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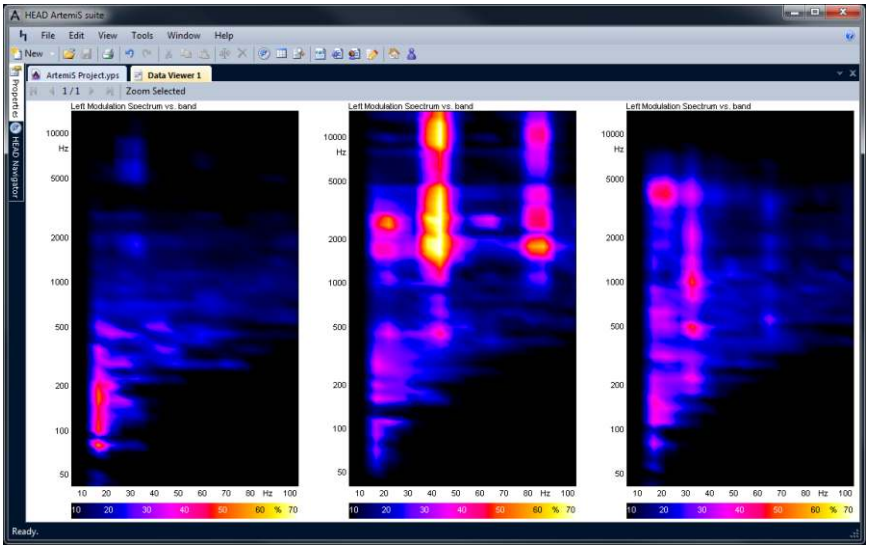
ArtemiS SUITE
ASM 17

DATA SHEET

ArtemiS SUITE Adv. Analysis Module (Code 5017)

ArtemiS SUITE Module to perform specific analyses



Overview

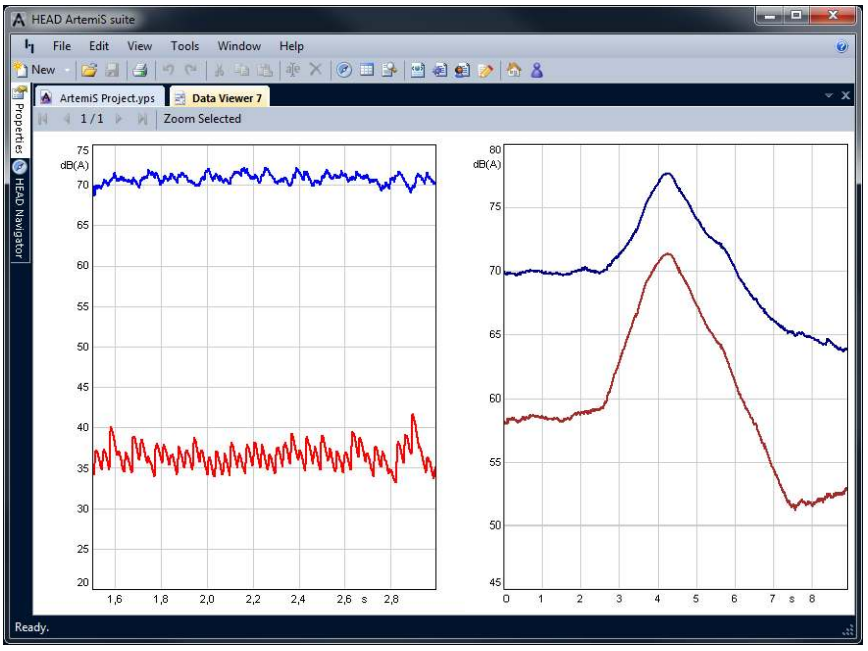
The Advanced Analysis Module provides the analysis Modulation Spectrum vs. band and filtered level versus time and versus RPM .

Features

- Expansion module of the ArtemiS SUITE for specific analyses:
  - Level vs. time (filtered)
  - Level vs. RPM (filtered)
  - Modulation Spectrum vs. band
- The filtered level variation of an input signal can be calculated versus time or versus RPM. With the help of the filtered level analysis, the analysis can be limited to the interesting content of a signal and thus provides important information e.g. about a disturbing component included in the signal.
- The modulation spectrum of an input signal can be calculated versus bands
- In addition to the analyses included in the Advanced Analysis Module of the ArtemiS SUITE, ArtemiS 12 provides the analyses of the Advanced Analysis Module (ATP 07).

Requirements

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



The diagrams above exhibit the analysis results of two disturbing noises, red curve: the filtered level, blue curve: the level of the complete signal. The left diagram shows that the disturbing component is comparatively strongly modulated. The right diagram shows that the ratio of the complete signal level to the filtered level is strongly shifted when passing through a resonance.

Analysis Pool

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

Spectral Weighting:	None / A / B / C / D / G / W_d / W_k / W_h etc. Weighting
Time Weighting:	Fast / Slow / Impulse / Manual / Rectangle
Time Constant (s):	Selectable
Downsampling:	Downsampling of the analysis result according to the time constant used
Step Size:	Selectable
Slope:	Auto Detect / Rising / Falling
Filter Type:	Butterworth / Bessel / Tschebycheff (0.5 / 1 / 2 / 3 dB)
Filter Order:	1 - 4
Frequency HP (Hz):	Selectable
Frequency LP (Hz):	Selectable

Modulation Spectrum vs. band

Bands:	Third Octave Bands / Octave Bands / Critical Bands
Range (Hz):	Selectable
Max. Envelope Frequency (Hz):	Selectable
Window Function:	Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32
Spectrum Size:	16 - 2^{23}
Overlap:	Selectable
Degrees of Modulation:	Scaling of the modulation spectra as modulation factor (0 to 100 %)
Cuts:	Extracting of 2D curves from the three dimensional spectrum (Cut Mode: First Abscissa / Second Abscissa / Free selectable cuts)

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ArtemiS SUITE

DATA SHEET

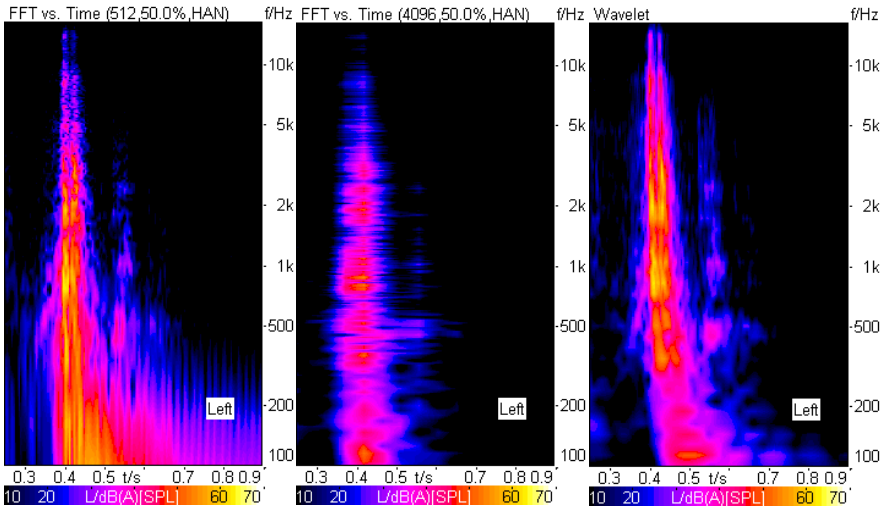
ATP 07 (Code 5017)

ArtemiS Advanced Analysis Module

ASM 17 (Code 5017) of the ArtemiS SUITE includes ATP 07.

Overview

The Advanced Analysis Module ATP 07 provides sophisticated methods to analyse modulation spectra, tonal signal components, transient signals etc.



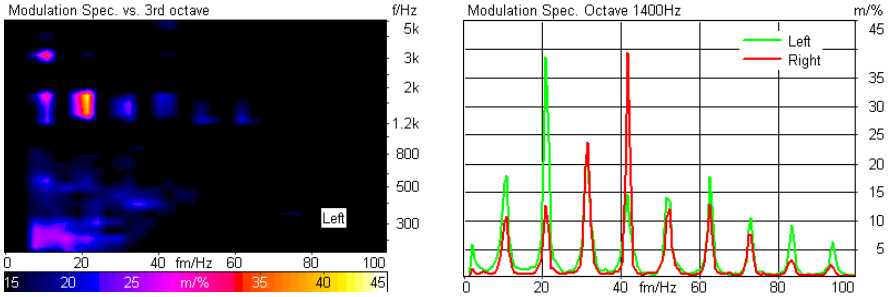
A comparison between a Wavelet analysis (right diagram) and two FFT vs. time analysis shows the advantages of the Wavelet analysis, which provides a good time resolution as well as a good frequency resolution.

Wavelet

The Wavelet analysis has proven to be especially suitable for examining short, transient signals, such as a few cycles of a combustion engine. Transient means that the signal is characterized by quick, non-periodic changes. The frequency resolution at low frequencies and the time resolution at higher frequencies are better in the Wavelet analysis than in a comparable FFT analysis.

Modulation Analysis

Modulation analysis delivers the envelope spectra of partial bands of an analyzed signal. This allows the user to recognize amplitude modulations including their frequency, strength and change over time. While the psychoacoustic parameters roughness and fluctuation strength allow only certain modulation frequencies to be examined and judged (e.g. modulation frequencies around 5 Hz for fluctuation strength), a modulation analysis covers a wider frequency range, which also includes the roughness and fluctutation strength areas, and does not add psychoacoustic weightings.



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

Features

Filter pool

- Envelope

Analysis pool

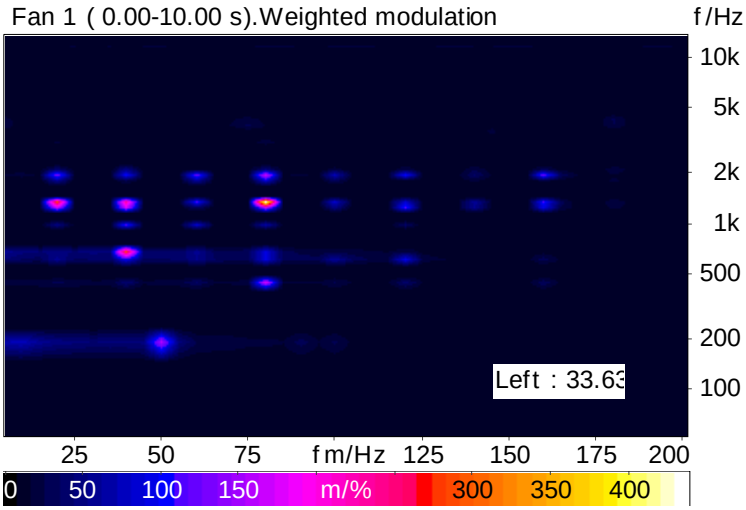
- Modulation Frequency vs. time
- Modulation Spectrum / Modulation Spectrum vs. time / Modulation Spectrum vs. Frequency Bands
- Degree of Modulation vs. time
- Weighted Modulation
- Wavelet Analysis
- Cepstrum / Cepstrum vs. time
- Kurtosis vs. time
- Level vs. time (filtered) / Level vs. RPM (filtered)
- Sound Power Measurement (DIN 45635)
- Envelope
- GFT (Gated Fourier Transformation) / GFT vs. time
- Spectral Analysis with VFR (Variable Frequency Resolution) / VFR vs. time
- Tonality DIN 45681 / Tonality DIN 45681 vs. time
- Tone-to-Noise Ratio / Tone-to-Noise Ratio vs. time
- Speech Transmission Index (STI: STITEL / STIPA / RASTI)

Applications

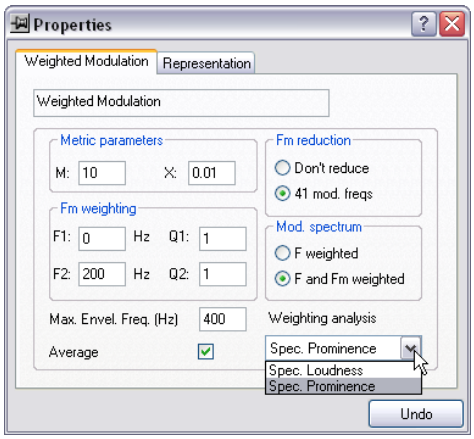
- Diverse analysis results with a high time/frequency resolution
- Modulation spec. analysis
- Transient signals analysis
- DIN measurements (sound power measurements of machines)
- Measurement of speech intelligibility

Weighted Modulation

The weighted modulation spectrum determines the modulation depths of stationary sounds (e.g. power supply fan noise) and derives from them a single value as a measure of the degree of annoyance. For this purpose, a modulation spectrum against the frequency groups is determined. Only modulation frequencies between 0 and 200 Hz are taken into account. The result consists of the single value and the modulation spectrum against the signal frequency.



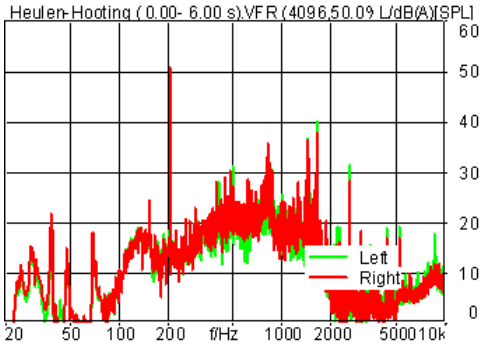
Analysis Weighted Modulation: It is clearly visible that individual points out of the lines visible in the spectra are emphasized. The actual result of this analysis is the single value for the modulation metric.

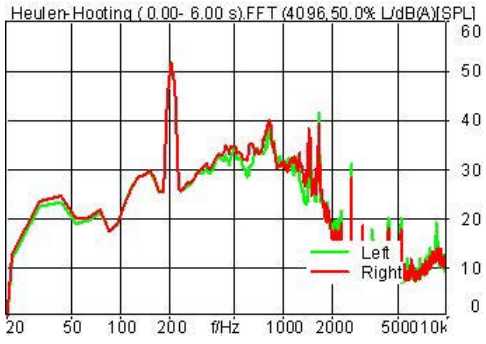


Properties of the Weighted Modulation Analysis

VFR (Variable Frequency Resolution)

The VFR analysis is an FFT analysis with a variable frequency resolution. Compared to the FFT, this method is better suited for the analysis of the low-frequency spectral components of an audio signal. While the FFT leads to a spectral representation with a constant frequency resolution in the entire frequency range covered by the analysis, the VFR has a higher resolution at low frequencies than in the higher frequency range - similar to human hearing.





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.

Technical data filter pool:

Envelope

Max. envelope frequency: 5 - 5000

Standard Band

Frequenzbänder: Oktave / 3rd octave / critical bands / full bandwidth

Row: A / B

Number: adjustable

Fixed Band

Frequency (Hz): 20 - 20000

Quality: 0.1 - 99.9

Tracking Band

Order: 0.5 - 999.9

Quality: 0.1 - 99.9

Optionally the envelope and the source data set display the same sampling rate

Technical data analysis pool:

Mod. freq. vs. time / Mod. spectrum octave / Mod. spectrum vs. time / Degree of mod. vs. time

Window Function: Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32

DFT Size: 16 - 2^{20}

Overlap: 0 - 99.9 %

Max. Envelope Freq. (Hz.): 5 - 5000

Standard Band

Band: octave / 3rd octave / critical bands

Row: A / B

Fixed Band

Frequency (Hz): 20 - 20000

Quality: 0.1 - 99.9

Tracking Band

Order: 0.5 - 999.9

Quality: 0.1 - 99.9

Mod. spectrum vs. critical bands

Bands: octave / 3rd octave / critical bands

Range: adjustable

Window Function: Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32

DFT Size: 16 - 2^{20}

Overlap: 0 - 99.9 %

Max. Envelope Freq. (Hz.): 5 - 5000

Degrees of modulation: selectable

Weighted Modulation

Metric parameters

M: number of values taken into account

X: stronger inclusion of the modulation depths

f_M reduction

Don't reduce: continuously evaluation of modulation frequencies in the range of 0-200 Hz

41 mod. frequencies: the range of 0-200 Hz is divided into 41 bands

Fm weighting

Conform to a high-pass filter (f1/Q1) or rather a low-pass filter (f2/Q2) for modulation frequencies

Mod. spectrum

Weighted by signal frequencies / modulation frequencies

Maximum envelope frequency: adjustable

Average: averages over the channels involved before the weighting is calculated

Weighting analysis: Specific Prominence Ratio / Specific Loudness

Wavelet

Spectral Weighting: none / A / B / C / D / G / W_d / W_k / W_h etc. Weighting

Filter Type: Butterworth / Bessel / Tschebycheff 0.5 - 3 dB

Filter Order: 2nd / 4th / 6th Order

Frequency Range (Hz.): 10 - 20 000

Resolution: low / medium / high

Cepstrum / Cepstrum vs. time

Window Function: Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32

DFT Size: 16 - 2^{20}

Overlap: 1 - 99 %

Kurtosis vs. time

Overlap: 0 - 99.9 %

Integration time (ms): 10 - 2500

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

Spectral Weighting:	none / A / B / C / D / G / W_d / W_k / W_h etc. Weighting
Time Weighting:	fast / slow / impulse / manual (0 - 60 s)
Filter Type:	Butterworth / Bessel / Tschebycheff 0.5 - 3 dB
Filter Order:	1st - 4th Order
Level vs. RPM (filtered)	
Step Size (rpm):	0.001 - 1000
Slope:	rpm (Detect) / rpm (Falling) / rpm (Rising))

Ton-to-Noise Ratio / Ton-to-Noise Ratio vs. time

Overlap:	0 - 99.9 %
Spectrum Size:	2^{12} - 2^{16}
Compensation threshold of hearing	
Transformation:	HSA / DFT
Resolution enhancement:	2 - 16
Iterations:	4 - 64
Ton-to-Noise Ratio	
Tolerance:	user-specific

Tonality DIN 45681 / Tonality DIN 45681 vs. time

Overlap:	0 - 99.9 %
DFT Size:	2^{11} - 2^{16}
Tonality DIN 45681 vs. time	
Averaging time (s):	user-specific

Sound Power Measurement

Standards:	Default, ISO 3744, ISO 3745, ISO 3576, ISO 3741 (direct), ISO 3741 (reference)
Procedure:	Meas of machine / Meas. of background noise (K 1) / Meas. of reference source (K 2)
Ares size (m^2):	0 - n

1/n Octave

Band Resolution:	octave / 3rd octave
Spectral Weighting:	none / A / B / C / D / G / W_d / W_k / W_h etc. Weighting
Row:	A / B
Window Function:	Rectangle / Hanning / Hamming / Blackman / Bartlet / Kaiser-Bessel 8 - 16 / Flat-top / Gauss 8, 16, 32
DFT Size:	16 - 2^{20}
Overlap:	0 - 99.9 %

Envelope

Max. Envelope Freq. (Hz.):	5 - 5000

Standard Band

Band:	octave / 3rd octave / critical bands / full bandwidth
Row:	A / B
Number:	adjustable

Fixed Band

Frequency	20 - 20000
Quality:	0.1 - 99.9

Tracking Band

Order:	0.5 - 999.9
Quality:	0.1 - 99.9

GFT / GFT 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 / W_d / W_k / W_h etc. Weighting
Method:	FFT / HSA
Analysis window definition:	Adjustment of the constant component and the width of the analysis window in time (fixed for each RPM value) or in angle (variable)
Trigger	
FFT / HSA:	selectable
Complex:	displays the result as a complex spectrum

VFR / VFR vs. time

DFT Size:	16 - 2^{20}
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 / W_d / W_k / W_h etc. Weighting
VFR Bandwidth:	low / medium / high
Overlap:	0 - 99.9 %

Speech Transmission Index (STI: STITEL / STIPA / RASTI)

Representation:	Modulation transfer index, Oktave levels, STI vs. channel, Modulation index (2D, 3D), MTF (2D, 3D, corrected), Effective SNR (2D, 3D), Transmissionsindex (2D, 3D)
Reference channel:	selectable
STIPA: selectable	male / female voice
STI-Signal (Generate):	32000 Hz, 44100 Hz, 48000 Hz

The functionality of the ArtemiS Advanced Analysis Module (ATP 07) is extended by the ArtemiS Signature Analysis Module (ATP 03). Further information you will find in the data sheet of ATP 03.