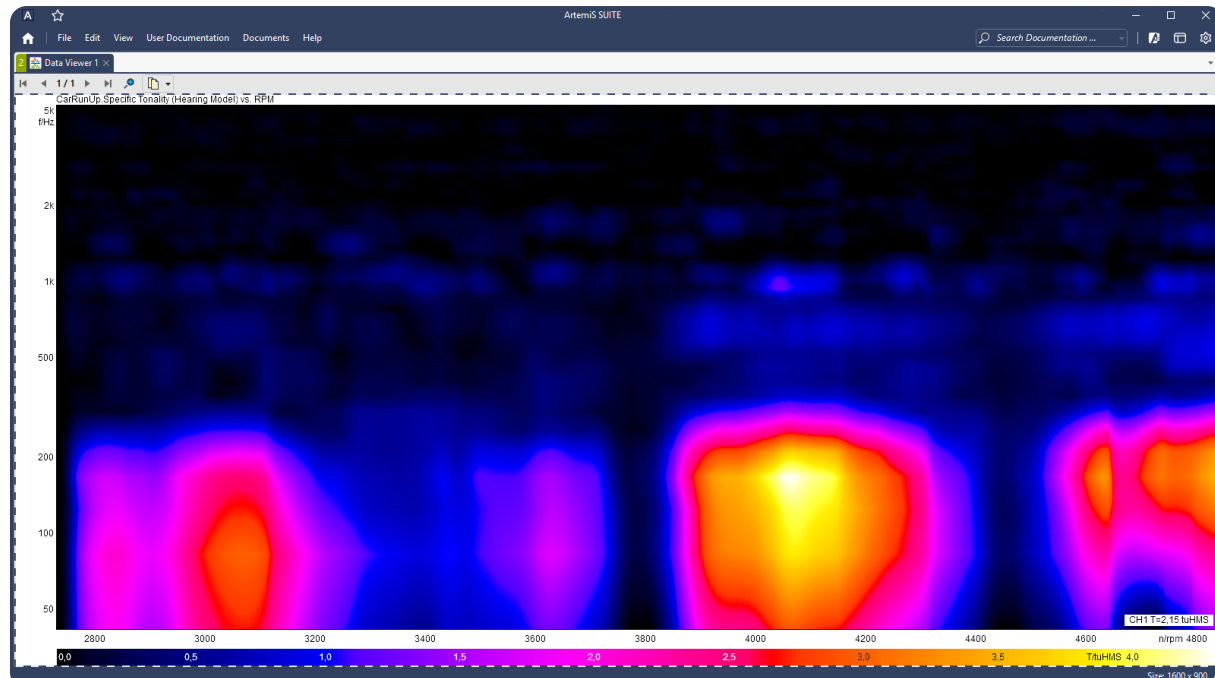




ArtemiS SUITE
Signal Processing

Code 51104

ASP 104 Psychoacoustics - Advanced Analysis vs. Control Channel

ASP 104 provides a variety of advanced psychoacoustic analyses as a function of control channels (RPM, force, ...) based on the Sottek Hearing Model.

OVERVIEW

ASP 104 Psychoacoustics - Advanced Analysis vs. Control Channel

Code 51104

ASP 104 provides advanced analyses as a function of control channels based on the Sottek Hearing Model.

ArtemiS SUITE provides further options (ASPs) including psycho-acoustic analyses:

- › ASP 101 (Psychoacoustics - Basic Analysis)
- › ASP 102 (Psychoacoustics - Basic Analysis vs. Control Channel)
- › ASP 103 (Psychoacoustics - Advanced Analysis)

ASP 101 and ASP 102 provide standards and methods:

- › DIN 45631, DIN 45631/A1, DIN 45681, DIN 45692
- › ISO 532-1, ISO 532-3, ISO/TS 20065, ANSI S3.4-2007
- › ECMA-418-1, ECMA-74 (Annex D)
- › Aures, von Bismarck

ASP 103 and ASP 104 provide standards and methods:

- › DIN 38455
- › ECMA-418-2, ECMA-74 (Annex F)

KEY FEATURES

ASP 104 includes a variety of analyses based on the Sottek Hearing Model that can be calculated as a function of RPM, force, temperature, or other control channels.

- › Loudness (Hearing Model) vs. RPM
- › Specific Loudness (Hearing Model) vs. RPM
- › Tonality (Hearing Model) vs. RPM
- › Specific Tonality (Hearing Model) vs. RPM
- › Tonality Frequency (Hearing Model) vs. RPM
- › Roughness (Hearing Model) vs. RPM
- › Specific Roughness (Hearing Model) vs. RPM
- › Impulsiveness (Hearing Model) vs. RPM
- › Specific Impulsiveness (Hearing Model) vs. RPM
- › Fluctuation Strength (Hearing Model) vs. RPM

ASP 104 can be used in Pool Projects (APR 010 is required), Automation Projects (APR 050 is required), Standardized Test Projects (APR 220 is required), and Metric Projects (APR 570 is required).

APPLICATIONS

- › Simulation of human perception using appropriate analyses
- › Improvement of product sound quality
- › Evaluation of environmental noise

OVERVIEW ASP 101 – ASP 104

PSYCHOACOUSTICS - BASIC ANALYSIS (ASP 101)

- › Loudness vs. Time
- › Specific Loudness
- › Specific Loudness vs. Time
- › Sharpness vs. Time
- › Specific Sharpness
- › Tonality
- › Tonality vs. Time
- › Tone-to-Noise Ratio
- › Tone-to-Noise Ratio vs. Time
- › Specific Prominence Ratio
- › Specific Prominence Ratio vs. Time

PSYCHOACOUSTICS - BASIC ANALYSIS VS. CONTROL CHANNEL (ASP 102)

- › Analyses from ASP 101 as a function of control channels

PSYCHOACOUSTICS - ADVANCED ANALYSIS (ASP 103)

- › Loudness (Hearing Model) vs. Time
- › Specific Loudness (Hearing Model)
- › Specific Loudness (Hearing Model) vs. Time
- › Tonality (Hearing Model) vs. Time
- › Specific Tonality (Hearing Model)
- › Specific Tonality (Hearing Model) vs. Time
- › Tonality Frequency (Hearing Model) vs. Time
- › Roughness (Hearing Model) vs. Time
- › Specific Roughness (Hearing Model)
- › Specific Roughness (Hearing Model) vs. Time
- › Impulsiveness (Hearing Model) vs. Time
- › Specific Impulsiveness (Hearing Model)
- › Specific Impulsiveness (Hearing Model) vs. Time
- › Spectrum (Hearing Model) vs. Time
- › Fluctuation Strength (Hearing Model) vs. Time

- › Specific Fluctuation Strength (Hearing Model)
- › Specific Fluctuation Strength (Hearing Model) vs. Time
- › Relative Approach 2D
- › Relative Approach 3D

PSYCHOACOUSTICS - ADVANCED ANALYSIS VS. CONTROL CHANNEL (ASP 104)

- › Analyses from ASP 103 as a function of control channels

STANDARDS AND CALCULATION METHODS

- › Loudness
 - › DIN 45631 (1991), DIN 45631/A1 (2010)
 - › ISO 532-1 (2017), ISO 532-3 (2023)
 - › ANSI S3.4-2007 (FFT) / (FFT / 3rd Octave)
- › Sharpness
 - › Aures
 - › von Bismarck
 - › DIN 45692 (2009)
 - › DIN 45631/A1 (2010)
 - › ISO 532-1 (2017), ISO 532-3 (2023)
 - › ANSI S3.4-2007 (FFT) / (FFT / 3rd Octave)
- › Tonality
 - › DIN 45681 (2006)
 - › ISO/TS 20065 (2022)
- › Specific Prominence Ratio
 - › ECMA-418-1 (3rd) (2024)
 - › ECMA-74 (8th) (2003) / (9th) (2005)
- › Tone-to-Noise Ratio
 - › ECMA-418-1 (2nd) (2022) / (3rd) (2024)
 - › ECMA-74 (9th) (2005)
- › Tonality (Hearing Model)
 - › ECMA-74 (15th) (2018) / (17th) (2019)
 - › ECMA-418-2 (1st) (2020) / (2nd) (2022) / (3rd-4th) (2025)
- › Loudness (Hearing Model)
 - › ECMA-418-2 (2nd) (2022) / (3rd-4th) (2025)
- › Roughness (Hearing Model)
 - › DIN 38455 (2024)
 - › ECMA-418-2 (1st) (2020) / (2nd) (2022) / (3rd-4th) (2025)
- › Fluctuation Strength (Hearing Model)
 - › ECMA-418-2 (4th) (2025)



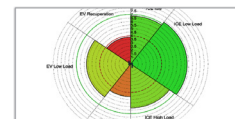
BINAURAL MEASUREMENT AND PLAYBACK



JURY TESTING SOFTWARE SQALA



SOUND QUALITY INDEX



DETAILS

Sottek Hearing Model

Human hearing is far superior to all available technical systems in terms of performance and flexibility for analyzing sounds. To capture the widest possible range of psychoacoustic phenomena, we developed the Sottek Hearing Model based on the physiology of the human ear. The model enables psychoacoustic effects and fundamental hearing impressions to be explained and described.

The Sottek Hearing Model is based primarily on an auditory time-frequency representation and exhibits a high correlation with the results of numerous psychoacoustic experiments. For example, amplitude and frequency fluctuations at the threshold of perception can be predicted, while nonlinear processing is of fundamental importance.

Analysis According to Standards

Assessing and ensuring sound quality have become important aspects of modern product design. Given that human hearing does not function like a linear measurement instrument, a simple signal level measure, such as dB(A), cannot adequately represent the loudness actually perceived. Therefore, DIN 38455 and ECMA-418-2 were developed based on the Sottek Hearing Model. These standards describe methods for the automatic quantification of spectrotemporal noise patterns, such as tonal noises or modulated signals.

To ensure compliance with these standards, ASP 103 provides the following analyses:

- › Loudness ECMA-418-2 (2nd) (2022) / (3rd-4th) (2025)
- › Roughness DIN 38455 (2024), ECMA-418-2 (1st) (2020) / (2nd) (2022) / (3rd-4th) (2025)
- › Tonality ECMA-418-2 (1st) (2020) / (2nd) (2022) / (3rd-4th) (2025) ECMA-74 (15th) (2018) / (17th)

(2019)

These analyses are performed in accordance with the standard procedures and provide an analytical assessment of subjectively perceived sound quality.

Advantages of Psychoacoustic Analyses

Given that human hearing does not function like a linear measurement instrument, a simple signal level measure, such as dB(A) cannot adequately represent the auditory impression perceived by the listener. Like human hearing, psychoacoustic analyses focus on level differences, modulations, tonal components, roughness components, and other characteristics present in a sound. This reflects the cognitive signal processing that occurs during listening.

Listening tests form the foundation of psychoacoustic analyses development. As a pioneer in the development and application of psychoacoustic methods, we have been conducting extensive listening tests for several decades, with the results continuously incorporated into the ongoing development of these analyses. The results of the listening tests confirm the high validity of all our psychoacoustic analyses.



Loudness

Loudness is the perceived magnitude of sound intensity. Since human loudness perception is frequency-dependent, sound events with the same level but different frequencies may evoke different loudness perceptions. The loudness scale therefore accounts for the fact that a sound perceived as twice as loud is also assigned twice the loudness value on the loudness scale, expressed in sones.

The calculation is based on the following standards:

- › ECMA-418-2 (2nd) (2022) / (3rd-4th) (2025)

The Loudness (Hearing Model) analysis accounts for the differing loudness perception of tonal and non-tonal sound components and is characterized by significantly improved prediction accuracy, for example for synthetic and technical sounds.

The following analyses are available:

- › Loudness (Hearing Model) vs. RPM
- › Specific Loudness (Hearing Model) vs. RPM

Roughness

The impression of roughness occurs whenever a time-variant envelope exists within a critical band, e.g., when tones exhibit a temporal structure due to a variation of their amplitude or frequency. Roughness depends on the center frequency, modulation frequency, and modulation depth. Perceived roughness increases with increasing modulation depth. Signal level has only a minor effect on the perceived roughness.

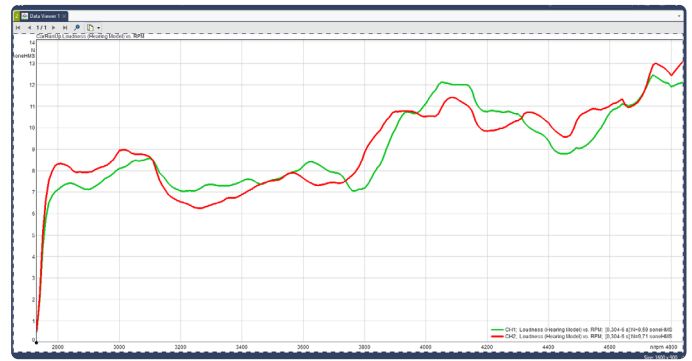
The Roughness (Hearing Model) analysis is very well suited for evaluating technical products, such as electric and combustion engines as well as products from the ITT (information technology and telecommunications) industry.

The calculation is based on the following standards:

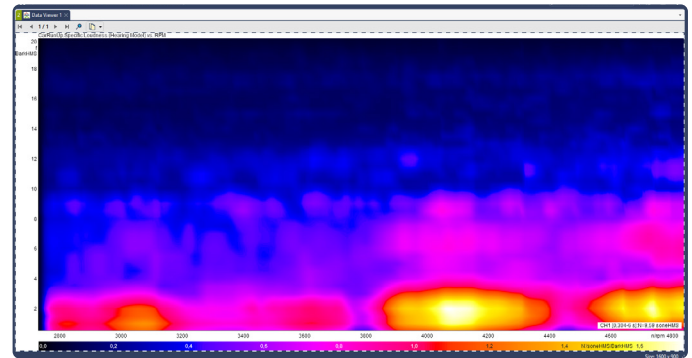
- › DIN 38455 (2024)
- › ECMA-418-2 (1st) (2020) / (2nd) (2022) / (3rd-4th) (2025)

The following analyses are available:

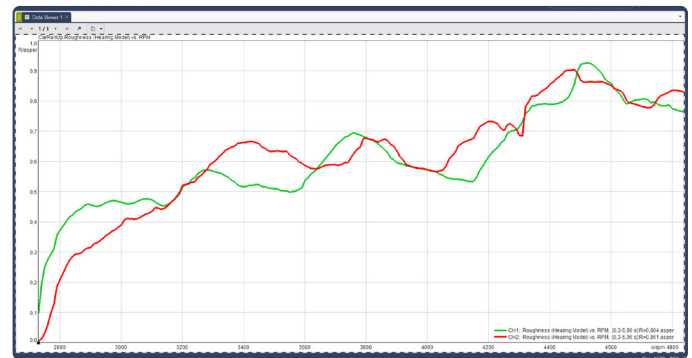
- › Roughness (Hearing Model) vs. RPM
- › Specific Roughness (Hearing Model) vs. RPM



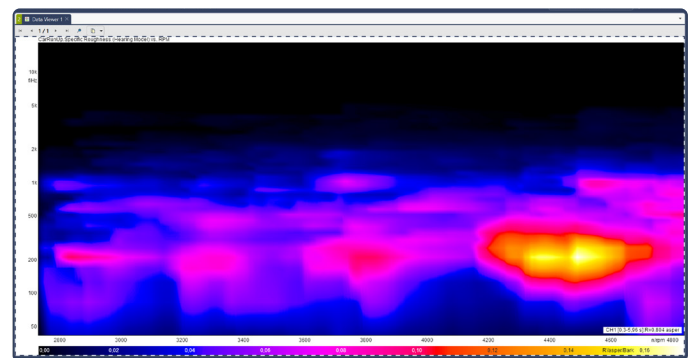
Loudness (Hearing Model) vs. RPM



Specific Loudness (Hearing Model) vs. RPM



Roughness (Hearing Model) vs. RPM



Specific Roughness (Hearing Model) vs. RPM

Tonality

Sounds are perceived as tonal when they contain distinct tones or narrowband noise. Unwanted tonal noises are perceived as more annoying than comparable noises without tonal components. If a product or machine causes pronounced tonal noises, this negatively affects perceived overall quality.

The Tonality (Hearing Model) vs. RPM analysis calculates the tonality of an input signal versus control channels. This analysis, based on the Sottek Hearing Model, is characterized by a linear representation of human perception of tonality, correlates well with listening-test results, and accurately detects rapidly varying tonal noise components.

In addition, the analysis is well suited for detecting tonal noise components using a metric. The Metric Project (APR 570 is required) is available for this purpose.

The calculation is based on the following standards:

- › ECMA-418-2 (1st) (2020) / (2nd) (2022) / (3rd-4th) (2025)
- › ECMA-74 (15th) (2018) / (17th) (2019)

The following analyses are available:

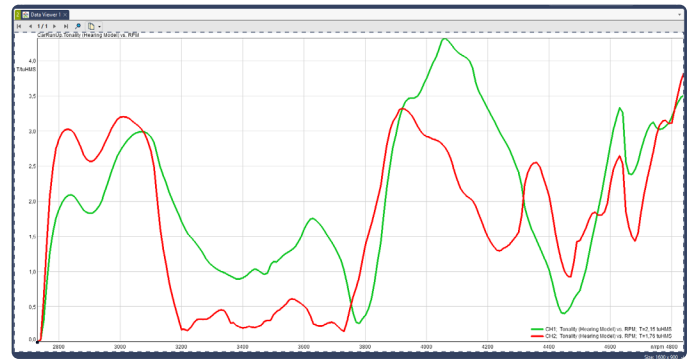
- › Tonality (Hearing Model) vs. RPM
- › Specific Tonality (Hearing Model) vs. RPM
- › Tonality Frequency (Hearing Model) vs. RPM

Impulsiveness

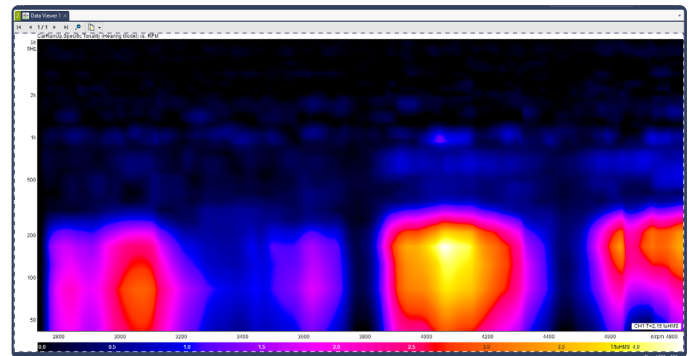
Impulsiveness is perceived when rapid, large signal level fluctuations occur. The Impulsiveness analyses account for this by representing human perception of such signal level fluctuations on a linear scale.

The following analyses are available:

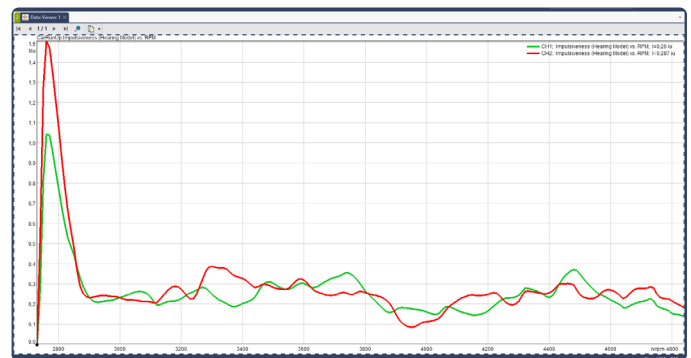
- › Impulsiveness (Hearing Model) vs. RPM
- › Specific Impulsiveness (Hearing Model) vs. RPM



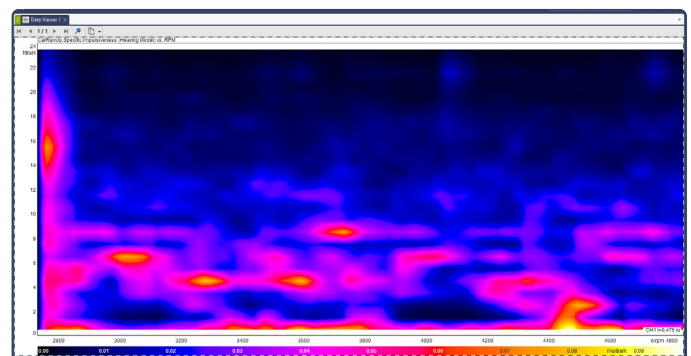
Tonality (Hearing Model) vs. RPM



Specific Tonality (Hearing Model) vs. RPM



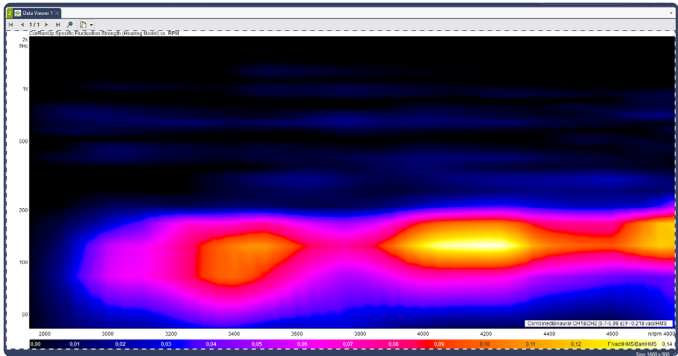
Impulsiveness (Hearing Model) vs. RPM



Specific Impulsiveness (Hearing Model) vs. RPM

Fluctuation Strength (Hearing Model) vs. RPM, Specific Fluctuation Strength (Hearing Model) vs. RPM

The Fluctuation Strength (Hearing Model) analysis represents human perception of amplitude modulations up to approximately 25 Hz on a linear scale. The calculation of the fluctuation strength is derived from the Roughness (Hearing Model) analysis.



Specific Fluctuation Strength (Hearing Model) vs. RPM

LICENSES AND OPTIONAL FEATURES

General Requirements

Code	Product Name	Description
50000	APR 000 APR Framework	Basis of ArtemiS SUITE
51104	ASP 104 Psychoacoustics - Advanced Analysis vs. Control Channel	Advanced psychoacoustic analyses based on the Sottek Hearing Model, including analyses as a function of control channels, standards, and methods for describing and explaining psychoacoustic effects and fundamental auditory impressions of human hearing
At least one of the central projects of ArtemiS SUITE—Pool Project, Automation Project, Standardized Test Project—or a Metric Project is required and must be licensed.		

Optional Features

Code	Product Name	Description
50010	APR 010 Pool Project	Central project of ArtemiS SUITE: interactive workflow, ease of use, and data processing based on the cross-product logic
50050	APR 050 Automation Project	Central project of ArtemiS SUITE: one-time definition of the processing steps, followed by automated and repeated execution for all subsequent data
50220	APR 220 Standardized Test Project	Central project of ArtemiS SUITE: recording multiple operating conditions of objects with the Recorder and analyzing the data using different evaluation methods
50570	APR 570 Metric Project	Creation of quality metrics by correlating listening test results with acoustic signal analyses
51101	ASP 101 Psychoacoustics - Basic Analysis	Psychoacoustic analyses, standards, and methods for the analytical characterization of perceived sound quality
51102	ASP 102 Psychoacoustics - Basic Analysis vs. Control Channel	Analyses from ASP 101 as a function of control channels
51103	ASP 103 Psychoacoustics - Advanced Analysis	Advanced psychoacoustic analyses, standards, and methods based on the Sottek Hearing Model for the characterization of psychoacoustic effects and fundamental auditory perceptions of the human auditory system

LICENSES AND OPTIONAL FEATURES

Optional Features

Code	Product Name	Description
51107	ASP 107 Spectral Audio Feature Analysis	Analyses for the detailed characterization of spectral features and the quantitative description of sound characteristics
51108	ASP 108 Spectral Audio Feature Analysis vs. Control Channel	Analyses from ASP 107 as a function of control channels
5097	ASX 07 Local Processing Service (API)	ASX programming interface: execution of Automation Projects, for example, in End-of-Line processes, based on automation specifications (calculation jobs); ArtemiS SUITE does not need to be installed
5092	ASX 02 Data Processing and Representation API	ASX programming interface: automated or interactive control of Pool Projects and Automation Projects, including the execution of Reports, exports, and other tasks from within your software; ArtemiS SUITE must be installed

Further modules of ArtemiS SUITE (see ArtemiS SUITE Overview data sheet)



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