

NOTE: This disposition is nonprecedential.

**United States Court of Appeals
for the Federal Circuit**

ANDREA ELECTRONICS CORPORATION,
Appellant

v.

APPLE INC.,
Appellee

2021-1248

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2017-00626.

Decided: April 22, 2022

WILLIAM D. BELANGER, Troutman Pepper Hamilton Sanders LLP, Boston, MA, argued for appellant. Also represented by FRANK D. LIU; ANDREW PETER ZAPPIA, Rochester, NY.

JOSHUA JOHN FOUGERE, Sidley Austin LLP, Washington, DC, argued for appellee. Also represented by THOMAS ANTHONY BROUGHAN, III, JEFFREY PAUL KUSHAN; TIMOTHY Q. LI, New York, NY.

Before MOORE, *Chief Judge*, REYNA and CHEN, *Circuit Judges*.

CHEN, *Circuit Judge*.

Patent owner Andrea Electronics Corp. (Andrea) appeals the *inter partes* review decision of the Patent Trial and Appeal Board (Board) finding claims 6–9 of U.S. Patent No. 6,363,345 ('345 patent) unpatentable as obvious over Hirsch¹ in view of Martin.² *Apple Inc. v. Andrea Elecs. Corp.*, No. IPR2017-00626, 2020 WL 6324693 (P.T.A.B. Oct. 28, 2020) (*Board Decision*).

This case is before us for a second time after we remanded part of the case back to the Board. *Apple Inc v. Andrea Elecs. Corp.*, 949 F.3d 697 (Fed. Cir. 2020), *vacating* No. IPR2017-00626, 2018 WL 3414463 (P.T.A.B. July 12, 2018) (*Prior Board Decision*). In the first appeal, we held the Board erred by not considering an argument made by petitioner Apple Inc. (Apple) on reply that we held did not present a new legal ground and properly responded to arguments raised by the patent owner's response. *Id.* at 706. The reply argument was that Martin discloses a "current minimum" and "future minimum" in an embodiment involving multiple subwindows. *Id.* at 699, 703–04. On remand, the Board considered the argument and found the claim limitations met but failed to properly analyze the motivation to combine Hirsch with Martin. We, therefore,

¹ H.G. Hirsch & C. Ehrlicher, *Noise Estimation Techniques for Robust Speech Recognition*, 1 International Conference on Acoustics, Speech, and Signal Processing 153 (1995). J.A. 453–456.

² R. Martin, *An Efficient Algorithm to Estimate the Instantaneous SNR of Speech Signals*, 92 Eurospeech 1093 (1993). J.A. 457–460.

vacate and remand. We affirm the Board's finding that Martin discloses the limitations of claim 9.

BACKGROUND

A

Our previous decision discusses the relevant technology, purported invention, and the prior art references. We therefore only provide details with particular relevance to this appeal.

Claims 6 through 9 are directed to an apparatus for canceling noise in an audio signal by detecting, for each frequency bin of the audio signal, a noise threshold using “current magnitude,” “future minimum,” and “current minimum” values. ’345 patent, claims 6–9. The current magnitude is the value of the audio signal at a given time. *See id.* at col. 5 ll. 35–38, col. 6 ll. 23–28. The future minimum is reset periodically to the current magnitude, and then updated to the current magnitude whenever the current magnitude is smaller than the future minimum. *Id.* at col. 6 ll. 24–32, col. 10 ll. 1–4, col. 10 ll. 9–12. The current minimum is initiated periodically with the value of the future minimum, and also follows the minimum value of the current magnitude. *Id.* at col. 6 ll. 33–41, col. 9 ll. 65–67, col. 10 ll. 5–8. The current minimum is used to determine the noise threshold, and the future minimum is used for initiation and refreshing of the current minimum. *Id.* at col. 6 ll. 38–57, col. 9 ll. 54–60. Based on the threshold, a portion of the signal that is estimated to be noise is removed in a technique called spectral subtraction. *See id.* at col. 1 ll. 19–21, col. 1 l. 58–col. 2 l. 10, col. 3 ll. 11–15, col. 3 ll. 24–45, col. 6 ll. 38–41, 58–61. The ’345 patent purports to differ from the prior art because its method can be used on audio signals that contain continuous speech rather than requiring a signal that contains explicit non-speech segments. *See id.* at col. 2 l. 45–col. 3 l. 15, col. 3 ll. 24–45.

Independent claim 1 and dependent claims 4 and 5 together recite an “apparatus for canceling noise” comprising a “threshold detector for setting a threshold for each frequency bin” of an audio signal “in accordance with a current minimum value,” which in turn is derived “in accordance with a future minimum value,” which itself is “determined as the minimum value of the magnitude . . . within a predetermined period of time.” *Id.* at col. 9 ll. 35–64. The dependent claims at issue in this appeal recite how the current minimum and the future minimum values are determined:

6. The apparatus according to claim 5, wherein said current minimum value is set to said future minimum value periodically.
7. The apparatus according to claim 6, wherein said future minimum value is replaced with the current magnitude value when said future minimum value is greater than said current magnitude value.
8. The apparatus according to claim 6, wherein said current minimum value is replaced with the current magnitude value when said current minimum value is greater than said current magnitude value.
9. The apparatus according to claim 5, wherein said future minimum value is set to a current magnitude value periodically; said current-magnitude value being the value of the magnitude of the corresponding frequency bin.

B

The prior art reference Hirsch discloses a noise estimation technique for use with spectral subtraction. J.A. 453, Abstract. Like the '345 patent, Hirsch explains that noise reduction is “usually done by detection of speech pauses to evaluate segments of pure noise” and that detecting speech

pauses “is a difficult task” in practical situations, specifically “if the background noise is not stationary.” J.A. 453. Hirsch acknowledges that “[s]ome approaches are known to avoid the problem of speech pause detection and to estimate the noise characteristics just from a past segment of noisy speech” and cites, among other references, Martin. J.A. 453 (citing reference [6]). Hirsch notes the “disadvantage of most approaches is the need of relatively long past segments of noisy speech.” J.A. 453. Hirsch then presents its spectral subtraction method for “estimat[ing] the spectral parameters of noise without an explicit speech pause detection” based on “calculat[ing] the noise level in each subband.” J.A. 453. Hirsch describes testing the accuracy of its method on “[d]ifferent stationary noise signals.” J.A. 454.

Hirsch’s estimation method involves a noise estimate that “is calculated with a first order recursive system,” in which an adaptive threshold is calculated as a weighted sum of past spectral magnitude values in a frequency subband according to a specific recursive algorithm. J.A. 453.

Martin, referenced in Hirsch, is directed to noise power estimation with a focus on using the noise power estimation to compute signal-to-noise ratios. J.A. 457–58. Martin also briefly discusses the use of the power estimation in spectral subtraction applications to reduce noise in a signal. J.A. 460. Like the ’345 patent and Hirsch, Martin describes the conventional approach of acquiring noise statistics based on “noise only segments.” J.A. 457. Like the ’345 patent and Hirsch, Martin then explains that its proposed algorithm “does not need an explicit speech/no-speech decision to gather noise statistics.” J.A. 457. Martin asserts that its algorithm is “capable [of] track[ing] non stationary noise signals and has a low computational complexity.” J.A. 457. The Board found Martin discloses a specific noise-level estimation algorithm that includes the steps recited in claims 6 through 9. *Board Decision*, at *6–7. In fact, Andrea does not dispute that Martin discloses

all of the limitations of claims 6 through 9, with the exception of the step in claim 9 “wherein said future minimum value is set to a current magnitude value periodically.” Appellant’s Br. 38–47.

Martin’s algorithm operates in a periodic manner on a window and subwindow basis. Specifically, the noise power estimate is calculated based on one period of L samples of an audio signal—which make up a “window”—that is further divided into periods of W subwindows of M samples. J.A. 458. The Board found that Martin’s $P_{Mmin}(i)$ (“minimum power of the last M samples”) value corresponds to the claimed future minimum value, *Board Decision*, at *4–5, $\bar{P}_x(i)$ (“smoothed power”) corresponds to the claimed current magnitude value, *id.* at *7 & n.9, and $P_n(i)$ (“estimated noise power”) corresponds to the claimed current minimum value, *id.* at *7. Martin teaches that at the beginning of every subwindow, $P_n(i)$ (current minimum) is set equal to the minimum power of the last M samples (future minimum of the preceding subwindow) or, alternatively, to the minimum power of the last L samples (future minimum of the preceding window). J.A. 458. Then, during the current subwindow period, whenever $\bar{P}_x(i)$ (current magnitude) is smaller than $P_n(i)$ (current minimum), $P_n(i)$ is updated with the smaller $\bar{P}_x(i)$ value. J.A. 458. During the subwindow period, by a samplewise comparison with $\bar{P}_x(i)$, $P_{Mmin}(i)$ (future minimum) is also updated to a smaller $\bar{P}_x(i)$ value whenever $\bar{P}_x(i)$ is less than $P_{Mmin}(i)$. J.A. 458, Fig. 2 (Flowchart conditional: if $\bar{P}_x(i) < P_{Mmin}$, then $P_{Mmin} = \bar{P}_x(i)$).

Relevant to claim 9, Martin discloses that at the end of every subwindow period, P_{Mmin} (future minimum) for the next subwindow period is reset to maximum value P_{max} . J.A. 458. Then, as just discussed, P_{Mmin} (future minimum) tracks $\bar{P}_x(i)$ (current magnitude) during the subwindow period whenever $\bar{P}_x(i)$ is less than P_{Mmin} . J.A. 458.

C

In its first final written decision, the Board rejected the obviousness ground based on Hirsch and Martin because Apple relied on an embodiment of Martin that involved no subwindows (in other words $W = 1$). *Prior Board Decision*, at *5–6. The Board first noted:

Initially, we agree with Petitioner that one skilled in the art would have considered Martin’s teachings, generally, when reviewing the teachings of Hirsch, as Martin is specifically referenced in Hirsch itself.

Id. at *5. But proceeded to say “[n]evertheless, we are not persuaded that one skilled in the art would have modified Hirsch’s system based on the teachings of Martin in the particular manner proposed by Petitioner” because “a scenario from Martin where $W = 1 \dots$ is counter to the entire purpose of Martin.” *Id.* at *6. The Board concluded, therefore, that there was no reason why one skilled in the art would have modified Hirsch’s teaching in a manner contrary to the express disclosure of Martin. *Id.*

On remand, as directed by this court, the Board considered the combination of Hirsch and Martin that relied on a multiple-subwindows embodiment of Martin and concluded the embodiment included and disclosed a “future minimum” as well as the other limitations of claims 6–9. *Board Decision*, at *4–7. That included Martin’s disclosing of claim 9’s limitation that a “future minimum value is set to a current magnitude value periodically.” *Id.* at *7.

The Board also found that a skilled artisan would have been motivated to combine the references based on three rationales. First, the Board said it had already sufficiently found a motivation in its prior decision when it said a skilled artisan would have generally considered Martin when looking at Hirsch, and Andrea did not appeal that determination. *Id.* at *7. Second, the Board reasoned that

this court also decided the motivation-to-combine issue, when we noted that “Hirsch refers to Martin as a ‘known’ approach ‘to avoid the problem of speech pause detection and to estimate the noise characteristics just from a past segment of noisy speech.’” *Id.* (quoting *Apple*, 949 F.3d at 703). And third, to the extent the first two reasons did not resolve the issue, the Board generically explained as a standalone analysis:

[W]e agree with Petitioner that one skilled in the art would have considered using the multiple sub-window approach taught by Martin in Hirsch’s system. “When a work is available in one field, design incentives and other market forces can prompt variations of it, either in the same field or in another.” *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 401 (2007). Based on the record before us, which includes an express suggestion in Hirsch to look to Martin’s teachings, Hirsch does not teach away from the proposed combination, and Petitioner has established by a preponderance of the evidence that one skilled in the art would have combined the teachings of Martin with those of Hirsch.

Id. at *8. Accordingly, the Board found claims 6–9 unpatentable over the combination of Hirsch and Martin. *Id.*

Andrea timely appealed to this court. We have jurisdiction under 28 U.S.C. § 1295(a)(4)(A).

DISCUSSION

Andrea appeals the Board’s findings that (1) Martin teaches the limitation of claim 9 that a “future minimum value is set to a current magnitude value periodically” and (2) a skilled artisan would have been motivated to combine Hirsch and Martin. The Board’s factual determinations are reviewed for substantial evidence and its legal determinations are reviewed de novo. *In re Mouttet*, 686 F.3d 1322, 1330–31 (Fed. Cir. 2012). Substantial evidence is

“such relevant evidence as a reasonable mind might accept as adequate to support a conclusion.” *Id.* at 1331.

A

Claim 9 requires that “the future minimum value is set to a current magnitude value periodically.” Before the Board, Apple argued that Martin’s algorithm meets this limitation with two steps. First, at the end of a subwindow period, P_{Mmin} (future minimum) is reset to a maximum value P_{Max} and, then, is set to the value of $\bar{P}_x(i)$ (current magnitude) at the beginning of the next subwindow period after P_{Mmin} and $\bar{P}_x(i)$ are compared. *Board Decision*, at *7. The Board credited the unrebutted testimony of Apple’s expert, Dr. Hochwald, that by resetting P_{Mmin} equal to P_{Max} , the next cycle of Martin’s algorithm sets P_{Mmin} to the smoothed power estimate $\bar{P}_x(i)$. *Id.* (citing J.A. 413 ¶ 140).

Andrea argues the Board erred by relying on Apple’s expert’s testimony because, supposedly, the Board previously rejected the testimony when it rejected the single-subwindow configuration of Martin for rendering the claims at issue obvious. Appellant’s Br. 39. According to Andrea, the Board provided no explanation as to why it relied on evidence from a previously rejected theory and, thus, acted arbitrarily and capriciously and reached a conclusion unsupported by substantial evidence. *Id.* at 39–44.

We are unpersuaded. Dr. Hochwald’s testimony regarding the periodic setting of P_{Mmin} (future minimum) to $\bar{P}_x(i)$ (the current magnitude) relied on the periodicity of M samples in a subwindow, irrespective of whether a single subwindow or multiple subwindows are in a window. See J.A. 413 ¶ 140. Because the Board originally rejected Apple’s obviousness theory for the more general reason that a *single* subwindow is contrary to Martin’s approach, the Board did not address or reject more specific issues including whether Martin discloses periodically setting P_{Mmin} to $\bar{P}_x(i)$ as explained by Dr. Hochwald. *Prior Board Decision*, at *4–6. There is nothing inconsistent about the Board’s

subsequent crediting of Dr. Hochwald's testimony to find that claim 9 was met by Martin, once it considered that testimony in the context of multiple subwindows as directed by this court.

Andrea also argues that Martin's algorithm does not "periodically" set the future minimum value to the current magnitude value. Andrea points to the fact that $\bar{P}_x(i)$ is a signal that varies and is set as P_{Mmin} 's value only when $\bar{P}_x(i)$ is less than P_{Mmin} . Appellant's Br. 42–47. But Andrea's arguments never address the crucial detail that right before the beginning of a new subwindow, P_{Mmin} is set to a maximum value, which the Board found meant that at the beginning of each new subwindow P_{Mmin} gets set to $\bar{P}_x(i)$. *Board Decision*, at *7 (citing Dr. Hochwald's testimony at J.A. 413 ¶ 140); *see* Appellee's Br. 45–46 (explaining the Board's finding based on P_{Mmin} being set to a maximum value); Appellant's Reply Br. 28 (not addressing the effect caused by setting P_{Mmin} to a maximum value). Andrea has not shown the Board's finding, that Martin discloses a "future minimum value is set to a current magnitude value periodically," is unsupported by substantial evidence.

B

With respect to the motivation to combine Hirsch and Martin, Andrea argues the Board erred by saying that itself and this court previously resolved the issue. On this score we agree with Andrea. The Board and this court made broad, general statements relevant to, but not conclusive of, motivation to combine the relevant portions of the cited references in a manner that renders claims 6–9 obvious. Hirsch does refer to Martin as a known approach to avoid the problem of speech pause detection to estimate noise and, based on that, it was reasonable for the Board to find that a skilled artisan would have considered Martin's teachings generally when reviewing Hirsch. But neither the Board nor this court addressed why a skilled artisan

would have specifically incorporated Martin’s noise power estimation algorithm into Hirsch’s spectral subtraction system or threshold calculation. *See In re Sang Su Lee*, 277 F.3d 1338, 1343 (Fed. Cir. 2002) (discussing that motivation is needed for making the “specific combination that was made by the applicant”). In addition, neither the Board nor this court addressed any of the specific motivation issues contested by Andrea. These include, for example, whether: Hirsch shows a need for improvement in nonstationary noise environments and whether Martin provides such improvement, *see, e.g.*, J.A. 1021–23; J.A. 2497; Hirsch obviates the need to address the speech pause detection problem and, therefore, a skilled artisan would not have looked to Martin to address the problem, *see, e.g.*, J.A. 1020; and Hirsch disparages Martin because of “the need of relatively long past segments of noise speech” and the “significant difference” in time requirements between Martin and Hirsch, *see, e.g.*, J.A. 1019; J.A. 2495. The Board’s failure to provide any explanation as to why it accepted the prevailing arguments over the counter-arguments precludes us from being able to affirm the Board’s finding of motivation. *See In re Nuvasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (“[I]t is not adequate to summarize and reject arguments without explaining why the PTAB accepts the prevailing argument.”).

The Board’s separate, standalone analysis of motivation is also inadequate for the same reason, *i.e.*, the failure to address the specific motivation issues argued by the parties. The Board generically invoked “design incentives and other market forces,” concluded without explanation that Hirsch does not teach away, and relied on the general point that Hirsch mentions Martin. *Id.* at *8. In the face of Andrea’s specific contentions, these statements amount to a conclusory analysis that we have held to be an insufficient articulation of motivation to combine. *See In re Nuvasive*, 842 F.3d at 1383.

We also reject Apple's reliance on the fact that, in its original decision, the Board found claim 25 unpatentable over the combination of Hirsch and Martin and that Andrea did not appeal the finding. Claim 25 recites an adaptive array comprising a plurality of microphones for receiving an audio signal. '345 patent col. 11 ll. 5–7. In the context of claim 25, Apple presented why a skilled artisan would have been motivated to incorporate "conventional adaptive microphone arrays" from Martin into Hirsch, and the Board found that Andrea provided no evidence or argument to rebut Apple's contentions. *Prior Board Decision*, at *7. However, any finding of motivation for claim 25 regarding the physical array of microphones is irrelevant to whether a skilled artisan would have been motivated to combine Martin's algorithm into Hirsch's algorithm.

For the foregoing reasons, we affirm the Board's decision finding that Martin discloses the limitations of claim 9 of the '345 patent but vacate the Board's final written decision and remand for further findings on the motivation to combine Hirsch and Martin with respect to claims 6–9.

**AFFIRMED IN PART, AND VACATED AND
REMANDED IN PART**

COSTS

No costs.