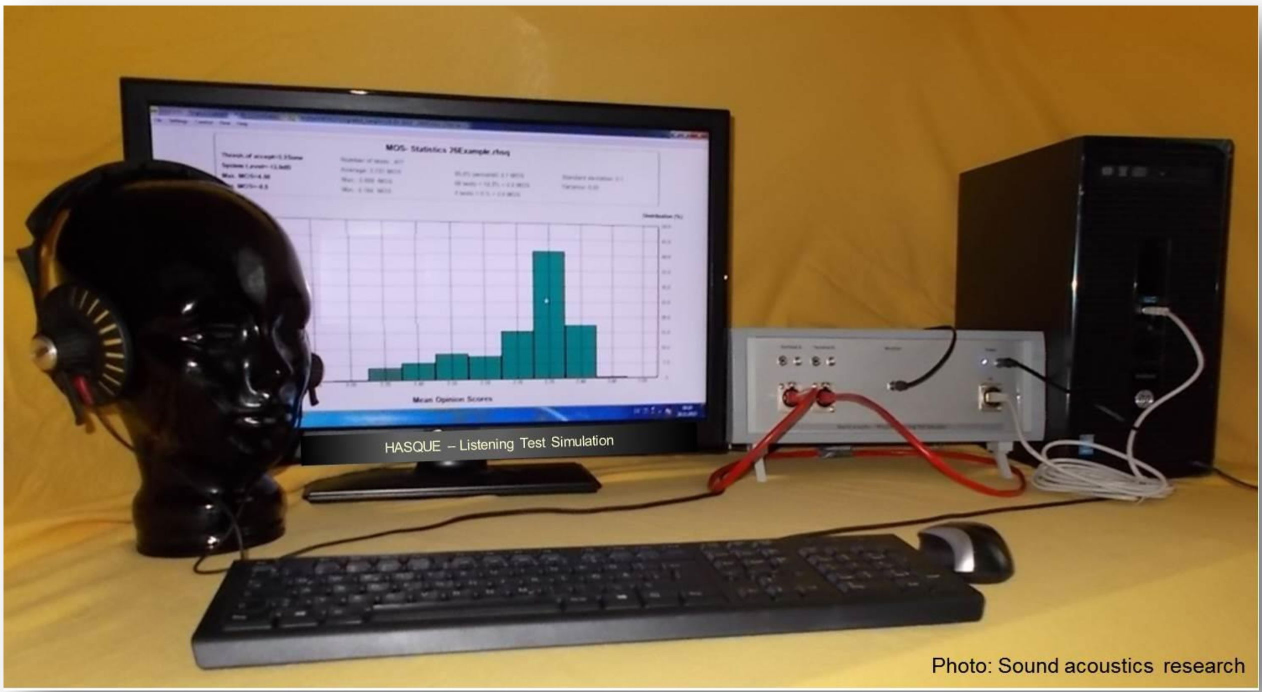
Sound acoustics Research, Development, Implementation

Reference signals for a correct listening test simulation



Abstract

This report deals with the requirements for reference signals which are applied for quality evaluation of audio systems.
A brief functional description of the listening test simulation clarifies the relationships between hearing loss and poor reference signals.
The influence on the quality measures is demonstrated with reference signals of various quality characteristics.
The resulting quality requirements for correct evaluation of audio systems are summarized in the last chapter.

Content

Listening test simulation

Listening test simulation is used for the objective quality evaluation of audio and telecommunication systems and replaces time-consuming listening tests with strongly fluctuating results by objective measurement methods with reproducible results.

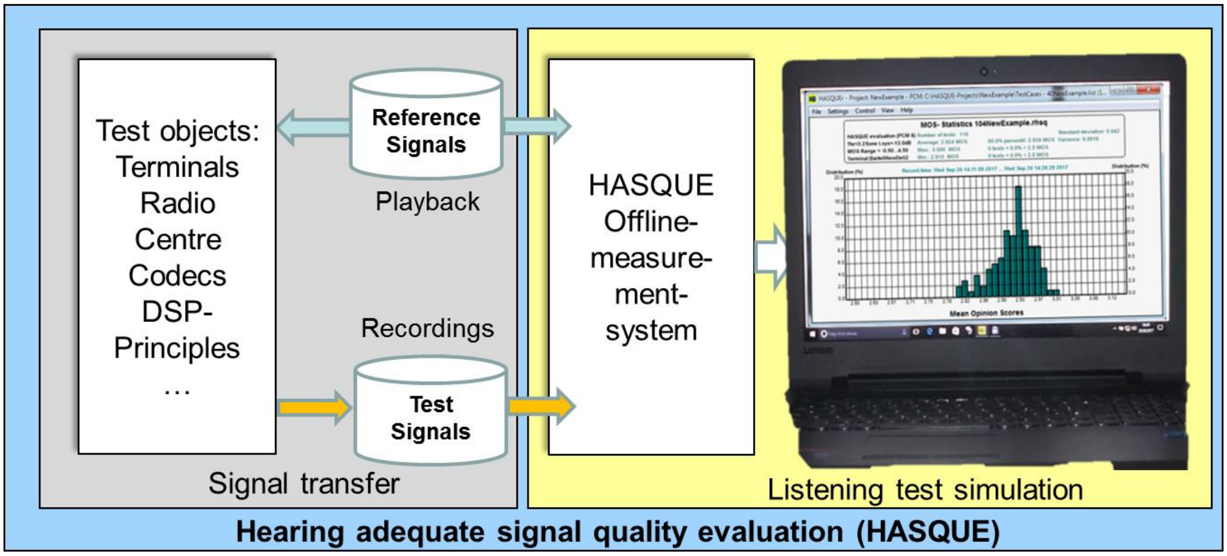


Figure 1: Quality evaluation by listening test simulation

Reference signals are transmitted over a test object to be examined. The output of the test object is recorded and compared with the reference signal using a **H**earing-**A**dequate **S**ignal **Qu**ality **E**valuation principle (HASQUE). The evaluation is based on the simulation of the human hearing properties and simulates excitation patterns for the reference signal as well as for the test signal, which can be compared with the perception of the human hearing. These excitation patterns are suitable for creating "audible" differences between reference and test recordings in order to be able to determine a quality measure for the test object to be examined.

Hearing tests are usually not carried out with ear plugs in order to be able to assess a hearing sample without disability. The same applies to the hearing test simulation. In the hearing test simulation, reference signals embody the hearing properties of a healthy ear. Band-limited, distorted or noisy reference signals are therefore synonymous with hearing damage and are not suitable for measuring the quality of audio systems.

Influence of the reference signals on the quality evaluation

The quality of the reference signals determines the reliability of a quality assessment. Artificial limitations, such as band limitation by narrow band filters, or distortions always lead to audible differences and to the concealment of quality influences on the test objects to be examined.

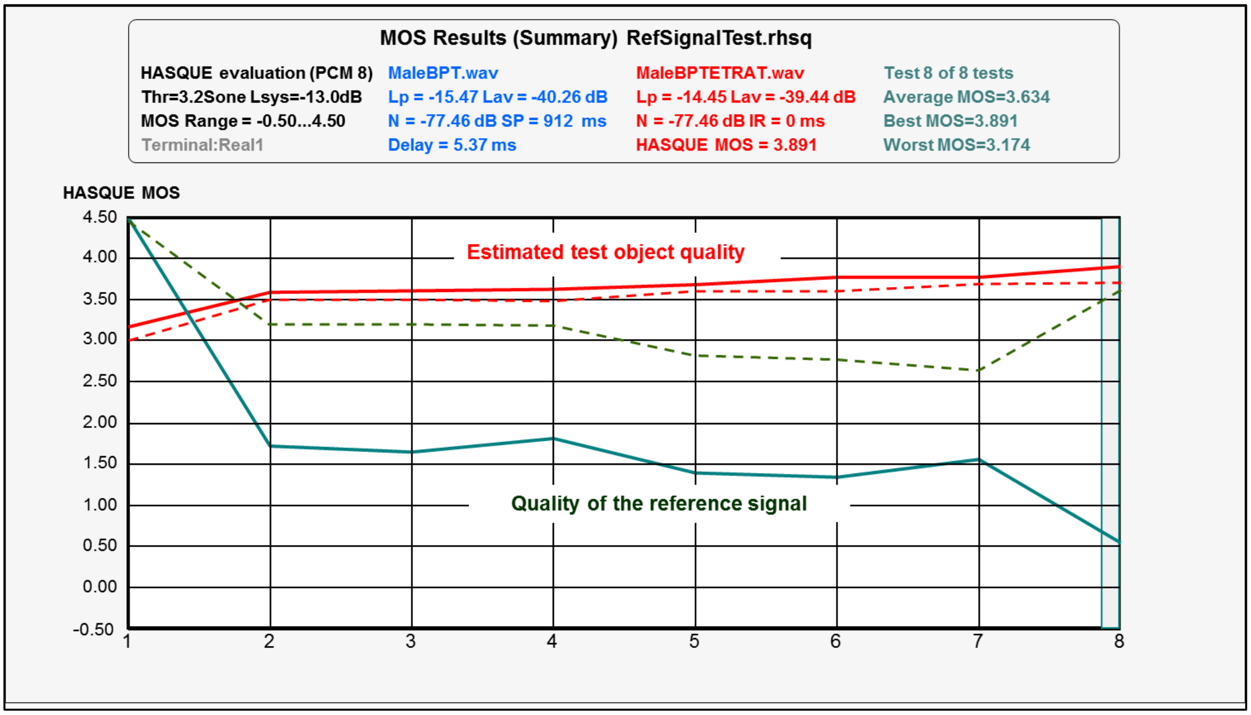


Figure 2: Influence of the reference signal on the estimated quality

Figure 2 shows an example of the evaluation of a test object with different reference signals, the speech content of which is exactly the same, but was recorded with a different bandwidth and distortion factor. Solid lines show results with HASQUE and dashed lines with PESQ. The green curves show the quality measures of the reference signals. It can be seen clearly that there are two completely different measurement methods with strong deviations different in the quality evaluation of the reference signal. The main differences occur with band limitations which are not recognized with PESQ.

The red curves show the measured quality for the same test object. In this example, the quality fluctuates by approx. 20% regardless of the measurement method used.
Measurement 1 was carried out with a pure reference signal and shows the actually achievable quality of the test object examined. In measurement 2 the reference signal is distorted. Distortions generate harmonics, which can hide the distortion of the test object and thus the quality measure appears to be almost 0.5 higher on the MOS scale than in measurement 1.
The highest quality is obtained with a strongly band-limited reference signal (measurement 8), since in this case the test object can only be tested in a narrow listening area.

In principle, the measurements in Figure 2 demonstrate the following: The poorer the quality of the reference signal, the better the result of the hearing test simulation, it appears.
This behavior has an effect on all measurement methods and generally leads to evaluation errors. The quality of the reference signal is therefore of particular importance.

Measurements to determine the voice quality must not be carried out with limited reference signals, as the result deviates significantly from the actual end device quality and the quality assessment can be manipulated as a result. Distorted reference signals in quality measurements for troubleshooting and system optimizing, can lead to incorrect conclusions and are therefore useless for this purpose.

Requirements for reference signals

With the aid of the listening test simulation, the actual quality of a test object should be recorded in a reproducible and comparable manner, without covering up any weak points in the test object. This is only possible with distortion-free reference recordings with which the entire available listening area can be assessed, except for system-related restrictions (sampling rate→transmission bandwidth).
Based on ITU-T P.862, the following guide values for reference signals also apply:

Speech level: L (peak) typ. - 6 dBov, L (avarage) typ. -30 dBov
Start of the first utterance> 500 ms (> latency) after the start of the recording
End of the last utterance> 500 ms (> latency) before the end of the recording
Speech activity:> 40 - <80% of the recording
Recording length: 5 -10 seconds
SNR:> 50 dB (distortion << 1%)
Noise floor:> 90dBov with 32 bit> 75dBov with 16 bit (samples without zero sequences)

Literatur

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