3SQM™ – Single Sided Speech Quality Measure

OPTICOM's 3SQM provides estimates of the speech quality degradation caused for example by telephony networks. Therefore the measurement model analyses the degraded voice signal output from a device or a network under test. 3SQM is based on models of the human vocal tract and the human perception of abnormalities in a voice signal.

OPTICOM's 3SQM includes and is fully compliant to ITU-T P.563.

OPTICOM who is the leading provider of signal based perceptual measurement technologies offers algorithms for voice, audio and video quality measurements.

3SQM is partially based on the earlier P3SQM technology developed by KPN Research and new development of OPTICOM together with partners.

Voice Quality Testing

OPTICOM Product Line:
Voice/Audio Quality
PESQ ITU-T P.862
3SQM ITU-T P.563
PSQM ITU-T P.861
ECHO
PEAQ ITU-T BS.1387
Video Quality
PEVQ
Network Quality
VQmon

Principle

The evaluation of the voice quality with 3SQM requires several steps.

Before the voice signal quality is assessed, it needs to be preprocessed. The important steps in the pre-process are: IRS receive filtering, speech level adjustment and separation in voice and non-voice parts via a Voice Activity Detection (VAD).

In the second step distortion and speech parameters are extracted from the voice signal parts. Three main functional analysis blocks that correspond to the main groups of distortion types in 3SQM help classifying the signal and its distortions. The main distortion types are defined as: unnaturalness of speech, basic speech quality, robotic voice, unnatural voice like beeps, strong additive noise, background noise, low segmental SNR, interruptions, mutes and clipping.

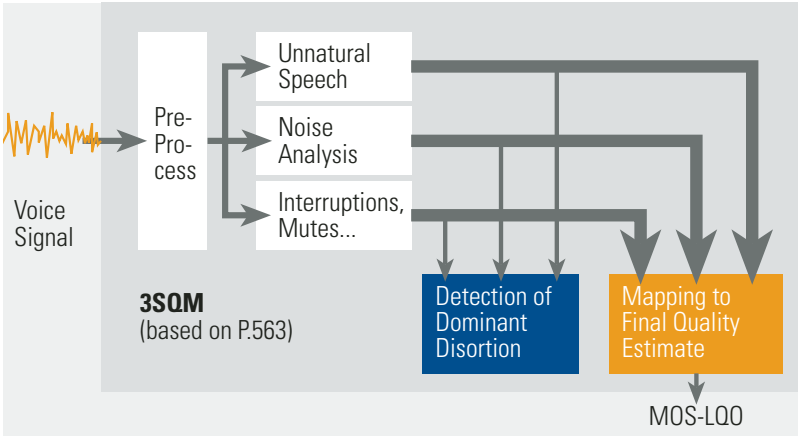
Finally after the analysis a dominant distortion class is determined and a single Mean Opinion Score (MOS) is generated. The MOS is commonly used to describe the voice quality on a scale from 1 (bad quality) to 5 (excellent quality).

One of the major advantages of 3SQM over other measurement approaches is that it does not need to make any assumptions on the network under test or the distortion types that may occur in a specific telephony test scenario. The only prerequisite employed within the model is the scientific knowledge on how human speech is produced and how it is perceived by humans.

3SQM already includes the effects of both packet level impairments (loss, jitter) and signal related impairments such as noise, clipping and distortions caused by coding processes. The distortion model, based on this knowledge is as generic as it can be and therefore independent from current and future telephony applications and networks.

Key Features:

- Perceptual analysis of degradations in voice signals
- Non-intrusive, single ended analysis method
- Output score correlates well with subjective MOS
- Available as DLL/Library or Source



Specifications

3SQM™– Single Sided Speech Quality Measure

Functionality

- ITU-T P.563 Perceptual Estimation of Speech Quality, with mapping to MOS scale

Input

- 16 bit linear audio sampled at 8kHz
- Input voice files 6 to 20 seconds in length

Output

Descriptors for mutes and interruptions in the signal:
Duration of muted signal parts, Indicator for interruptions, Counter for sharp declines, Indicator for silenced signal parts.

Results of the noise analysis:
Estimated background noise level, Estimated segmental signal to noise ratio, Mean spectral level deviation and level range, Speech level, Noise level, Signal to noise ratio, Descriptor for variations of high frequencies, Spectral clarity indicator, Percentage of samples that were classified as local background noise, Mean energy of frames that were classified as local background noise, Indicator for the number of occurrences of sever local background noise, Percentage of samples that were classified as global background noise

Descriptors for unnatural voice, e.g. by describing the vocal tract:
Indicator for validity of estimated vocal tract, Maximum section size of the first VTP tube, Averaged section size of the last vocal tract tube, Average of maximum VTP section sizes, Average of VTP back section sizes, Ratio of total voiced signal length over the total length of speech sections, Average of peak to mean difference of cross power of 2 consecutive voiced frames, Average of peak to mean ratio of cross power of 2 consecutive voiced frames, Number of repeated frames occurrences, Average of energy sum of all repeated frames, Number of detected tones/beeps, Average of energy sum of all frames containing tones/beeps, Average sum of samples that contain beeps, Indicator for the amount of highly periodic signals, Absolute standard deviation of the cepstrum, Skewness of the cepstrum, Curtosis of the cepstrum, Curtosis of the LPCs, Skewness of the LPCs, Absolute Skewness of the LPCs

Basic voice descriptors:
Speech level in dBov, Average of the pitch frequency, Level variations between sentences

Basic speech quality metrics:
Aggregation of the asymmetric frame disturbances, Output of the psychoacoustic model

Distortion classes found in the speech signal:
Distortion due to a high background noise level, muted (all zeros) parts or interrupts or sharp declines, Noise related to the signal envelope, Strongly reverberant voice signal due to e.g. band limitation in GSM networks, Basic voice quality indicator

The finally estimated MOS-LQO value:
The MOS-LQO value according to the P.800 standard within a range from 1 (bad) to 5 (excellent). R-Factor (LQ) according to standard G.107 which is derived from final MOS

Complexity

- Estimated MFLOPS required for real-time operation: 175..262
- Floating point library required
- Program Memory: 200..490Kb (depending on used features and optimizations)
- Data Memory: 4...5Mb per 8s speech file. The total amount is dependent on the voice file length

Platforms

- Windows
- Linux

About OPTICOM

With PSQM, PESQ and PEAQ, OPTICOM GmbH, the pioneer in perceptual quality testing has been providing three international world-class standards for voice and audio quality measurement since its foundation in 1995. With their new single-sided speech quality measure 3SQM™, a joint development with partners, the perceptual experts from Germany now presented their fourth ITU standard. At its 10th anniversary, the presentation of the new PEVQ™ video measure leverages the company's huge experience towards the multimedia testing domain. Recognized an industry reference, OPTICOM's OPERA voice/audio quality test tools are available to users world wide. And while specialized on OEM customers in particular, the directory of OEM licensees today reads like the 'Who-is-Who' of the Telecoms industry. OPTICOM is a privately held company located in Erlangen, Germany.

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