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Datasheet for the decision of 20 May 2009

Case Number: T 0287/07 - 3.4.01

Application Number: 02754004.6

Publication Number: 1417679

IPC: G10L 21/02

Language of the proceedings: EN

Title of invention:
Sound intelligibility enhancement using a psychoacoustic model and an oversampled filterbank

Applicant:
Emma Mixed Signal C.V.

Headword:
-

Relevant legal provisions:
EPC Art. 123(2)

Relevant legal provisions (EPC 1973):
EPC Art. 56

Keyword:
"Added subject-matter (no)"
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0287/07 - 3.4.01

D E C I S I O N
of the Technical Board of Appeal 3.4.01
of 20 May 2009

Appellant: Emma Mixed Signal C.V.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 22 August 2006 refusing European application No. 02754004.6 pursuant to Article 97(1) EPC 1973.**

Composition of the Board:

Chairman: B. Schachenmann
Members: P. Fontenay
G. Assi

Summary of Facts and Submissions

I. The appeal lies from the decision of the examining division, dispatched on 22 August 2006, refusing the European patent application No. 02 754 004.6 on the ground of lack of inventive step (Article 56 EPC 1973) of the subject-matter of the independent claims.

II. The appellant (applicant) filed an appeal against this decision by notice received on 25 October 2006 and paid the prescribed appeal fee on the same date. A written statement setting out the grounds of appeal was filed in due time on 11 December 2006. The appellant requested that the contested decision be set aside and a patent be granted on the basis of claims 1 to 26 filed on 24 February 2006. Oral proceedings were requested as an auxiliary measure.

III. In a communication of the Board pursuant to Article 15(1) Rules of Procedure of the Boards of Appeal (RPBA) dated 13 February 2009, issued in view of oral proceedings scheduled to take place on 23 April 2009, the Board expressed some concerns regarding the compliance of the claims then on file with the requirements of Article 123(2) EPC. Taking due account of the fact that these concerns as to added subject-matter made a preliminary assessment of the claims as to novelty and inventive step groundless, the Board indicated that it considered some of the embodiments disclosed in the description to be both new and inventive.

IV. With facsimiles dated 19 March 2009, 15 April 2009 and 22 April 2009, the appellant filed modified requests

addressing the various issues raised by the Board in its communication of 13 February 2009 or during ensuing telephone conversions between the representative of the appellant and the rapporteur on 31 March 2009 and 21 April 2009.

V. Following the filing of modified application documents on 22 April 2009, the Chairman of the Board declared, on the same day, the debate closed with regard to the request on file; oral proceedings were accordingly cancelled.

VI. The appellant requested that the contested decision be set aside and a patent be granted on the basis of:

- claims 1 to 19, filed on 22 April 2009;
- description pages:
1, 2, 4, 5, 7, 9, 11-18, 20-27, filed on 15 April 2009;
3, 6, 8, 10, 19, filed on 22 April 2009;
- drawing sheets:
1/13, 2/13, 4/13, 6/13-13/13 as originally filed;
i.e. as published under the PCT;
3/13 as filed on 15 April 2009;
5/13 as filed on 22 April 2009.

VII. Independent claim 1 reads as follows:

"*1. A system for improving a signal intelligibility over an interference signal, the system comprising:*

a first input (501, 600, 1000, 1101, 1110) for receiving an information signal including a signal-of-interest;

a second input (520, 620, 1022, 1055, 1120, 1201, 1207) for receiving an interference signal including an

environmental noise, possibly contaminated with the signal-of-interest, the second input being capable of receiving the interference signal on a continuous basis regardless of whether the signal-of-interest is present or absent;

an analysis filterbank (503, 601, 1005, 1103, 1213) for receiving the information signal through the first input and transforming the information signal in the time domain into a plurality of sub-band information signals in the transform domain;

a second analysis filterbank (530, 625, 1040, 1070, 1123, 1203, 1209) for transforming the interference signal in the time domain into a second plurality of sub-band interference signals in the transform domain;

a signal processor (507, 611, 635, 1007, 1072, 1075, 1107, 1150, 1153, 1155, 1160, 1163, 1165, 1140, 1215, 1260) for receiving and processing the plurality of sub-band information signals output from the analysis filterbank (503, 601, 1005, 1103, 1213) and the second plurality of sub-band interference signals from the second analysis filterbank (530, 625, 1040, 1070, 1123, 1203, 1209) on a continuous basis, the signal processor including a psychoacoustic processor (507, 635, 1075, 1260) for computing a dynamic range using a psychoacoustic model to render the sub-band information signal audible over the interference signal; and

a synthesis filterbank (509, 612, 1010, 1110, 1217) for combining the sub-band information signals output from the signal processor to generate an output signal having the signal-of-interest with improved signal intelligibility."

Claims 2 to 18 depend on claim 1. Independent claim 19 relates to the corresponding method of improving signal intelligibility over an interference signal and includes substantially the same features as claim 1 cited above.

VIII. The following documents were relied on during the appeal procedure:

D1: Young-Cheol Park et al.: "High Performance Digital Hearing Aid Processor with Psychoacoustic Loudness Correction", ICCE, International Conference on Consumer Electronics, 1997, pages 312,313;

D2: WO-A-98/47315;

D5: Schneider Todd et al., "A Multichannel Compression Strategy For a Digital Hearing Aid", IEEE International Conference on Acoustics, Speech, and Signal Processing, 21-24 April 1997 in Munich (Germany), pages 411-414, Los Alamitos, CA (US), IEEE Comput. Soc.

IX. In the following, reference is made to the provisions of the EPC 2000, which entered into force as of 13 December 2007, unless the former provisions of the EPC 1973 still apply to pending applications. In this latter case, the citation of Articles or Rules is followed by the indication “1973” (cf. EPC, page 4, "citation practice").

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 EPC 1973 and Rule 64 EPC 1973. It is, thus, admissible.

2. *Amendments*

In the context of this decision, references to the original disclosure apply to the published PCT application WO-A-03015082.

Claim 1 differs from claim 1 as originally filed, firstly, in that the concepts of "information signal" and "interference signal" have been specified so as to establish that the information signal includes a signal-of-interest and that the interference signal includes an environmental noise, possibly contaminated with the signal-of-interest.

Claim 1 further distinguishes from original claim 1 in that, secondly, it now recites the additional features of:
- a first and a second input for receiving, respectively, the information signal (including a signal-of-interest) and the interference signal (including an environmental noise, possibly contaminated with the signal of interest) and
- a second analysis filterbank for transforming the interference signal into a plurality of sub-band interference signals.

Finally, the features of the signal processor and synthesis filterbank have been specified so as to more precisely define the relationships existing between these components and the other constitutive elements of the claimed system.

2.1 The term "information signal" was present, as such, in original claim 1 and in the paragraph bridging pages 2

and 3 of the original application as published, in the section relating to the "Summary of the invention". Although this passage does not contain any explicit definition of the term, it nevertheless implies, when interpreted in the light of the whole disclosure, that the information signal corresponds to the desired audio signal, possibly contaminated by a noise component.

In fact, despite the inconsistent use of the term "signal-of-interest", which is equated in some embodiments with the desired audio signal (cf. page 12, lines 19, 20) or, alternatively, with the combination of said signal with a noise component (cf. page 16, lines 10-17; page 23, lines 13-17), the Board concludes that the technical teaching derivable from these passages is concrete enough to define an information signal comprising a signal-of-interest and, possibly, an additional noise component. In the Board's view, the skilled person, namely, understands from the indication according to which the signal-of-interest contains noise, that what is actually meant is that the signal-of-interest (desired audio signal) is contaminated by noise. It follows that the reference to "an information signal including a signal-of-interest", in claim 1, is supported by the original disclosure.

The statement on page 4, lines 23-26 of the published application, according to which: "*Typical applications of the invention include headsets used in call centres, mobile phones, and other miniature/portable audio devices when used in noisy environments (e.g., aircraft, concerts, factories, etc.)*" corroborates the introductory statement on page 1, lines 5, 6 that the interference signal comprises environmental noise. The

Board notes, however, that the literal basis for the mention in claim 1 that the environmental noise may possibly be contaminated with the signal-of-interest, on page 8, lines 15-18 of the description, refers to a configuration which is excluded from amended claim 1. In spite of that, it concludes that the embodiments of the invention relying on a "closed loop" modus (cf. page 10, lines 19-22; page 12, line 27 - page 13, line 2) support the concept of an interference signal including an environmental signal contaminated with the signal-of-interest, as optionally referred to in claim 1.

2.2 The features of a first and a second input for receiving, respectively, an information signal and an interference signal is supported by the general statement concerning the invention on page 3, lines 18-23. This passage implies, namely, that a (second) input is indeed required by the Signal intelligibility Enhancement (SIE) algorithm for measuring the level of interference to adjust the gain of a signal-of-interest, thus, implicitly establishing the existence of a corresponding (first) input for receiving this signal-of-interest. This view is consistently corroborated by Figures 5, 6, 6A, 10, 11, and 12 of the description as well as by the corresponding sections of the description.

The feature of a second analysis filterbank is directly derivable from these Figures and related passages of the description.

2.3 In the Board's judgement, the association of the multiplier (505, 611, 1007, 1107, 1215) with the

psychoacoustic Model Blocks (507, 635, 1075, 1140, 1260) in Figures 5, 6, 6A, 10, 11 and 12 constitutes a valid basis for the feature of a signal processor for receiving and processing the plurality of sub-band information signals from the two analysis filterbanks on a continuous basis, as recited in claim 1. It is, in particular, noted that such a signal processor includes a psychoacoustic processor (the psychoacoustic Model Block) for computing a dynamic range using a psychoacoustic model to render the sub-band information signal audible over the interference signal as required by the claim definition (cf. page 14, lines 10-16).

2.4 Dependent claims 2-15 and 17 are, in essence, identical to original dependent claims 3-14, 19, 21 and 24. Dependent claim 16 finds its basis in original claim 23 and has been further amended by specifying that the estimate is supplied to the psychoacoustic model, which aspect is directly derivable from Figure 6A. Dependent claim 18 results from a combination of original claims 2 and 25.

Original system claim 1 and the various passages referred to above in relation with claim 1 constitute, as well, an adequate support for independent claim 19 as to the corresponding method of improving signal intelligibility over an interference signal.

2.5 The statement on page 1, lines 4-6 of the description, according to which "*The present invention relates to audio reproduction applications where a desired audio signal is received in an uncontaminated form and interference (e.g. environmental noise) is present as an acoustic signal*", has been amended by deleting the

terms "in an uncontaminated form". This amendment is supported by the indications on page 16, lines 10, 11 and page 23, lines 13-17, that the signal-of-interest is often not entirely noise-free.

New Figure 5 differs from Figure 5, as published, in that the output of the (first) analysis filterbank is transmitted to the psychoacoustic model block 507. This amendment results from the obvious correction of a mistake in the original application documents (Rule 139 EPC). The description, in its entirety, establishes that sub-band signals pertaining to the information signal, as well as sub-band signals relating to the interference signal, are required by the psychoacoustic model block to perform its function. This view is further confirmed by the indication relating to the embodiment of Figure 5, on page 12, lines 14 and 15 of the description that the "sub-bands from the second analysis filterbank 530 are also passed to the Psychoacoustic model block 507".

The application documents have been further amended to correct various clerical errors.

2.6 The Board is thus satisfied that the requirements of Article 123(2) EPC are met.

3. *Novelty - Inventive step*

3.1 *Novelty*

Documents D1, D2 and D5 concern hearing aids. Although the systems referred to in these documents attempt to improve a signal intelligibility over an interference

signal (background noise) as recited in claims 1 and 19, they fail to disclose a system with a first input for receiving an information signal including a signal-of-interest and a second input for receiving an interference noise including an environmental noise.

In D2, means are provided to determine the noise level in the absence of speech signals (cf. D2, page 6, lines 8-15) whereas, in D5, it is suggested to further improve the system disclosed therein by identifying a specific band (channel) representative of the noise level (cf. D5, page 414, left column, last full paragraph). However, in the Board's view, the means required in D2 and D5 to process the monitored noise signal define internal circuits of the disclosed systems. These circuits cannot, thus, be equated with a second input in the sense of present invention.

3.2 *Inventive step*

3.2.1 The jurisprudence of the boards of appeal has repeatedly stated that the closest prior art for assessing inventive step is normally a document disclosing subject-matter conceived for the same purpose as the claimed invention and having the most relevant technical features in common (cf. Case Law of the Boards of Appeal, 5th edition, page 121, §3). Contrary to the view expressed by the examining division, the Board concluded that none of the prior publications D1, D2 or D5 qualifies as closest prior art. In reaching its conclusion, the Board noted that the features of a first and second inputs, as recited in claims 1 and 19, are essential for the system and method underlying the present invention. Consequently,

the purpose of improving a signal intelligibility over an interference signal should be assessed in the context of such systems and methods wherein both signals would be available at two separate inputs, as actually recited in claims 1 and 19.

This approach appears all the more justified as the description consistently discloses systems with one input for receiving an information signal and a second input, separate from the first one, adapted for receiving an interference signal.

3.2.2 For these reasons, the Board considers that the prior art referred to on page 1 of the published application under item (d), referring to the Simple Automatic Gain Control (AGC) technique, illustrates the closest prior art. This known technique improves signal intelligibility by measuring the noise level and amplifying the signal-of-interest accordingly.

None of the available prior art suggests to split the information and interference signals in sub-band channels so as to provide a separate adaptation of the amplification level for each sub-band. Document D1 relates to the field of hearing aids and merely suggests to adapt the amplification level for each frequency sub-band to the impairment of the listener; it does not address the problem associated to interference signals.

3.2.3 In view of the above, in the Board's judgement, the subject-matter of claims 1 and 19 is not rendered obvious by the available prior art and therefore

involves an inventive step within the meaning of Article 56 EPC 1973.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent on the basis of:

- claims 1-19 as filed on 22 April 2009;

- description pages:
1, 2, 4, 5, 7, 9, 11-18, 20-27, filed on 15 April 2009;
3, 6, 8, 10, 19, filed on 22 April 2009;

- drawing sheets:
1/13, 2/13, 4/13, 6/13-13/13 as originally filed
(i.e. as published under the PCT);
3/13 as filed on 15 April 2009;
5/13 as filed on 22 April 2009.

The Registrar: The Chairman:

R. Schumacher B. Schachenmann