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# Datasheet for the decision of 14 December 2016

**Case Number:** T 2176/11 - 3.4.01

**Application Number:** 09154541.8

**Publication Number:** 2226794

**IPC:** G10L21/02

**Language of the proceedings:** EN

**Title of invention:**
Background Noise Estimation

**Applicant:**
Harman Becker Automotive Systems GmbH

**Headword:**

**Relevant legal provisions:**
EPC Art. 56

**Keyword:**
Inventive step - (yes)

**Decisions cited:**

**Catchword:**

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**Beschwerdekammern**
**Boards of Appeal**
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**Case Number: T 2176/11 - 3.4.01**

# D E C I S I O N
## of Technical Board of Appeal 3.4.01
## of 14 December 2016

| | |
|---|---|
| **Appellant:** (Applicant) | Harman Becker Automotive Systems GmbH<br>Becker-Göring-Strasse 16<br>76307 Karlsbad (DE) |
| **Representative:** | Westphal, Mussgnug & Partner<br>Patentanwälte mbB<br>Herzog-Wilhelm-Strasse 26<br>80331 München (DE) |
| **Decision under appeal:** | **Decision of the Examining Division of the European Patent Office posted on 23 May 2011 refusing European patent application No. 09154541.8 pursuant to Article 97(2) EPC.** |

**Composition of the Board:**

| | |
|---|---|
| **Chairman** | G. Assi |
| **Members:** | T. Zinke |
| | J. Geschwind |

## Summary of Facts and Submissions

I. The appeal, filed on 19 July 2011, lies from the decision of the examining division, posted on 23 May 2011, refusing European patent application No. 09 154 541.8, published with publication No. 2 226 794. The statement setting out the grounds of appeal was filed on 19 September 2011.

II. In its decision the examining division refused the application due to lack of inventive step of claims 1 and 10 of the then pending main request with regard to document D2 (US-B-6,263,307) as closest prior art being combined with document D1 (EP-A-1 918 910) in the light of common general knowledge. Concerning the then pending auxiliary requests, the examining division raised objections against the first auxiliary request due to extension beyond the content of the application as originally filed (Article 123(2) EPC), and against the second and third auxiliary requests due to insufficient disclosure (Article 83 EPC).

III. With the statement setting out the grounds of appeal the appellant (applicant) requested to set aside the decision and to grant a patent based on the "*main request as filed on Dec. 6, 2010*". Moreover, the appellant stated that *"The first auxiliary request as amended with letter of 9 May, 2011, the second and the third auxiliary requests as filed on 6 December, 2010 are maintained."* The appellant also provided counter-arguments with regard to the objections raised by the examining division in the decision under appeal.

IV. By summons of 23 September 2016 the appellant was summonsed to oral proceedings due to take place on 14 December 2016. A communication under

Article 15(1) RPBA was issued on 26 October 2016 drawing attention to the issues to be discussed during oral proceedings. In particular, the Board introduced document D4 (Hänsler, Schmidt: Acoustic Echo and Noise Control, Hoboken, US, Wiley Interscience, 2004, Chapter 14.1 *"Estimation of Spectral Power Density of Background Noise"*, pages 349-363) into the appeal proceedings. With regard to the main request, the Board understood that the statement setting out the grounds of appeal actually referred to the main request as filed by letter of 2 March 2010, to which the letter dated 6 December 2010 referred. Further, the Board addressed the issue of inventive step (Article 56 EPC) taking into account the disclosure of documents D1, D2 and D4.

Concerning the auxiliary requests, the Board pointed to issues under Article 123(2) EPC, Article 83 EPC and Article 56 EPC to be discussed during oral proceedings.

V. With letter of 18 November 2016, the appellant replaced the main request then on file with a revised main request, maintained the first, second and third auxiliary requests then on file and submitted new claim sets according to fourth and fifth auxiliary requests, respectively. Further, the appellant provided arguments with regard to the issues raised by the Board.

VI. Oral proceedings took place on 14 December 2016, as scheduled. The appellant replaced the main request then on file with a revised new main request and requested that the decision under appeal be set aside and a patent be granted on the basis of sets of claims according to the main request as filed during the oral proceedings or the first to fifth auxiliary requests on file.

VII. Claim 1 of the main request reads as follows:

*"1. A system for estimating the power spectral density of acoustical background noise; the system comprises:*
*a sensor unit for obtaining a noise signal (MIC(ω)) representative of the background noise;*
*a power spectral density calculation unit (6) that is adapted for continuously determining the current power spectral density from the noise signal and is adapted for providing a corresponding power spectral density output signal (PsdMic(ω));*
*a time domain signal smoothing unit (7) that is adapted for smoothing the power spectral density output signal (PsdMic(ω)) in the time domain and is adapted for providing a resulting timely smoothed signal;*
*a frequency domain signal smoothing unit (8) that is adapted for smoothing the timely smoothed signal received from the time domain signal smoothing unit (7) in the frequency domain and is adapted for providing a resulting smoothed power spectral density signal (SmoothedPsdMic(ω));*
*an increment calculation unit (9) that is adapted for calculation of an increment (Inc(ω)) depending on an estimate value of the power spectral density of the background noise (PsdNoise(ω));*
*a decrement calculation unit (10) that is adapted for calculation of a decrement (Dec(ω)) depending on the estimate value of the power spectral density of the background noise; and*
*an estimate signal smoothing unit (11) that is adapted for calculation of the estimate value of the power spectral density of the background noise (PsdNoise(ω)) from the increment (Inc(ω)) and decrement (Dec(ω));*
*where,*

*if the value of the smoothed power spectral density (SmoothedPsdMic(ω)) currently determined in a new calculation cycle is larger than the estimate value of the power spectral density of the background noise (PsdNoise(ω)) determined in the previous calculation cycle, the increment value (Inc(ω)) is increased, starting from a minimum increment value (Inc(ω)), by a predetermined amount (ΔInc) until a maximum increment value (IncMax) is reached; and*
*if the value of the smoothed power spectral density (SmoothedPsdMic(ω)) currently determined in a new calculation cycle is smaller than the estimate value of the power spectral density of the background noise (PsdNoise(ω)) determined in the previous calculation cycle, the decrement value (Dec(ω)) is increased, starting from a minimum decrement value (DecMin), by a predetermined amount (ΔDec) until a maximum decrement value (DecMax) is reached."*

Independent claim 9 is a correspondingly formulated method claim.

Claims 2-8 and 10-14 are dependent on claims 1 and 9, respectively.

VIII. The claims of the first to fifth auxiliary requests are not relevant for this decision.

## Reasons for the Decision

1. The appeal is admissible.

2. Main request

2.1 Admissibility

Since the amendments for the main request were made in response to objections raised by the Board in its communication of 26 October 2016 and during oral proceedings of 14 December 2016, the Board admitted the main request into the appeal proceedings according to Article 13(1) RPBA.

2.2 Article 123(2) EPC

The Board is satisfied that the amendments made to claims 1 and 9 according to the main request meet the requirements of Article 123(2) EPC.

In particular, the features *"for cases in which the level of the smoothed power spectral density signal (SmoothedPsdMic(ω)) increases"* and *"for cases in which the level of the smoothed power spectral density signal (SmoothedPsdMic(ω)) decreases" are redundant and, therefore, their cancellation is justified in that it does not lead to an undue extension beyond the content of the application as filed.* Moreover, due to the replacement of the expression *"for cases in which"* with the conjunction *"if"*, it is clearly claimed that - in accordance with Figure 2 of the originally filed application - either the increment value or the decrement value is increased, depending on which condition is met, and used for the calculation of the estimate value of the power spectral density of the background noise. In other words, a derivation of the estimate value of the power spectral density of the background noise without a calculation of increments or decrements and without using these newly calculated increments and decrements is not foreseen.

2.3 Article 84 EPC

The Board is satisfied that the claims of the main request meet the requirements of Article 84 EPC.

2.4 Article 83 EPC

The Board is also satisfied that the requirements of Article 83 EPC are met.

In particular, the features relating to the determination of *"coefficients for smoothing over time and/or frequency representing psychoacoustic sensory properties of the human ear"* which were objected to in the appealed decision (cf. sections II.3 and II.4) are no longer mentioned in the claim set of the main request.

2.5 Novelty (Article 54(1) and (2) EPC)

2.5.1 Document D1 deals with a *"Model-based enhancement of speech signals"* (cf. title). In paragraphs [0055] to [0057] a method for estimating noise in a speech signal is disclosed. According to the method, a short-time power density spectrum of the noise in a speech input signal is smoothed in time and frequency. Afterwards, the smoothed power density spectrum is compared with a smoothed power spectrum correspondingly determined at a previous time. D1 neither discloses an increment calculation unit, nor a decrement calculation unit, nor an estimate signal smoothing unit that is adapted for calculation of the estimate value of the power spectral density of the background noise from the increments and decrements.

Hence, the subject-matter of claim 1 is novel with regard to document D1.

2.5.2 Document D2 discloses estimating a noise power spectrum in speech analysis in a current time frame by updating the estimate from a previous time frame, using a current frame frequency-smoothed estimate for the noisy speech power spectrum based on decrements and increments (cf. column 8, line 61 to column 9, line 8, *"multiplicative factor 0.978"*, *"multiplicative factor 1.006"* in equations on top of column 9), wherein the increments (*"multiplier"*) are increased, when for a given number of successive time frames the current smoothed estimate is higher by a certain amount than the smoothed estimate of a respective previous time frame (cf. column 12, lines 57 to 67).

D2 does neither disclose that the increment value is increased until a maximum increment value is reached, nor a time domain signal smoothing unit, nor a decrement calculation unit (no change of the multiplicative factor 0.978 is disclosed). This was already acknowledged in the decision under appeal (cf. section II.1.2) with regard to the then pending main request.

Moreover, due to the amendments made during oral proceedings before the Board, a further distinguishing feature is present. Document D2 does not disclose either that the estimate value of the power spectral density of the background noise is calculated from increments and decrements, which are newly calculated for every cycle. From the equations in column 9, lines 1 to 5, it is evident that in document D2 the estimate value of the power spectral density of the background noise can be the actual power spectral density of the background noise itself without taking into account increments or decrements, if the actual power spectral

density is in a predefined range to the estimated power spectral density of a previous time frame.

Hence, the subject-matter of claim 1 is also novel with regard to document D2.

2.5.3 Document D3 (US-B-7,177,805) discloses a noise estimation method (cf. Figure 3 and column 3, line 39 to column 4, line 47), in which a new noise estimate ("$n^n(i)$") is calculated from fixed increments ("*upconst*") and decrements ("*downconst*") and a last noise estimate ("$n^{n-1}(i)$"), if a new smoothed power estimate ("$p^t(i)$") is greater or smaller by a respective predefined amount than the last noise estimate. However, as in document D2, the new noise estimate is equal to the new smoothed power estimate, if the new smoothed power estimate is within a range defined by the value of the fixed increment or decrement and the last estimate (cf. in particular, column 4, lines 42 to 44, "*Otherwise, $p^t(i) = n^n(i)$. The new noise estimate equates the new smoothed power value.*").

Hence, document D3 also at least does not disclose that the estimate value of the power spectral density of the background noise is always calculated from the increments and decrements, which are newly calculated for every calculation cycle.

Consequently, the subject-matter of claim 1 is novel with regard to document D3.

2.5.4 Document D4 was introduced by the Board in order to discuss the implications of the time domain and frequency domain smoothing units as claimed. At least it does neither disclose an increment calculation unit,

nor a decrement calculation unit, nor an estimate signal smoothing unit that is adapted for calculation of the estimate value of the power spectral density of the background noise based on the increments and decrements.

Therefore, the subject-matter of claim 1 is novel with regard to document D4.

2.5.5 Hence, the subject-matter of independent system claim 1 is novel, the same conclusion applying for independent method claim 9.

2.6 Article 56 EPC

2.6.1 Document D2 is considered as representing the closest prior art, since it is the only document dealing with variable increments used for noise estimation.

2.6.2 With particular regard to the distinguishing feature as discussed in section 2.5.2 (third paragraph) above, it is noted that, due to the calculation of the estimate value of the power spectral density of the background noise from the increment and the decrement values in each cycle, the estimate value is never directly obtained from the actual smoothed power spectral density.

2.6.3 As described on page 13, line 31 to page 14, line 4 of the application as filed, the technical effect achieved consists in preventing *"any voice signals that may exist in the current noise value Noise[n], which typically have faster rises in level than the broadband background noise in the interior of an automobile, from significantly affecting the algorithm and consequently the computation of the estimate value."* On page 16,

lines 8 to 12 , it is further stated that *"..., the novel system and method increases the quality of the estimate of the power spectral density in this regard without increasing the susceptibility of the algorithm in response to concurrently arising voice signals."*

2.6.4 As discussed above, none of the prior art documents D1, D2, D3 and D4 suggests to systematically rely on calculated increments and decrements in order to determine a new estimate value for the power spectral density of the background noise. Hence, the person skilled in the art could not get any hint towards this solution from any of these documents. It is also not apparent that such a solution could be found by relying on the common general knowledge of a person skilled in the art.

2.6.5 Hence, the subject-matter of system claim 1 is based on an inventive step. The same applies for the correspondingly formulated independent method claim 9.

2.7 In conclusion, the main request is allowable.

**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 the main request (claims 1 to 14) as filed during oral proceedings of 14 December 2016 and a description to be adapted thereto.

The Registrar: The Chairman:

R. Schumacher G. Assi

Decision electronically authenticated