limitation. *See, e.g.*, Prelim. Resp. 6–13. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on the current record and for the reasons advanced by Petitioner and supported by Dr. Anderson’s testimony, Petitioner establishes sufficiently for purposes of institution that the disclosure in Meisel teaches or at least suggests claim 1’s “identifies unvoiced speech” limitation. *See* Pet. 50–56; Ex. 1003 ¶¶ 83–88.

*i) Processor Identifies Information
of the Acoustic Signals as Noise*

Claim 1 specifies that the processor “identifies information of the acoustic signals as noise when the difference parameters are less than the gain threshold.” Ex. 1001, 11:33–35.

Petitioner asserts that Meisel suggests detecting noise to minimize its effects on accurate speech detection. Pet. 56–57. But, according to the Petition, “Meisel does not expressly disclose identifying acoustic signals as noise.” *Id.* at 60. Petitioner asserts that a person of ordinary skill in the art “would have been motivated to combine Meisel’s speech processing system with Kaneda’s conventional speech and noise determination using difference parameters between two acoustic input signals.” *Id.* at 59 (citing Ex. 1006, 1:51–2:22; Ex. 1003 ¶¶ 93–94).

In particular, Petitioner explains that using a threshold as recited would have been obvious in view of Kaneda. *Id.* at 57–58 (citing Ex. 1006, 1:61–63, Figs. 2(a), 2(b), 3(a), 3(b); Ex. 1003 ¶ 91). Petitioner explains that Kaneda’s system identifies the signals as noise when the difference between the speech power output is below a threshold. *Id.* at 58 (citing Ex. 1006, 2:12–22; Ex. 1003 ¶ 92). Petitioner notes that “Meisel discloses that the acoustic signals from two acoustic microphones would be compared with each other to determine the difference in their signal amplitudes,” and likewise, Kaneda “uses a difference in signal amplitudes, and explains how the difference would be used to distinguish between noise and speech instead of determining speech type.” *Id.* at 59–60 (citing Ex. 1005, 9:12–50; Ex. 1006, 2:12–22).

Patent Owner disagrees and first argues Meisel does not disclose identifying any information as noise at all, because it does not receive sound unless its push-to-talk button is pressed. Prelim. Resp. 12. According to Patent Owner, “[e]ven if the absence of receiving were an ‘identification’ (it is not), Meisel makes that determination based on whether its push-to-talk button is pressed, not based on any comparison of signals, let alone a comparison of ‘difference parameters’ to a ‘gain threshold.’” *Id.*

As discussed previously, we are unpersuaded that Meisel uses a “push-to-talk” button to the exclusion of a throat microphone. *See* Prelim. Resp. 8–9 (citing Ex. 1005, 11:8–15, Fig. 13). The “push-to-talk” button or switch 34 identified by Patent Owner is a button used to detect voicing activities, but only is depressed “during the time that the words being spoken by the speaker are intended to be reproduced in a printed or typewritten form.” *See* Ex. 1005, 3:40–53, 6:24–29, Figs. 3, 5, 13. The use of a button

to indicate when spoken word should be converted to written text does not detract from the fact that Meisel discloses and uses a throat microphone that detects vibration from the vocal cords. *See* Ex. 1005, 2:31–48.

Patent Owner then argues that Meisel compares two mouth microphones to determine if a plosive or fricative is being pronounced, not to identify noise. Prelim. Resp. 14–15 (citing Ex. 1005, 10:6–9, Fig. 1). According to Patent Owner, Meisel explains that some sounds are not plosives or fricatives, such as nasal sounds, and these sounds are not noise but would be classified as such under Petitioner’s interpretation. *Id.* at 15–16. Patent Owner asserts that “Petitioner’s combination relies on the false premise that Meisel’s ADCI (rather than its push-to-talk button) detects whether sounds are noise by comparing amplitude” which “is demonstrably false.” *Id.* at 15.

Petitioner, though, explains that Kaneda would be implemented as an additional signal-processing step that would detect noise in parallel. Pet. 63. Patent Owner’s arguments about plosives and fricatives do not squarely address this reasoning. Prelim. Resp. 15–16. That is, according to our understanding, Petitioner is not proposing to replace Meisel’s signal-processing functions. Rather, Petitioner explains that “implementing Kaneda’s noise detection in Meisel’s system would not inhibit Meisel’s signal processing functions, which are used to determine the types of speech for speech recognition.” Pet. 63–64.

Patent Owner, however, presumes that it would be the two mouth microphones. Prelim. Resp. 15. Patent Owner argues that “Petitioner’s proposed system would calculate the difference between the power output of two microphones (the example given is the two mouth microphones) and,

when that difference is greater than a threshold, speech is detected.” *Id.* (citing Pet. 57). Patent Owner further argues implementing Kaneda in Meisel, as Petitioner proposes, would destroy Meisel’s inventive purpose:

Meisel already compares the signals of the two mouth microphones and, as explained above, does not consider those signals noise. Instead, if the mouth microphones’ amplitudes are similar, Meisel interprets that sound as not fricative or plosive. Meisel, 10:7-9. Similarly, if the Petition is interpreted such that the inputs to the Kaneda system are the mouth microphone and nose microphone, Meisel uses those comparisons to detect partial closure of the mouth or nasal sounds. Meisel, 10:4-7. Adding Kaneda would instead, at best, result in at least some of those desired signals as being recorded as noise, frustrating Meisel’s intention to detect speech. A POSITA would not make such a combination, as it would destroy the objective of Meisel. *Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1068 (Fed. Cir. 2016); *Chemours Co. FC, LLC v. Daikin Indus., Ltd.*, 4 F.4th 1370, 1376-77 (Fed. Cir. 2021).

Id. at 15–16.

Here, Patent Owner argues that Petitioner proposes changing how Meisel interprets sound. *See id.* But we do not understand that to be part of Petitioner’s obviousness rationale. Rather, Petitioner proposes adding a step to Meisel: “Kaneda’s conventional signal processing for detecting noise uses the signals received and difference parameters already calculated in Meisel’s system, *adding an additional signal processing step to detect noise.*” Pet. 63–64 (emphasis added). Petitioner explains that “Kaneda’s conventional noise detection would be implemented *in parallel* with Meisel’s speech detection.” *Id.* at 64 (citing Ex. 1003 ¶ 100) (emphasis added). At this stage, we see nothing on this preliminary record that would

lead us to conclude that adding a noise-detection step in parallel to Meisel's processing would destroy its inventive purpose.

Patent Owner next argues "Meisel generally assumes that received signals will not include noise because of Meisel's use of 'close-talking microphones.'" Prelim. Resp. 15 (citing Ex. 1005, 2:54–60, 6:8–11). We disagree at this stage because this argument does not give sufficient weight to Meisel's discussion of Sakoe's system, which detects background noise to minimize "its effect on recognition accuracy." Pet. 57 (citing Ex. 1005, 1:46–50; Ex. 1003 ¶ 89). Here, Meisel expressly acknowledges that noise is a problem for accurate recognition, so noise should be minimized. Ex. 1005, 1:46–60.

Petitioner explains that that Kaneda would be used "to identify noise periods to mitigate errors in speech recognition." Pet. 60. Petitioner sufficiently explains that Meisel's closely spaced microphone arrangement meets the conditions for Kaneda's system to accurately distinguish speech and noise. *See id.* at 60–63. And, according to Petitioner, "Kaneda's teachings are directly implementable in Meisel's system." *Id.* at 60. At this stage, Petitioner sufficiently supports its reasoning that adding noise detection would improve Meisel. *See id.* at 56–64. During trial, though, the parties are invited to address the performance of Meisel's closely spaced microphones in the presence of noise.

At this stage, Petitioner has sufficiently shown that the proposed combination teaches or suggests a processor that "identifies information of the acoustic signals as noise when the difference parameters are less than the gain threshold." *See id.*

k) Preliminary Conclusion for Obviousness/Nonobviousness of Claim 1

As discussed above, Petitioner’s analysis explains how the combined disclosures in Meisel, Kaneda, and Freidin teach claim 1’s subject matter. *See supra* §§ III.E.1(a)–(i). Additionally, Petitioner provides a reason with rational underpinning as to why an ordinarily skilled artisan would have had a reason to combine the teachings of Meisel, Kaneda, and Freidin in the way Petitioner proposes and would have had a reasonable expectation of success. *See* Pet. 33–37, 42–43, 63–64. Hence, Petitioner demonstrates a reasonable likelihood of prevailing in proving claim 1 unpatentable under § 103(a) as obvious over Meisel, Kaneda, and Freidin.

2. Analysis of Independent Claim 2

Independent claim 2 recites “[a] method for removing noise from acoustic signals” comprising steps that parallel the processor operations specified in claim 1. Ex. 1001, 12:1–24.

Petitioner’s challenge to claim 2 largely relies on its analysis of claim 1. Pet. 65–67.⁸ Petitioner asserts that independent claim 2 does not recite denoising. *Id.* at 65. Petitioner asserts that identifying and removing noise would have been obvious because it provides better speech recognition and mitigates the problems discussed by Kaneda. *Id.* (citing 1003 ¶ 105).

⁸ Petitioner states that “Meisel teaches or suggests each element of claim 2.” Pet. 65. But Petitioner relies on an analysis of Meisel, Freidin, and Kaneda. *See id.* at 65–66. For example, Petitioner refers to sections V.A.4.e and V.A.4.i of the Petition (*id.*), which analyzes teachings from all three references. *See, e.g., id.* at 31–36 (discussing Freidin in section V.A.4.e); *id.* at 55–64 (discussing Kaneda in section V.A.4.i). Also, Petitioner lists all three references in its summary of the challenges. *Id.* at 2. Thus, all three references are used in Petitioner’s challenge to claim 2.

Petitioner asserts that Meisel discusses Sakoe’s noise-removing method in the *Background* section. *Id.* at 66 (citing Ex. 1005, 1:46–50).

Patent Owner does not present separate arguments specific to the subject matter recited in claim 2. *See* Prelim. Resp. 18. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

For the reasons discussed in Section III.E.1. and based on our review of the Petitioner’s analysis of the subject matter specific to claim 2, we determine Petitioner has sufficiently shown, at this stage, that the proposed combination of Meisel, Kaneda, and Freidin teaches or suggests the subject matter of claim 2. *See* Pet. 65–67.

3. *Analysis of Dependent Claims 4 and 5*

Claims 4 and 5 depend directly from claim 2. Ex. 1001, 12:25–33. Claim 4 recites, “The method of claim 2, further comprising performing denoising on the identified noise.” Ex. 1001, 12:28–29. Claim 5 recites, “The method of claim 2, wherein the voicing sensor includes at least one detector selected from a group including . . . acoustic throat microphones” *Id.* at 12:30–33.

Regarding claim 4, Petitioner contends “that the identification and minimization of noise disclosed in Meisel and Kaneda correspond to ‘performing denoising on the identified noise.’” Pet. 68 (citing Ex. 1003 ¶ 114). Petitioner then asserts that a person of ordinary skill in the art would have combined Meisel and Kaneda and that “Kaneda also discloses detecting noise and minimizing its effect on speech recognition.” *Id.* (citing Ex. 1006, 4:59–63; Ex. 1003 ¶ 115).

Regarding claim 5, Petitioner contends that Meisel uses throat microphone 20 to detect vocal-cord vibration. Pet. 68 (citing Ex. 1005, 2:31–35). According to the Petition, a person of ordinary skill in the art would have understood “that Meisel’s throat microphone (20) is an acoustic throat microphone because it ‘is disposed to detect vibration of the vocal cords through sounds emanating from the throat of a speaker.’” *Id.* at 69 (citing Ex. 1005, 5:29–36; Ex. 1003 ¶ 116)

At this stage of the proceeding, Patent Owner does not provide arguments specific to claims 4 and 5. *See, e.g.*, Prelim. Resp. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on the current record and for the reasons advanced by Petitioner and supported by Dr. Anderson’s testimony, Petitioner establishes sufficiently for purposes of institution that the references teach the limitations in claims 4 and 5. *See* Pet. 67–69; Ex. 1003 ¶¶ 110–116. Hence, Petitioner demonstrates a reasonable likelihood of prevailing in proving claims 4 and 5 unpatentable under § 103(a) as obvious over Meisel, Kaneda, and Freidin.

*E. Alleged Obviousness in view of Meisel,
Kaneda, Freidin, and Lyons: Claim 3*

Petitioner contends that claim 3 is unpatentable under § 103(a) as obvious over Meisel, Kaneda, Freidin, and Lyons. *See* Pet. 2, 69–73. Patent Owner disputes Petitioner’s contentions. *See* Prelim. Resp. 24. As explained below, Petitioner establishes sufficiently for purposes of institution that the combined disclosures in Meisel, Kaneda, Freidin, and Lyons teach claim 3’s subject matter.

1. Analysis of Dependent Claim 3

Claim 3 depends directly from claim 2 and further requires “generating the gain threshold using standard deviations corresponding to the generation of the difference parameters.” Ex. 1001, 12:25–27.

Petitioner asserts that Meisel discloses a gain threshold, but “does not expressly disclose generating the gain threshold using standard deviations corresponding to the generation of the difference parameters.” Pet. 71. For this feature, Petitioner relies on Lyons. *Id.* According to Petitioner,

A POSITA would understand that applying this well-known statistical technique to calculate standard deviations of the differences in the received signals (alternatively, the difference of the standard deviations of each received signal) represents the general variation that corresponds to the meaningful threshold difference in the signals (gain thresholds).

Id. (citing Ex. 1003 ¶ 123; Ex. 1001, 8:41–47). Petitioner then asserts that a person of ordinary skill in the art would have recognized “that applying standard deviations to generating the gain threshold for speech signal processing would have been obvious because the standard deviation represents the background power in signal processing that corresponds to the threshold at which the difference in signals is meaningful.” *Id.* at 72 (citing Ex. 1003 ¶ 125). Petitioner then asserts that claim 3 “appears to lack written description and be indefinite as written.” *Id.* at 70 n.4.

Indefiniteness “does not necessarily preclude the Board from addressing the patentability of the claims on section 102 and 103 grounds.” *Samsung Elecs. Am., Inc. v. Prisia Eng’g Corp.*, 948 F.3d 1342, 1353 (Fed. Cir. 2020). Rather, “[t]he indefiniteness of a limitation . . . precludes a patentability determination only when the indefiniteness renders it logically impossible for the Board to reach” a determination of the patentability of a

claim on the presented prior-art grounds. *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 801, 813 (Fed. Cir. 2021). *Intel* explained that “[t]he inter partes review scheme as a whole confirms the limited character of the impossibility qualifier to” the Board’s obligation to determine the patentability of every challenged claim:

That scheme protects the interests not only of the petitioner in securing a determination on the patentability of a claim, but other interests as well. It protects interests of the patentee, as well as of the judicial system and the agency, in diminishing duplication of adjudication burdens and risks in specified respects. *See, e.g.*, 35 U.S.C. § 315(b) (timing limit on seeking IPR once district court action filed), § 315(e) (estoppel provision against other proceedings). And it reflects a public interest in the Board’s answering the patentability questions, reflected in the statutory authorization for the Board to decide an inter partes review even after petitioners have withdrawn. 35 U.S.C. § 317.

Id.

We invite the parties to discuss whether any alleged indefiniteness precludes a patentability determination in this case. *See* Pet. 70 n.4.

Patent Owner disputes that Meisel, Kaneda, Freidin, and Lyons teach claim 3’s subject matter. Prelim. Resp. 24. Specifically, Patent Owner asserts that Petitioner’s arguments for claim 3 “do not remedy the deficiencies” of the challenge to the independent claims. *Id.*

Based on the current record and for the reasons discussed above for claims 1 and 2, we disagree with Patent Owner that there are deficiencies in the references as applied to claim 3. *See supra* §§ III.E.1(a)–(i). Thus, we find Petitioner establishes sufficiently for purposes of institution that the combined disclosures in Meisel, Kaneda, Freidin, and Lyons teach claim 3’s subject matter. *See* Pet. 69–73; Ex. 1003 ¶¶ 120–127.

*F. Alleged Obviousness over Meisel, Kaneda,
Freidin, and Sakoe: Claim 4*

Petitioner contends that claim 4 is unpatentable under § 103(a) as obvious over Meisel, Kaneda, Freidin, and Sakoe. *See* Pet. 2, 74–75. Patent Owner disputes Petitioner’s contentions. *See* Prelim. Resp. 24. As explained below, Petitioner establishes sufficiently for purposes of institution that the combined disclosures in Meisel, Kaneda, Freidin, and Sakoe teach the subject matter in claim 4.

1. Analysis of Dependent Claim 4

Claim 4 recites, “The method of claim 2, further comprising performing denoising on the identified noise.” Ex. 1001, 12:28–29.

Petitioner asserts that Meisel, Kaneda, and Freidin render claim 4 obvious. Pet. 74; *see supra* § III.E.1. (discussing denoising). Petitioner argues that claim 4 is also rendered obvious by Meisel, Kaneda, Freidin, and Sakoe. *Id.* at 74–75. Petitioner explains that Meisel’s *Background* section discusses using Sakoe to detect noise and minimize its effect on speech-recognition accuracy. *Id.* at 75–76. According to Petitioner, “both Meisel and Kaneda, as modified by Freidin, provide some teaching, suggestion, or motivation to remove noise to improve the accuracy of Meisel’s speech recognition system.” *Id.* at 75.

Patent Owner does not present separate arguments specific to the Petitioner’s arguments and evidence about the subject matter recited in claim 4. *See* Prelim. Resp. 24. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on our review of the arguments and evidence submitted for claim 4 and the reasons presented in the discussion of noise detection and Sakoe in Sections III.E.1.i. and III.E.2., Petitioner has sufficiently shown at this stage that the combination of Meisel, Kaneda, Freidin, and Sakoe teaches or suggests “performing denoising on the identified noise,” as recited in claim 4.

IV. CONCLUSION

Based on the arguments and evidence presented by the parties, we determine that there is a reasonable likelihood Petitioner would prevail with respect to at least one claim challenged in the Petition. Hence, we institute an *inter partes* review of all challenged claims on all challenges included in the Petition. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1355 (2018) (noting that the language of 35 U.S.C. § 314(b) “indicates a binary choice—either institute review or don’t”); *see also PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (interpreting the statute as requiring “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition”).

V. ORDER

Accordingly, it is

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 1–5 in the ’058 patent is instituted on all challenges included in the Petition;

FURTHER ORDERED that, according to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial that commences on the entry date of this Decision.

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