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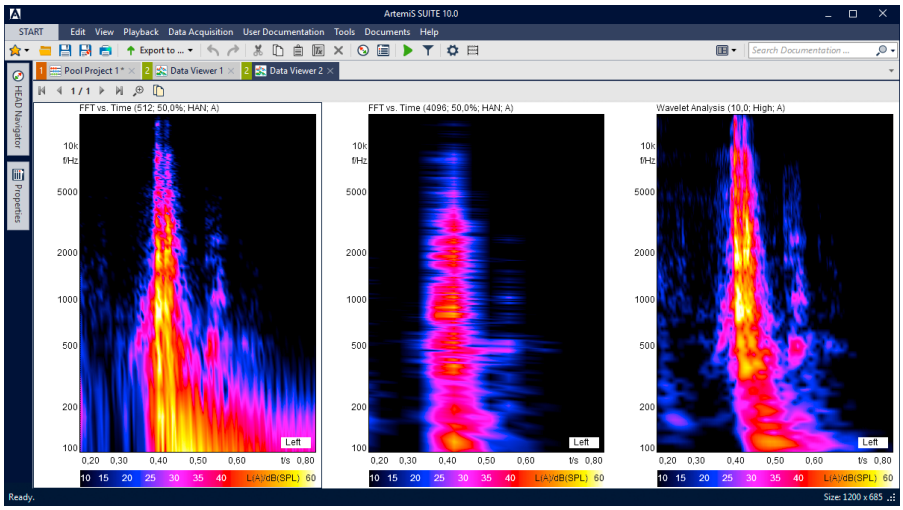
ArtemiS SUITE
ASM 17

DATA SHEET

ArtemiS SUITE Advanced Analysis Module (Code 5017)

Expansion module for the implementation of sophisticated analyses



Overview

The Advanced Analysis Module provides methods to analyze modulation spectra, tonal signal parts etc.

Features

Expansion module for the implementation of sophisticated analyses

Filter Pool:

- Envelope filter for calculating the envelope of a bandpass-filtered input signals

Analysis Pool:

- Cepstrum
- Cepstrum vs. Time
- Degree of Modulation vs. Time
- Gated DFT (average)
- Gated DFT vs. Time
- Kurtosis vs. Time
- Level vs. RPM (filtered)
- Level vs. Time (filtered)
- Modulation Frequency vs. Time
- Modulation Spectrum
- Modulation Spectrum vs. Band
- Modulation Spectrum vs. Time
- Spectral analyses with VFR (Variable Frequency Resolution)
  - VFR (average)
  - VFR vs. Time
- Speech Transmission Index 2D
- Sound Power vs. Time
- Sound Power vs. RPM
- Sound Power Spectrum
- Sound Power Spectrum vs. Time
- Sound Power Spectrum vs. RPM
- Tonality DIN 45681
- Tonality DIN 45681 vs. Time
- Tone to Noise Ratio
- Tone to Noise Ratio vs. Time
- Wavelet
- Weighted Modulation Analysis

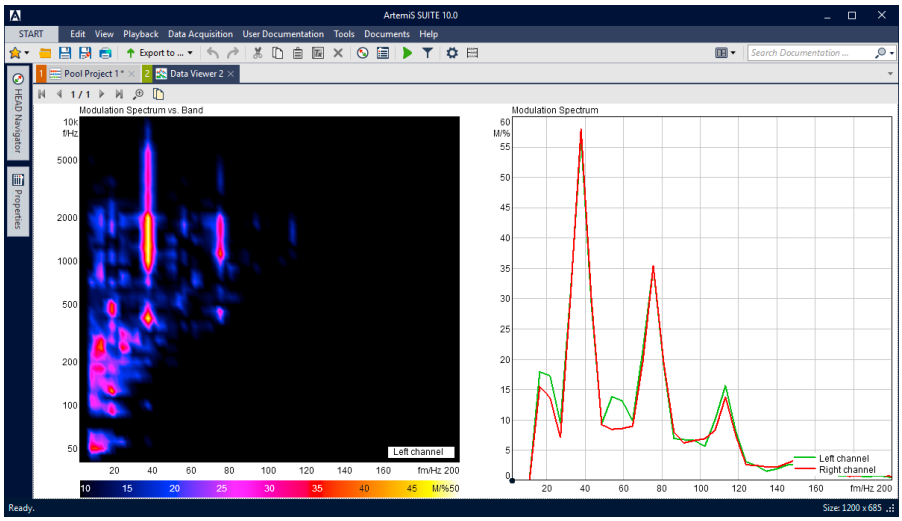
Wavelet

The wavelet analysis is particularly suited for examining short, transient signals, such as a few cycles of a combustion engine. Transient means that the sound is characterized by rapid, non-periodic changes. The wavelet analysis (as compared to the FFT analysis) is characterized by a high frequency resolution at low frequencies and, at the same time, a high time resolution at high frequencies.

The above example of a door slam sound illustrates the good frequency and time resolution of the Wavelet analysis (right diagram) compared to the FFT analysis, which provides either a good time resolution or a good frequency resolution, but not both.

Modulation Analysis

The modulation analysis delivers the spectra of the envelopes of partial bands of the analyzed signal. This allows the user to identify amplitude modulations with their frequency, strength and variation over time. While the psychoacoustic parameters roughness and fluctuation strength account for certain modulation frequencies (e.g. frequencies around 5 Hz for the fluctuation strength), the modulation analysis covers a broad frequency range including the ranges for roughness and fluctuation strength



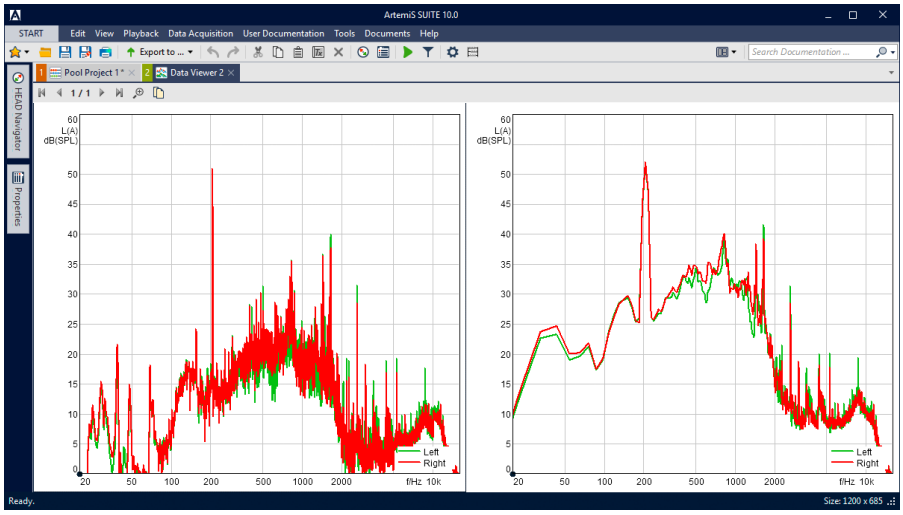
The modulation depth and the modulation frequency can be detected by using several modulation analysis.

Weighted Modulation

The weighted modulation spectrum examines the modulation of stationary sounds (e. g. power supply fan noise) and turns it into a single value as a measure of annoyance. For this purpose, the modulation spectrum of the frequency groups is calculated. Only modulation frequencies between 0 Hz and the configured maximum envelope frequency are taken into account. The result comprises the single value and the modulation spectrum plotted against the signal frequency.

VFR (Variable Frequency Resolution)

The VFR analysis is based on the FFT analysis, but features a variable frequency resolution, which is better suited for analyzing low-frequency spectral components of a time-domain signal than the FFT. While the FFT delivers a spectral representation with a constant frequency resolution across the entire frequency range covered, the VFR is more similar to human hearing in that it has a higher frequency resolution at low frequencies than at higher ones.



For this low-frequency tonal sound, which hardly changes over time, the averaged VFR analysis (left diagram) is especially well suited. Unlike the averaged FFT analysis (shown in the right diagram), the VFR analysis has a better spectral resolution in the low-frequency range and shows the frequency of the hooting sound with a very narrow peak at 205 Hz.

Sound Power Analysis

Sound power is an acoustical quantity that determines the sound energy of a sound source per unit of time.

With ArtemiS SUITE the sound power can be calculated according to the standards ISO 3741, ISO 3743, ISO 3744, ISO 3745, and ISO 3746.

Speech Transmission Index 2D

The Speech Transmission Index (STI) is used to measure speech transmission systems.

For the calculation of the Speech Transmission Index (STI) the degrees of modulation of the intensity envelope of signals are determined. The measurement takes into account the frequency range of speech (125 Hz to 8 kHz) as well as the typical modulation frequencies appearing in speech (0.63 Hz to 12.5 Hz).

For the calculation of the Speech Transmission Index of an input signal, ArtemiS SUITE provides the methods STITEL, STIPA und RASTI as well as the standards IEC 60268-16:2003 and IEC 60268-16:2011.

Requirements

- ArtemiS SUITE Basic Framework (Code 5000)
- ArtemiS SUITE Basic Analysis Module (Code 5001)

Scope of Supply

- License file
  - ArtemiS SUITE Advanced Analysis Module (Code 5017)

Technical Data

Filter Pool

Envelope

Band Type:	Standard Band / Fixed Band / Tracking Band
Bands:	1/3 Octave / Octave / Critical Bands / Full Bandwidth
Row:	A / B
Band Number:	Selectable
Frequency [Hz]:	Selectable
Quality:	Selectable
Tracking Order:	Selectable
Envelope Lowpass [Hz]:	Selectable
Lock Sampling Rate:	Selectable

Analysis Pool

Modulation Frequency vs. Time / Modulation Spectrum / Modulation Spectrum vs. Time / Modulation Spectrum vs. Band / Degree of Modulation vs. Time

Band Type:	Standard Band / Fixed Band / Tracking Band
Standard Band:	Selectable
Bands:	1/3 Octave / Octave / Critical Bands / Full Bandwidth
Row:	A / B
Band Number:	Selectable
Fixed Band:	Selectable
Frequency [Hz]:	Selectable
Quality:	Selectable
Tracking Band:	Selectable
Tracking Order:	Selectable
Envelope Lowpass [Hz]:	Selectable
Spectrum Size:	16 - 2^{23} Samples
Window Function:	Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32
Overlap:	Selectable
Degrees of Modulation:	Selectable
Max. Nbr of Time Values:	Selectable
Add Tolerance Scheme:	Display of tolerance curves with tolerance test of the analysis result
Representation Settings:	Individual scaling of the axes in the analysis result
Cuts:	Extracting of 2D curves from the three dimensional spectrum (Cut Mode: First Abscissa / Second Abscissa / Free selectable cuts)

Weighted Modulation

Metric Parameters:	M (number of the major degrees of modulation to be considered) / X (determination of the weighting of degrees of modulation with the same modulation frequency)
Modulation Frequency Reduction:	No Reduction / 41 Modulation
Modulation Spectrum Weighting:	Frequency weighted / Frequency and Modulation Frequency weighted
Modulation Frequency Weighting:	Selection of the cutoff frequencies and the steepnesses of the high-pass filter / low-pass filter
Envelope Lowpass [Hz]:	Selectable
Average:	Selectable
Weighting Analysis:	Specific Prominence / Specific Loudness
Representation Settings:	Individual scaling of the axes in the analysis result
Cuts:	Extracting of 2D curves from the three dimensional spectrum (Cut Mode: First Abscissa / Second Abscissa / Free selectable cuts)

Wavelet

Spectral Weighting:	None / A / B / C / D / G / Wd / Wk / Wh etc. Weighting
Filter Type:	Butterworth / Bessel / Chebyshev
Ripple [dB]:	0.01 dB to 3 dB
Filter Order:	2 / 4 / 6
Frequency Range [Hz]:	Selection of the lower and the upper cutoff frequencies
Filter Quality:	Selectable
Resolution:	Low / Medium / High
Max. Nbr of Time Values:	Selectable

Cepstrum / Cepstrum vs. Time

Spectrum Size:	2^8 - 2^{23} Samples
Window Function:	Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32
Overlap:	Selectable
Max. Nbr of Time Values:	Selectable
Envelope:	Selectable

Kurtosis vs. Time

Overlap:	Selectable
Integration Time [ms]:	Selectable

Level vs. Time (filtered) / Level vs. RPM (filtered)

Spectral Weighting:	None / A / B / C / D / G / Wd / Wk / Wh etc. Weighting
Time Weighting:	Fast / Slow / Manual / Impulse / Rectangle
Time Constant [ms]:	Selectable
Downsampling:	Selectable
Step Size [rpm, ...]:	Selectable
Slope:	Auto Detect / Rising / Falling
Filter Type:	Butterworth / Bessel / Chebyshev
Ripple [dB]:	0.01 dB to 3 dB
Filter Order:	1 / 2 / 3 / 4 / 5 / 6
Frequency HP [Hz]:	Selectable
Frequency LP [Hz]:	Selectable

Gated DFT / Gated DFT vs. Time

Window Function:	Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32
Spectral Weighting:	None / A / B / C / D / G / Wd / Wk / Wh etc. Weighting
Analysis to use:	GFT / HSA
HSA Resolution Enhancement:	1 / 2 / 4 / 8 / 16
HSA Iterations:	Selectable
Complex:	Calculation of a complex spectrum
Trigger:	First Used Impulse

Number of Rotations per DFT:	Selectable
Analysis Window Definition:	By Time / By Crank Angle (CA)
Delay by Time [ms] / Delay by CA [°]:	Selectable
Width by Time [ms] / Width by CA [°]:	Selectable

Tonality DIN 45681 / Tonality DIN 45681 vs. Time

Spectrum Size:	2^8 - 2^{23} Samples
Overlap:	Selectable
Max. Nbr of Time Values:	Selectable
Averaging Time [s]:	Selectable

Tone to Noise Ratio / Tone to Noise Ratio vs. Time

Spectrum Size:	2^{12} - 2^{16} Samples
Overlap:	Selectable
Max. Nbr of Time Values:	Selectable
Compensate Threshold of Hearing:	Selectable
Transformation:	DFT / HSA
HSA Resolution Enhancement:	Selectable
HSA Iterations:	Selectable
User Tolerance File:	Selectable

VFR (average) / VFR vs. Time

Spectrum Size:	16 - 2^{23} Samples
Window Function:	Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32
Spectral Weighting:	None / A / B / C / D / G / Wd / Wk / Wh etc. Weighting / Equal Loudness
VFR Bandwidth:	Low / Medium / High
Overlap:	Selectable
PDS Correction:	Selectable
Max. Nbr of Time Values:	Selectable

Speech Transmission Index 2D

Method:	STIPA / STITEL / RASTI
Standard:	IEC 60268-16:2003 / IEC 60268-16:2011
Female Voice:	Selectable (Method: STIPA)
Reference Channel:	Selectable

Sound Power vs. Time / Sound Power vs. RPM / Sound Power Spectrum / Sound Power Spectrum vs. Time / Sound Power Spectrum vs. RPM

Standard:	User defined, ISO 3743, ISO 3744, ISO 3745, ISO 3546, ISO 3741 (Direct), ISO 3741 (Reference)
Unequal Areas:	Number of Areas / Area Size [m^2]
Area Size [m^2]:	Selectable
Frequency Range [Hz]:	Selectable

1/n Octave Spectrum / 1/n Octave Spectrum vs. Time / 1/n Octave Spectrum vs. RPM

Method:	FFT / Filter
Band Resolution:	Octave / 3rd Octave / 1/6 - 1/96 Octave
Row:	A / B
Spectral Weighting:	None / A / B / C / D / G
Band Border Frequency:	Nominal / Octave / Decade
Spectrum Size:	16 - 2^{23} Samples
Window Function:	Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32
Overlap:	Selectable
Step Size [rpm, ...]:	Selectable
Slope:	Auto Detect / Rising / Falling
Filter Order:	4th Order / 6th Order
Time Weighting:	Fast / Slow / Manual / Impulse
Time Constant [ms]:	Selectable
K0 - Atmosphere Correction [dB]:	Barometric Pressure [hPa] / Temperature [°C]
K1 - Background Noise Correction:	None / Spectrum / Single Value
If Noise ≤ Signal - 6 dB:	Apply Correction / Limit Correction to 1.3 dB / Set Correction to 0 dB
K2 - Environmental Correction:	Selectable
Reverberation Room:	Volume [m^3] / Surface [m^2] / Reverberation or Absorption File
Additional Results:	Microphone Spectra / Directivity / Surface Spectrum / Microphone Max Difference Spectrum / K1 Correction Spectrum / K2 Correction Spectrum

Available for all Analyses

Representation Settings:	Individual scaling of the axes in the analysis result
Add Tolerance Scheme:	Display of tolerance curves with tolerance test of the analysis result (not available for the analyses Weighted Modulation, Wavelet, Sound Power Spectrum)
Cuts:	Extracting of 2D curves from the three dimensional spectrum (Cut Mode: First Abscissa / Second Abscissa / Free selectable cuts

Single Values

Available for all 2D analyses as well as for 3D analyses that have been reduced to two-dimensional curves using cuts.

Only Single Values as Result:	Selectable
Abscissa Range:	Selectable
Options:	Average / Sum / Min / Max / Percentile

Definition of threshold values for whose compliance the determined single values shall be tested for.

Quantity:	Selectable
Unit:	Selectable

Recast 2D Abscissa

Transforming the abscissa of a two-dimensional data set versus time or RPM.

Abscissa Range:	Selectable
Step Size:	Selectable
Optional Manual Configuration:	Interpolation / Aggregation