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| **CONTRIBUTION** |
| **Source:** | Volkswagen AG, Technische Universität Braunschweig |
| **Title:** | Proposal of a Reference-free SNR Measurement |

**Proposal of a Reference-free SNR Measurement**

This contribution delivers the annex text of a reference-free SNR measurement approach as requested by FG CarCOM, along with proposed references to it in the main body of FG.VSSR.

Our work on a reference-free SNR measurement approach was initiated by the group at the FG CarCOM meeting held in Holland, MI, USA, on August 29-30, 2012. An approach developed for wideband signals only was introduced at the FG CarCOM meeting in Braunschweig, Germany, on Dec. 8-9, 2011, and afterwards published on the DAGA 2012 conference [1]. Then, the approach was enhanced to work consistently with narrowband signals, too, as reported at the last meeting in Detroit, MI, USA, on July 16-17, 2012. Since then, the enhanced approach has been published on the ITG Conference on Speech Communication in Braunschweig, Germany, on September 26-28, 2012 [2]. This paper, which was presented also at the last meeting meeting in Detroit, MI, USA, on July 16-17, 2012, is now accessible online for interested readers over IEEE Xplore.

According to the decisions taken by the group at the last meeting, we prepared a full description of the proposed method as an annex. The proposed annex text to be included into the Draft of FG.VSSR can be found below as an attachment.

References:

[1] Fodor, B.; Fingscheidt, T. “Reference-free SNR Measurement for Stationary Noises”, in Proc. of DAGA, Darmstadt, Germany, Mar 2012.

[2] Fodor, B.; Fingscheidt, T., “Reference-free SNR Measurement for Narrowband and Wideband Speech Signals in Car Noise”, in Proc. of ITG Conference on Speech Communication, Braunschweig, Germany, Sep 2012.

Further, we propose to refer to this new annex in the Draft Recommendation text as follows:

* On page 25 of the Draft Recommendation the literature reference should be cited:

“…

**8.2.1.1.4.1 Parameter description**

The SNR measurement is based on individual broadband estimations of the speech signal power and the noise signal power and is performed using the reference-free measurement method described in [28].

NOTE 1 – It is recognized that fan noise, which varies from car to car and depends upon the relative positioning of the microphone and fan, may contribute significantly to the noise perceived by the far end user. In order to determine the impact of the level and spectral content of this noise under different operating conditions, a noise test as described below may be used.

The microphone signal to noise ration SNRM is measured at the test point (S1a) or the test point (S2). Test point (S2) should only be used if test point (S1a) is not accessible.

**8.2.1.1.4.2 Test**

1) The test arrangement is according to clause 8.1.

2) The speech test signal used is the British-English single talk sequence described in clause 7.3.2 of ITU-T Recommendation P.501 [xx]. To account for the Lombard effect, the test signal level is adjusted to the level as specified in clause 8.1, the test signal level is measured as "active speech level" according to [13].

3) For the measurement speech and background noise are recorded simultaneously while driving.

4) A reference measurement is conducted at 20 cm in front of the MRP. The reference microphone output signal is filtered by a highpass filter with 100 Hz and 24 dB/oct.

5) The actual measurement is conducted with the hands-free microphone.

6) The SNR is calculated according to Annex X for both microphones. The measurement approach allows for an SNR range between -10dB and 30dB.

7) The SNR difference between the hands-free microphone and the reference microphone is determined:

 SNRD = SNRM - SNRRef

Note: If different microphones or different positions are to be compared the measurements shall be conducted simultaneously.

…”

* On page 2 of the Draft Recommendation a new reference [28] should be added:

“…

**2) References**

…

[28] Fodor, B.; Fingscheidt, T., “Reference-free SNR Measurement for Narrowband and Wideband Speech Signals in Car Noise”, in Proc. of ITG Conference on Speech Communication, Braunschweig, Germany, Sep 2012.

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Annex X attachment for inclusion into the Draft Recommendation:



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