Technical Specification
for the OPERA™ Software Suite V3.0
OPR-000-XXX-S

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Feature Overview

Voice Quality Measurement

- PESQ, perceptual evaluation of speech quality according to ITU-T rec. P.862 [2001]. Combines PSQM with PAMS, optimized for VoIP and hybrid end-to-end applications
- PSQM, perceptual speech quality measure according to ITU-T rec. P.861 [1996]
- PSQM+, advanced perceptual speech quality measure according to ITU-T COM 12-20 [1998]
- PSQM/IP, perceptual speech quality measure according to ITU-T rec. P.861 [1996], incl. advanced delay compensation for end-to-end measurements, developed by OPTICOM
- Echo measurement based on real speech, Echo Return Loss ERLmom, ERLpeak, ERL vs. delay
- One way delay measurement, with PESQ also delay jitter vs.time
- Front-end clipping FEC measurement[1] (PESQ)
- Hold-over time HOT measurement[1] (PESQ)
- Background noise measurement[1] (PESQ)
- Utterances detection[1] (PESQ)
- Delay histogram[1] (PESQ)
- Signal-to-noise SNR measurement of speech and silence portions of a test signal
- Official ITU voice samples for testing and conformance verification

Audio Quality Measurement

- PEAQ, perceptual evaluation of audio quality according to ITU-R rec. BS.1387 [1999], Basic and Advanced Model
- Result logging functionality, including user definable log intervals and quality score threshold
- Official ITU audio samples for testing and conformance verification

Common Functionality

- Advanced delay compensation for end-to-end measurements, suitable for constant and variable delays (VoIP), developed by OPTICOM
- Delay measurement with real speech/music. Results in samples as well as ms
- Attenuation measured in dB
- File-based analysis capability
- Comprehensive scripting interface
- Trigger functionality for targeted analysis long duration test signals (PEAQ and PSQM)
- Graphical user interface
- Extensive scripting and command line options for automated testing
- Printing and graph exporting functionality

[1] Available Q4/2001

Graphical Displays

- Time signal displays, zoomable
- FFT Spectra displays, zoomable
- Excitation and various psychoacoustic parameters, like NMR, Masked Threshold and Loudness
- Audible distortion measurement
- Result summary display with MOV, PSQM MOS, PESQ MOS and PEAQ ODG numerical scores and bar graphs
- Delay Jitter vs. Time min/max scores and graph (PESQ)
- Echo Return Loss vs. Delay

Feature Description

PESQ Measurement

Description:	Perceptual measurement of speech quality according to ITU-T rec. P.862. Indicates call clarity. Results can be directly compared to subjective listening tests. Capable of handling varying delays and severe distortions as they occure in VoIP applications.
Algorithm standard:	Based on standard ITU-T rec. P.862
Sample rates:	8 kHz and 16 kHz
Sound file formats:	WAVE-files containing A-law, mu-law, linear PCM (8 or 16 bit)
Max. duration of measurement signals:	As defined by WAVE-format
Gain Compensation:	Maximum gain difference = ±60 dB
Automated operation:	Supported
Available Measurement Results:	Timesignal, Delay vs. Time, PESQ MOS, Jitter, Minimum, maximum and average delay, Front-end clipping FEC[1], Hold-over time HOT[1], Attenuation[1], Background noise[1], Signal-to-noise (SNR) measurement, MOS of silent and speech portions, Detailed analysis of silent and speech portions, Utterances detection[1], Delay histogram[1]

[1] Available Q4/2001

Additional Features:	File-based measurements, Printing and graph exporting functionality, Includes official ITU voice samples for testing, Includes PESQ conformance test samples, Includes PSQM conformance test samples

PSQM Measurement

Description:	Perceptual measurement of speech quality according to ITU-T rec. P.861. Indicates call clarity. Includes highly optimized proprietary mapping from raw PSQM values to P.800 Mean Opinion Score (MOS) scale. Results can be directly compared to subjective listening tests.
Algorithm standard:	Based on standard ITU-T rec. P.861
Sample rates:	8 kHz and 16 kHz
Sound file formats:	WAVE-files containing A-law, mu-law, linear PCM (8 or 16 bit)
Max. duration of measurement signals:	As defined by WAVE-format
Gain Compensation:	Maximum gain difference = ±60 dB
Automatic Delay Compensation:	±1000 ms
Static Delay:	Automatic Delay Compensation ±10 s
Automated operation:	Supported
Available Measurement Results:	Timesignal, Spectrum, Excitation, Percentage of silent intervals during measurement (Silence), Percentage of time clipped frames during measurement (Time Clipped), Percentage of severely distorted frames during measurement (Sev. Distorted), PSQM according to P.861, silence weight = 0.0 (PSQM-W0), PSQM according to P.861, silence weight = 0.2 (PSQM-W2), PSQM according to P.861, silence weight = 0.4 (PSQM-W4), PSQM value of the silent intervals (PSQM-Silence), Mean Opinion Score (MOS), silence weight = 0.0 (OMOS-W0), Mean Opinion Score (MOS), silence weight = 0.2 (OMOS-W2), Mean Opinion Score (MOS), silence weight = 0.4 (OMOS-W4), Mean Opinion Score (MOS) vs. Time, Delay between the Reference Signal and the output signal of the device under test, Attenuation of the test signal compared to the reference signal
Additional Features:	File-based measurements, Trigger functionality, Printing and graph exporting functionality,

	Includes official ITU voice samples for testing, Includes PESQ conformance test samples, Includes PSQM conformance test samples

PSQM+ Measurement

Description:	Perceptual measurement of speech quality according to ITU-T rec. P.861. Indicates call clarity. Includes highly optimized proprietary mapping from raw PSQM values to P.800 Mean Opinion Score (MOS) scale. Results can be directly compared to subjective listening tests. PSQM+ is optimzed for severe distortions, such as packet loss and time clipping.
Algorithm standard:	Based on standard ITU-T rec. P.861
Sample rates:	8 kHz and 16 kHz
Sound file formats:	WAVE-files containing A-law, mu-law, linear PCM (8 or 16 bit)
Max. duration of measurement signals:	As defined by WAVE-format
Gain Compensation:	Maximum gain difference = ±60 dB
Automatic Delay Compensation:	±1000 ms
Static Delay:	Automatic Delay Compensation ±10 s
Automated operation:	Supported
Available Measurement Results:	Timesignal, Spectrum, Excitation, Percentage of silent intervals during measurement (Silence), Percentage of time clipped frames during measurement (Time Clipped), Percentage of severely distorted frames during measurement (Sev. Distorted), PSQM according to P.861, silence weight = 0.0 (PSQM-W0), PSQM according to P.861, silence weight = 0.2 (PSQM-W2), PSQM according to P.861, silence weight = 0.4 (PSQM-W4), PSQM value of the silent intervals (PSQM-Silence), Mean Opinion Score (MOS), silence weight = 0.0 (OMOS-W0), Mean Opinion Score (MOS), silence weight = 0.2 (OMOS-W2), Mean Opinion Score (MOS), silence weight = 0.4 (OMOS-W4), Mean Opinion Score (MOS) according to PSQM+ (OMOS+), Mean Opinion Score (MOS) vs. Time, Delay between the Reference Signal and the output signal of the device under test, Attenuation of the test signal compared to the reference signal
Additional Features:	File-based measurements, Trigger functionality,

	Printing and graph exporting functionality, Includes official ITU voice samples for testing, Includes PESQ conformance test samples, Includes PSQM conformance test samples

PSQM/IP Measurement

Description:	Same as PSQM and PSQM+. Includes advanced time alignment algorithm to cope with static and variable latencies, developed by OPTICOM (Delay Tracking functionality).
Algorithm standard:	Based on standard ITU-T rec. P.861
Sample rates:	8 kHz and 16 kHz
Sound file formats:	WAVE-files containing A-law, mu-law, linear PCM (8 or 16 bit)
Max. duration of measurement signals:	As defined by WAVE-format
Gain Compensation:	Maximum gain difference = ±60 dB
Automatic Delay Compensation:	±1000 ms
Static Delay:	Automatic Delay Compensation ±10 s
Delay Tracking:	±512 samples
Automated operation:	Supported
Available Measurement Results:	Timesignal, Spectrum, Excitation, Percentage of silent intervals during measurement (Silence), Percentage of time clipped frames during measurement (Time Clipped), Percentage of severely distorted frames during measurement (Sev. Distorted), PSQM according to P.861, silence weight = 0.0 (PSQM-W0), PSQM according to P.861, silence weight = 0.2 (PSQM-W2), PSQM according to P.861, silence weight = 0.4 (PSQM-W4), PSQM value of the silent intervals (PSQM-Silence), Mean Opinion Score (MOS), silence weight = 0.0 (OMOS-W0), Mean Opinion Score (MOS), silence weight = 0.2 (OMOS-W2), Mean Opinion Score (MOS), silence weight = 0.4 (OMOS-W4), Mean Opinion Score (MOS) according to PSQM+ (OMOS+), Mean Opinion Score (MOS) vs. Time, Delay between the Reference Signal and the output signal of the device under test, Attenuation of the test signal compared to the reference signal
Additional Features:	File-based measurements, Trigger functionality,

	Printing and graph exporting functionality, Includes official ITU voice samples for testing, Includes PESQ conformance test samples, Includes PSQM conformance test samples

Echo Algorithm

Description:	Algorithm using real speech as stimulus for calculating echo. Measures the Echo return Loss (ERL) in terms of attenuation and delay values. Includes graphical representation of the ERL vs. Delay.
Sample rates:	8 kHz and 16 kHz
Sound file formats:	WAVE-files containing A-law, mu-law, linear PCM (8 or 16 bit)
Max. duration of measurement signals:	As defined by WAVE-format
Gain Compensation:	Maximum gain difference = $\pm$60 dB
Maximum echo delay:	1000 ms
Frame size:	16 ms at 8 kHz
Averaging window size:	800 ms at 8 kHz
Automated operation:	Supported
Available Measurement Results:	Timesignal, Echo Return Loss (ERL) vs. Delay, Momentary attenuation of the highest echo peak (ERLmom), Momentary delay of the highest echo peak (ERLmom Delay), Attenuation of the highest echo peak during the whole measurement period (ERLpeak), Delay of the highest echo peak during the whole measurement period (ERLpeak Delay)
Additional Features:	File-based measurements, Printing and graph exporting functionality, Includes official ITU voice samples for testing, Includes PESQ conformance test samples, Includes PSQM conformance test samples

PEAQ Algorithm

Description:	Perceptual measurement of wide band audio according to ITU-R rec. BS.1387. Includes the basic version of PEAQ, defined for computational efficiency and the advanced version yielding for highest possible accuracy. Detailed analysis of test signals through BS.1387 model output variables (MOVs).
Algorithm:	Based on standard ITU-R rec. BS.1387
Sample rates:	48 kHz (according to recommendation ITU-R BS.1387), 44.1 kHz

Sound file formats:	WAVE-files containing A-law, mu-law, linear PCM (8 or 16 bit)
Max. duration of measurement signals:	As defined by WAVE-format
Gain Compensation:	Maximum gain difference = ±60 dB
Automatic Delay Compensation:	±1000 ms (File-based measurements), ±500 ms (On-line measurements)
Static Delay:	Automatic Delay Compensation ±10 s
Delay Tracking:	±512 samples
Automated operation:	Supported
Available Measurement Results:	Timesignal, Spectrum, Excitation, Noise-to-Mask Ratio (NMR), averaged, Noise-to-Mask Ratio (NMR) vs. Time, Masked Threshold, Loudness, Objective Difference Grade (ODG), averaged (Advanced and Basic Version), Objective Difference Grade (ODG) vs. Time, Distortion Index (DI), for the Advanced and the Basic Version, Delay between the Reference Signal and the output signal of the device under test, Attenuation of the test signal compared to the reference signal, Modulation of the reference and test signal
BS.1387 intermediate results (MOVs):	Average Bandwidth of the Reference Signal (AvgBwRef), Average Bandwidth of the output signal of the device under test (AvgBwTst), Total Noise-to-Mask Ratio (NMRtotB), Relative fraction of frames for which at last one frequency band contains a significant noise component (RDF), Average Distorted Block (=Frame), taken as the logarithm of the ratio of the total distortion to the total number of severely distorted frames (ADB), Maximum of the Probability of Detection after low pass filtering (MFPD), Harmonic structure of the error over time (EHS), Windowed averaged difference in modulation (envelopes) between Reference Signal and Signal Under Test (WinModDif1B), Averaged modulation difference (AModDif1B), Averaged modulation difference with emphasis on introduced modulations and modulation changes where the reference contains little or no modulations (AmodDif2B, RModDifA), RMS value of the averaged noise loudness with emphasis on introduced components (NloudB, NLA), Averaged Linear Distortions (ALD)

Additional Features:	File-based measurements, Trigger functionality, Result logging option, including user definable log intervals and ODG threshold, Printing and graph exporting functionality, Includes official ITU audio samples for testing, Includes PEAQ conformance test samples

System Requirements

Processor:	Intel Pentium III, 500 MHz or above
RAM:	≥ 128 MB, 256 MB are recommended
Screen resolution:	1024*768, ≥ 64k colours
Graphics adapter:	NVIDIA TNT2 ASUS AGP – V7100 SDRAM V5.33, NVIDIA GeForce2 MX, Matrox G400, ATI 3D Rage IIC (GT-B3U1) Various cards from ELSA (Erazor III Pro, Gladiac 511/MX), Various cards from Diamond
Graphics memory:	≥ 8 MB
Operating system:	Microsoft Windows NT4.0 SP4, Microsoft Windows NT4.0 SP5, Microsoft Windows 2000