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KiSUITE

Type 2840A

NVH Analysis software for KiNOVA

Extracting insightful engineering conclusions is the main aim of any noise and vibration measurement. KiSUITE is the software platform designed to do that in the analysis phase, and which is fully compatible with the KiNOVA data acquisition hardware.

Benefits of KiSUITE:
- Comprehensive software with hundreds of functions
- User-friendly, worksheet-based interface
- Suitable for workflow automation
- Automated reporting
- Application-specific add-on modules

Software structure and modules
KiSUITE is a comprehensive software package with hundreds of functions to analyse noise and vibration and also general measurement data. The software has a simple and intuitive interface. By linking and cascading multiple functions and data, the user can customize workflows, automate analysis processes and generate reports up to nearly any level of complexity. KiSUITE is compatible with the KiNOVA hardware and acquisition software. Moreover, it allows embedding live acquisition functions into workflow execution, thus allowing immediate post-processing of measured data.

KiSUITE Analysis is the main software platform for signal processing, workflow automation and reporting. It includes basic and advanced functions to extract information from measured data during post-processing. It offers a high degree of customization and high level of functionality.
Application-specific modules allow performing advanced operations related to the various noise and vibration domains. The following modules can be added on to KiSUITE Analysis:
- KiSUITE NVH module – for the analysis of powertrain NVH data
- KiSUITE Rotating Machinery module – for the analysis of machineries with cyclic and rotating excitation
- KiSUITE Acoustics module –for acoustic and psychoacoustic analysis
- KiSUITE SCA module – for source contribution analysis
- KiSUITE Structural Animation module – for the animation and visualization of measured data

The additional package KiSUITE HITS, for hammer impact testing, is standalone and its license is separate from KiSUITE Analysis, but it can also be embedded into the KiSUITE Analysis platform as add-on module.

The table below depicts the KiSUITE offering, with its add-on modules.

	Standalone	Add-on module
KiSUITE Analysis	X	
KiSUITE NVH		X
KiSUITE Rotating Machinery		X
KiSUITE Acoustics		X
KiSUITE SCA		X
KiSUITE Structural Animation		X
KiSUITE HITS	X	(X)

The following datasheet describes in detail the operations and functionalities of each of these packages.

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KiSUITE Analysis

Application

Data analysis and processing is an essential part of any noise and vibration investigation. However, noise and vibration problems might be so complex in nature that require high flexibility and freedom in post-processing the data. In most of the cases, the same raw data must be analysed in various ways to extract the relevant insight and solve the problem at hand. To achieve all this, a broad range of analysis functions is necessary.
Additionally, it is often necessary to automate data analysis processes, where multiple functions and conditional operations are needed. Finally, when the analysis process is completed it is often useful to produce reports, which inform about key results and can be dispatched preserving consistency.
All these needs are taken into account in KiSUITE Analysis.

Software features

KiSUITE Analysis is a flexible and powerful platform for noise and vibration data analysis. More than 220 different functions can be seamlessly cascaded within fully customizable workflows thanks to a drag-and-drop approach and virtually reaching any level of thinkable complexity.
KiSUITE Analysis allows including also complex structures like loops and conditions to automate the workflow further. Even data acquisition can be part of a workflow, thus allowing a direct interaction with the measurement chain.
A broad choice of visualization possibilities complements the software to capture the insightful details of the analysis. And in case the application requires even further customization, a built-in scripting language allows programming dedicated functions. KiSUITE Analysis also allows automating report generation functionalities.

Within the KiSUITE environment, Analysis works as a main platform, which can be complemented by the following application-oriented modules: NVH, Rotating Machinery, Acoustics, Structural Animation and SCA.

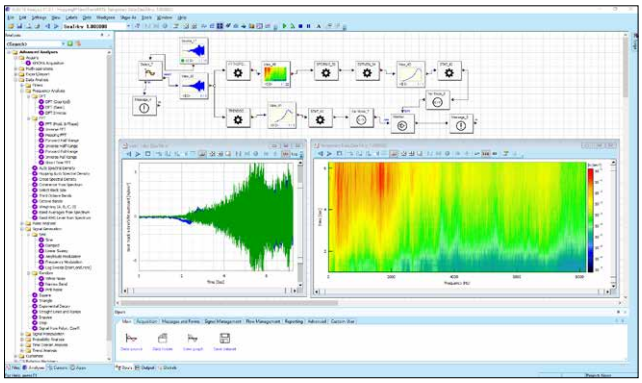
KiSUITE Analysis covers the following main analysis functionalities:

- Arithmetic, complex and math operations – essential math and calculus functions.
- Import / export functions – to ensure compatibility with past measured data and future post-processing possibilities
- Filter – a comprehensive set of filters allows filtering the data
- Frequency analysis – sweeping a broad range of frequency-domain functions
- Pulse analysis – functions for the analysis of tacho signals
- Signal generation – to control sources like shakers and generate signals
- Signal manipulation – to ensure full control on the measured data
- Probability analysis – to include signal statistics
- Time domain analysis – wide range of computations on the signals
- Trend analysis – for extracting main trends and key parameters from the signal
- Built-in scripting language – to further automate and customize your workflows
- Automated reporting functions

KiSUITE Analysis extends the functionalities of KiNOVA Acquisition. When both licenses are active, KiNOVA Acquisition also allows performing: review time history, ASD spectrum, RMS spectrum, 3rd octave spectrum and speed curve.

KiSUITE Analysis is designed to:

- Provide extensive and comprehensive data analysis possibilities thanks to 220+ functions
- Customize workflow for noise and vibration analysis
- Automate data analysis
- Produce reports



Technical features

Arithmetic operations	Signal and signal (+, -, /, *), signal and constant (+, -, /, *)
Complex functions	Complex to mod/phase, mod/phase to complex, extract real, extract imaginary, conjugate signal
Math functions	Calculate resultant, trigonometric functions, abs, antilog, exponential, log e, log 10, square root, dB to linear, linear to dB, Nth integer root, raise to integer power, reciprocal, sum
Export	ASCII, CSV, Excel, Matlab, RPC-III, SDF (Agilent), TDM, TecPlot Create, Universal (Tyle 58/58b), WAV (Mono), WAV (Stereo)

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Import	ArtemiS Data, ASCII, Binary general, B+K Pulse, CATMAN Data, CSV, DASY Data, Dewesoft DXD/D7D, DIA-Dago/DIADem, DX3, Matlab, nCode DAC, PICOLog Data, RealWave Analyzer, RES Data, RPC II/ III, SDF (Agilent), LMS SDF, Store Plex (Racal), Sun/SGI Unix Format, SYEN Log Data, Sony Convert Data, TAFFmat, TDM, Universal (Type 58/58b), LMS UFF TrF data, WAV (Calibration), WAV (No Calibration), WaveView (IOTECH)
Filters	Bessel (high, low, band pass and band stop), Butterworth (high, low, band pass and band stop), Chebyshev Bessel (high, low, band pass and band stop), Notch, infinite impulse response, finite impulse response design, finite impulse response
Frequency analysis	Omega arithmetic (in frequency), DFT (Goertzel, basic, inverse), FFT, inverse FFT, hopping FFT, forward half range, FFT, inverse half range FFT, forward full range FFT, inverse half range FFT, short time FFT, auto spectral density, hopping auto spectral density, cross spectral density, coherence from spectrum, select block size, third octave bands, weighting (A, B, C, D), band averages from spectrum band RMS level from spectrum, cepstrum
Pulse analysis	Angular vibration of shaft, pulses to rate, pulses to amount, create speed signal, pulse crossing times, add tacho accumulated times, add tacho individual periods
Signal generation	Sine, damped sine, linear sweep, amplitude modulation, frequency modulation, log sweep, white noise, narrow band, pink noise, square, triangle, exponential decay, straight lines and ramps, impulse, step, signal from polynomial coefficients

Signal manipulation	Average signals, copy signals, join signals, extend by repetition, mesh signals, resample, reverse signal, extract, interpolate signal, recalibrate, extract/remove events, mark events, event removal based on signal thresholds
Probability analysis	Amplitude, peak/trough, level crossing probability (for each: amplitude count, probability density, cumulative probability, exceedance probability)
Time domain analysis	Convolution, normalisation, ensamble averaging, statistics, differentiate, smoothed first derivative, integrate (traditional), integrate (wide band), omega arithmetic (in time), coherence from time, classic windows (Parzen/triangular, Barlett/rectangular, Hanning, hamming, Kaiser-Bessel, Flat Top, Blackman-Harris), exponential decay window, transfer functions (H0, H1, H2, H3, H4, Hs, Hv, Hc, Hr), causal transmissibility, normal transmissibility, thermocouple conversion
Trend analysis	Mean, standard deviation, RMS values, MIN, MAX, peak-to-peak, exponential averaging
Workflow-based and additional functionalities	Conditional operations (if-then-else, while-next, numeric loop), workflow synchronization, automated reporting functions, user-defined messages, customization of inputs and workflow operations, built-in scripting language. Lines, bars, symbols, X vs Y graph, Bode plots, polar plots, modulus and phase, isometric, surfaces, waterfall, contour, color maps, intensity plots, and much more
Graph styles	Lines, bars, symbols, X vs Y graph, Bode plots, polar plots, modulus and phase, isometric, surfaces, waterfall, contour, color maps, intensity plots, and much more.

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KiSUITE NVH module

Application

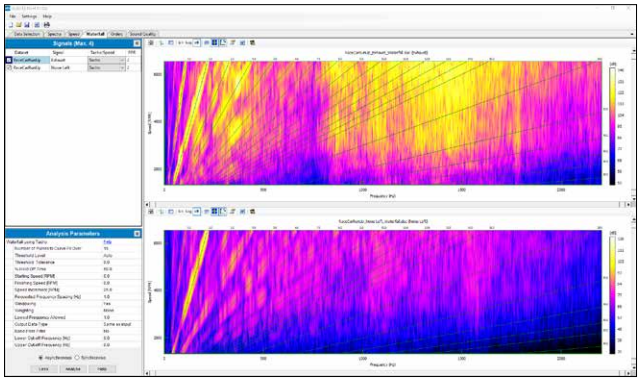
In today's automotive world, it is not simply about making low noise, but also about making the right noise, and whether it is a conventional, hybrid or electrical propulsion system, its NVH refinement is key. Various tools are necessary for this task, but waterfall diagrams and order analysis are the starting point. Waterfall diagrams tie together rotating speed, frequency and amplitude of vibration or pressure levels, allowing graphically identifying if engine or motor orders are hitting structural resonances, thus leading to large structural vibrations or sound pressure levels. Order analysis allows separating the contribution of each order to the overall vibration or sound pressure level. This technique is of extreme importance to characterise and design the dynamic and acoustic behaviour of the powertrain.

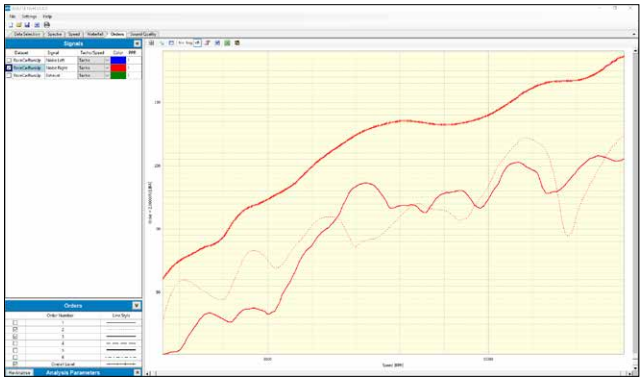
Software features

KiSUITE NVH answers the key needs of powertrain NVH engineering. It comes as an extension module, including both extra application-oriented functions for KiSUITE Analysis and a standalone application that guides the user through data analysis. Starting from the noise and vibration signals, this toolbox allows performing a broad range of functions to analyse and process for better and more efficient decision making.
KiSUITE NVH features signal analysis functions, which allow to pre-analyse powertrain data in the frequency domain and to filter them. Waterfalls can be calculated and visualized, by associating dynamic signals to encoder information. Even in the case where no tacho signal is available, it is possible to estimate the rotational speed and enable displaying waterfalls. Order analysis (either in synchronous and asynchronous mode) is also possible in KiSUITE NVH, together with acoustic functionalities and a variety of sound metrics, like loudness, Articulation Index and others.

The KiSUITE NVH module is designed to perform:

- Spectral analysis on noise and vibration signals
- Speed analysis with or without tacho signal
- Waterfall analysis
- Order analysis
- Acoustic analysis
- Variety of sound quality analysis





Technical features

Signal and dataset averaging	Average spectrum over frequency range, average signals in datasets, average over datasets, create blank waterfall
Spectrum input	Third octave from spectrum, Nth octave from spectrum, Nth octave smoothing, sound quality auto extract, sound quality named extract, specific loudness, spectrum weighting (A, B, C, D)
Time signal input	A, B, C weight time signal, reconstruct speed curve, AI vs time, loudness vs time, Nth octave RMS vs time, Nth octave filter vs time, Nth octave frequency response, third octave spectrum, Nth octave spectrum, set overall dB level, octave limits
Tacho signal-based analyses	Orders from constant speed frequency, speed signal from tacho, equalisation order filter, waterfall, extract nominated orders and overall, extract specific orders, equalisation order filter, waterfall analysis, extracted nominated orders and overall, extract specific orders, extract orders from FFT hop, tacho signal from speed
Sound quality	Overall dB level, Loudness Zwicker Diffuse, Loudness Zwicker Free, Loudness Stephens, Speech Articulation Index, Speech Articulation Index Vehicle Oriented, Speech Interference Level, Preferred Speech Interference Level, Spectral Balance, High Frequency Factor, Composite Rating Performance; variable vs fixed speed analysis

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KiSUITE Rotating Machinery module

Application

Several machineries and appliances of everyday use present cyclical excitation due to rotating components. Gearboxes, motors and engines are very common examples. To understand how their cyclical forces generate and transmit noise and vibration, engineers require a specific set of tools.

When rotating motion is transmitted via a shaft, issues with torsional vibration may occur. This might require advanced operations on the tacho signal. Additionally, it is important to analyse and manipulate measured signals to extract information like speed and orders. For example, it is of high importance for rotating machinery optimization to extract and reduce orders which contribute to high level of transmitted vibration or high sound pressure level. Such an analysis is called order analysis and requires both vibration (or acoustic) and tacho information. The KiSUITE Rotating Machinery module is designed to address these challenges.

Software features

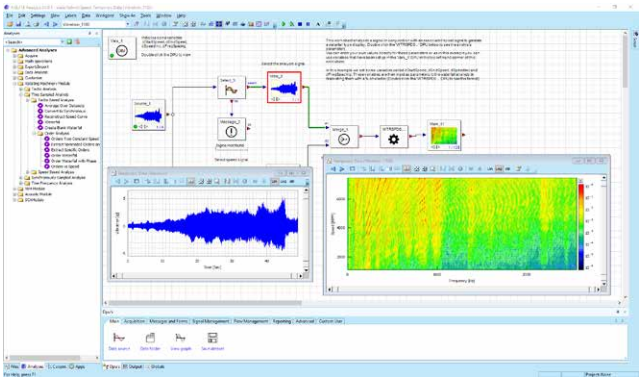
The KiSUITE Rotating Machinery module provides a complete set of functions to deal with noise and vibration issues caused by cyclic and rotating machinery operations. KiSUITE Rotating Machinery comes as an extension module package to KiSUITE Analysis, thus extending its functionalities with application-oriented operations on data.

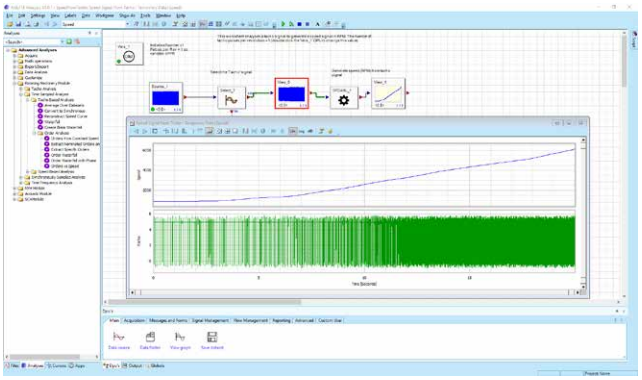
KiSUITE Rotating Machinery performs advanced tacho analysis. Besides allowing deeply analysing and manipulating the signals coming from tachometers, the functions enable performing torsional vibration analysis. KiSUITE Rotating Machinery sweeps from classic analysis of time sampled data to more advanced functionalites. Common operations like waterfalls, order analysis, order extraction can be performed and automated. Synchronous data can also be analysed in depth. Besides synchronous waterfall and order analysis, the included functions can perform synchronous spectral analysis, DFT, FFT, transfer functions and more. KiSUITE Rotating Machinery also includes wavelets and a number of specific algorithms for advanced time-frequency analysis.

KiSUITE Rotating Machinery also extends the functionalities of KiNOVA Acquisition. If both licenses are activated, KiNOVA Acquisition also allows: calculating orbit plots, waterfall with full FFT mode, order tracking with adjustable order bandwidth, tracking of specific orders, including a digital panel for order tracking, and including alarm profiles.

The KiSUITE Rotating Machinery module is designed to perform:

- Advanced tacho analysis
- Time sampled analysis (waterfall, order analysis, order extraction, …)
- Synchronously sampled analysis (waterfall, order analysis, order extraction, spectral analysis, DFT, transfer functions, …)
- Wavelets and time-frequency analysis





Technical features

Tacho analysis	Pulse crossing times, tacho ideal equivalent, new tacho pulses per rev, tacho period smoothing, tacho synthesis, tacho signal from speed, add tacho accumulated times, add tacho individual periods, angular vibration of shaft, angular vibration from tacho, angular vibration waterfall, raw speeds vs period number, raw speeds vs time, average period speeds, smooth curve fitted speeds, interpolated speeds, speed signal from tacho, tacho crossing stats, tacho to time periods
Time sampled analysis	Average over datasets, convert to synchronous, reconstruct speed curve, waterfall, create blank waterfall, orders from constant speed frequency, extract nominated orders and overall, extract specific orders, order waterfall, order waterfall with phase, orders vs speed, speed from vibration, waterfall analysis, extract orders from FFT hop, order filter

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Synchronously sampled analysis	Convert to synchronous, synchronous to time, calculate the average cycle, replicate the average cycle, calculate cycle statistics, order RMS level, waterfall, waterfall with phase, orders vs speed, extract specific orders, auto spectral density (ASD), limit hold ASD, hopping ASD, auto RMS spectrum, limit hold auto RMS spectrum, cross spectral density (CSD), CSD mod/phase, limit hold CSD, limit hold mod/phase, DFT (Goetzel), DFT (Basic), DFT (Goetzel mod/phase), DFT (Basic mod/phase), DFT inverse, forward half range, inverse half range, forward full range, inverse full range, moph output, hopping FFT, select size, select size (Moph output), Chebishev (band pass), Chebishev (band stop), H1, H2, H3, H4, Hs, Hv, causal transmissibility, normal transmissibility, coherence, zoom, extract cycles for stacked chart
Time frequency analysis	Mother wavelet generation, wavelet transforms, wavelet reconstruction, wavelet denoising, wavelet filtering, Born Jordan, transpose data, Wigner Ville, Zaho Atlas Marks

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KiSUITE Acoustics module

Application

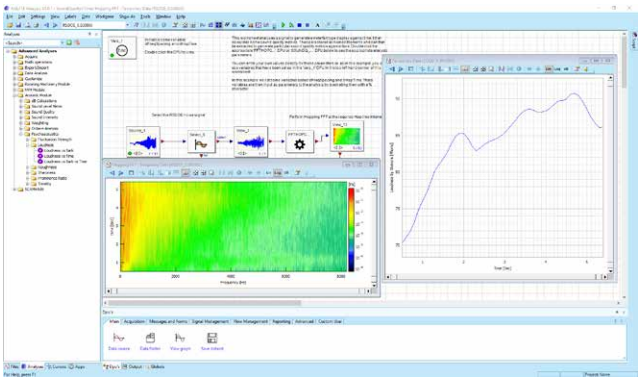
The vibration of any object or a component surrounded by air generates noise. Therefore, the study of mechanical vibration is often related to its acoustic emissions. However, because the physical nature of these phenomena presents differences, it is important to rely on specific tools and functions.
It is very common in acoustics to refer to widely adopted ways of visualizing and quantifying data. For example, sound level meters, weighting functions and octave band averaging are everyday tools for NVH engineers and acousticians. Moreover, because of its subjective character, it is common to rely on measures which link the measured quantity to the way we perceive it. The branch of acoustics, which deals with this aspect, is called psychoacoustics and it is important when assessing the influence of acoustic sources on humans.

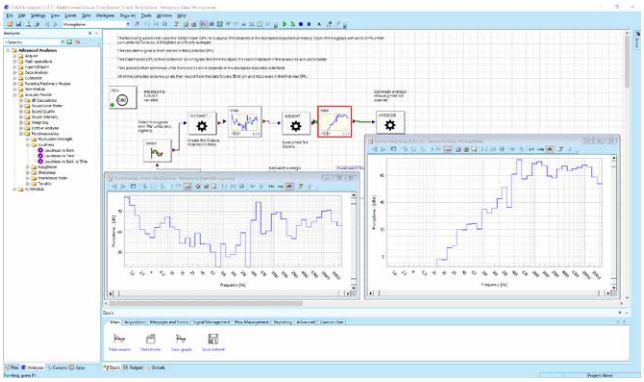
Software features

KiSUITE Acoustics module allows performing acoustic post-processing on the measured data. It comes as an extension module for KiSUITE Analysis, thus extending its functionalities with application-oriented operations on data.
KiSUITE Acoustics embeds a set of functions that allows mimicking the operation of a sound level meter, including various options. A set of octave and third octave band operations can be used to analyse the frequency content of either narrow-band or time-based data. Sound intensity can be calculated and depicted in various formats to assess the flow of acoustic energy at a given point. The Acoustics module also includes psychoacoustic and sound quality evaluation functions, like articulation index, loudness, sharpness, roughness and many others. These can be used to account for physical and psychological effects of the noise source on the ear and the brain.

The KiSUITE Acoustics module is designed to perform:

- 1/N octave operations
- Sound level meter calculations
- Sound intensity calculations
- Sound quality
- Psychoacoustics





Technical features

Sound level meter	Rms S/F/I/selectable time constant, Leq S/F/I/selectable time constant, LN measure S/F/selectable time constant, SEL S/F/selectable time constant
Sound quality	Sound quality auto extract, sound quality named extract, specific loudness
Sound intensity	Sound intensity, Nth octave sound intensity, hopping intensity, pressure intensity index
Weighting	Spectrum weighting (A, B, C, D), A, B, C weight time signal
Octave analysis	Nth octave smoothing, Nth octave RMS output, Nth octave filter, Nth octave frequency response, third octave spectrum, Nth octave spectrum, octave to RMS spectrum, Nth octave from spectrum, third octave from spectrum, octave limits
Psychoacoustics	Fluctuation vs Bark, fluctuation vs time, fluctuation vs Bark vs time, loudness vs Bark, loudness vs time, loudness vs Bark vs time, roughness vs Bark, roughness vs time, roughness vs Bark vs time, sharpness vs Bark, sharpness vs time, sharpness vs Bark vs time, prominence ratio, prominence with time, spectral flatness, spectral flatness with time, tonality index, tonality index with time

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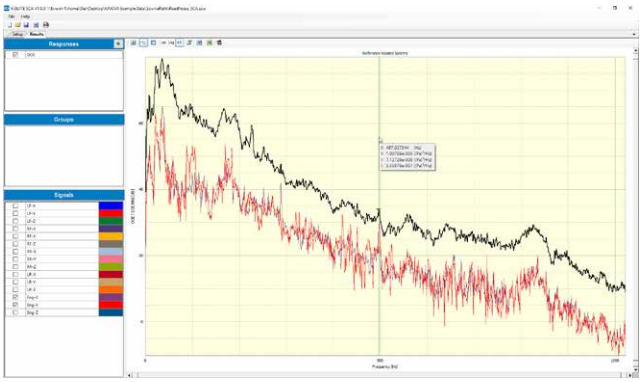
KiSUITE SCA module – Source Contribution Analysis

Application

Understanding and separating the noise contributions to a receiver is one of the most crucial and challenging NVH engineering tasks. Approaches like Transfer Path Analysis (TPA) address this problem, but the amount of necessary data is often very large, thus resulting into a very resource intensive process.
Source Contribution Analysis allows quantifying the contribution of multiple sources to the overall NVH, by limiting the measurement to the sources and the receiver. Its efficiency and essential character make SCA a tool for effective troubleshooting and design.



Software features

KiSUITE SCA – Source Contribution Analysis – is specifically designed to perform Source Contribution Analysis and comes as an extension module to KiSUITE Analysis.
This approach makes the source identification process simple and straight with minimal number of measurement information. Given the measured response (pressure or vibration) and the measured sources under stationary regime, KiSUITE SCA allows identifying and quantifying the sources contributing to the response – enabling faster NVH troubleshooting, development and refinement. Because the approach only considers how sources contribute to the receiver's signal, there is no need for intermediate frequency response function measurements and path identification. This results into a much faster measurement process, which can still reveal important insights for the design phase.

The KiSUITE SCA module is designed to perform:
- Source Contribution Analysis
- Visualization of data and contributions
- Export of test results

Technical features

Setup	Visualization of measured data, grouping under different sources/receivers
SCA visualization	Visualization of contribution of different sources/receiver and groups, exporting and reporting

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KiSUITE Structural Animation module

Application

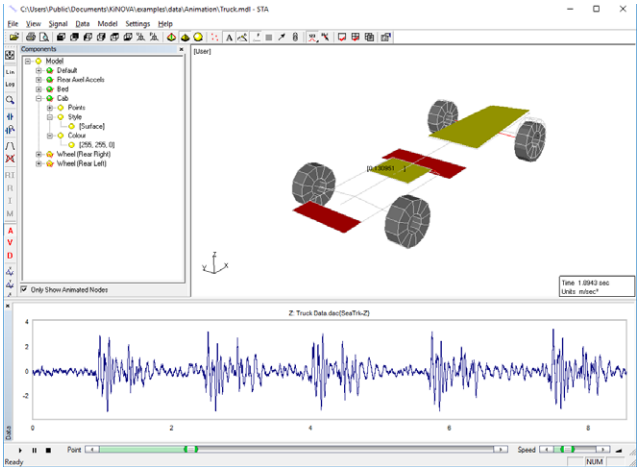
Noise and vibration data are mainly visualized in terms of graphics and charts. However, visualizing how a component or a structure vibrates is very important, as it provides a more direct feeling and more intuitive interpretation of a complex motion. Therefore, it is useful to rely on a software that allows the visualization of how the structure under analysis vibrates and move during operation or excitation.

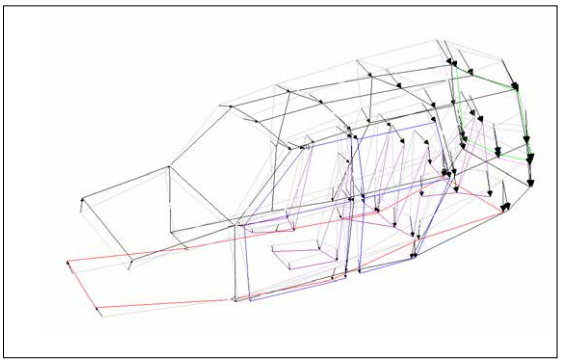
Software features

The Structural Animation module has two main functions. The first one is to allow the creation of simple 1D, 2D and 3D geometries, to which measurement data can be associated. The module allows generating both predefined and customized geometries and meshes, which can be successively used for animation. Additionally, it is possible to import pre-existing geometry data. The second function is to visualize the deflection of the measured object. Starting from the geometry, Structural Animation allows the user to visualize the Operating Deflection Shape (ODS). This can be done by importing FRFs or FFTs at each measurement position to revel the motion of the structure at a certain frequency. Filters allow focusing on frequency regions of interest for the analysis. The software can also use time-based data to visualize the motion of each measurement point at a certain moment in time. To simplify data interpretation, it is possible to visualize not only the motion of the geometry, but also the resultant vectors, the intensity, and the overall motion envelope. Dataset coming from separate acquisitions can be compared to spot the changes between different configurations. To capture the details of the vibration, the software allows to replay the signal at various speeds and even change the magnification factor of the animation. Finally, it is possible to export the animation with several options, for independent visualization and presentations.
Structural Animation comes as an extension module of KiSUITE Analysis.

The KiSUITE Structural Animation module is designed to perform:

- Creation of 1D, 2D, 3D geometries
- Association of measured data to a geometry
- Visualization of operating deflection shape in time and frequency domains
- Filtering of animation data
- Export of the animation





Technical features

Import format	.csv (CSV points) .blk, .dat (Nastran) .unv (Universal file format)
Export format	. avi

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KiSUITE HITS

Application

Hammer impact testing is a well-established method to evaluate the forced response of structural components in the automotive industry. It involves the use of a hammer and, due to the short duration of the hit, it allows a broadband excitation of the structure. The dynamic performance of the structure can be quantified by means of accelerometers or microphones. The simplicity, yet effectiveness of this technique makes it extremely useful for the identification and solution of many types of structural and acoustic problems often related to resonant frequencies leading to excessive noise emission and vibration transmission. Hammer impact testing results are also a perfect starting point for the validation of simulation models.

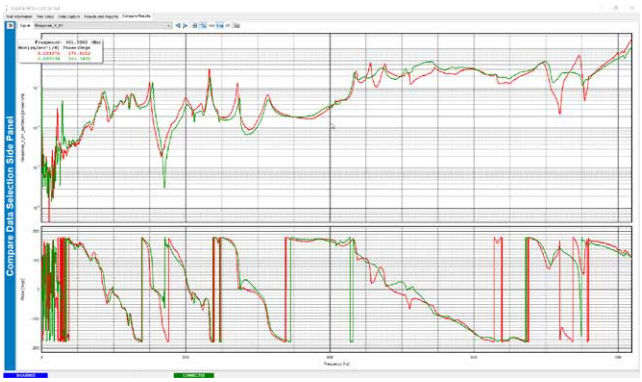
Software features

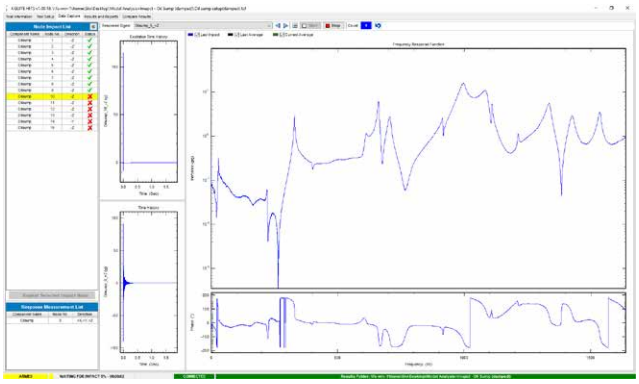
KiSUITE HITS is the application-oriented software for hammer impact testing. It is a standalone software and can be used independently from KiSUITE Analysis.
The workflow is designed to simplify the measurement process, still ensuring the most reliable results thanks to its background automatic signal processing.
KiSUITE HITS guides the user through the whole measurement process and gives full control over the all testing aspects. The user is assisted in setting up the trigger levels, response window weighting function and force window profile. Pre-test displays allow to identify and choose the preferred setting before the test starts. Time series, Frequency Response Functions (FRFs) and coherence can be monitored during the test, leaving full flexibility to the user and ensuring maximal efficiency. In the final phase, the results can be analysed, compared, and exported. Additionally, the peak-picking and damping estimation functions help the user in the analysis of the measurements.

If used together with KiSUITE HITS, the add-on module Structural Animation allows visualizing and animating the Frequency Response Functions of the analysed geometry, thus allowing visual insights into the dynamics of the measured objects.

KiSUITE HITS is designed to perform:

- Step-by-step procedure for FRF acquisition
- Natural frequencies and peak detection
- Real-time calculation and comparison of FRFs
- Evaluation of damping factors from the FRFs
- Export of test results to Word/Excel for FEA validation





Technical features

Test information	Channel setup, component and node information, TEDS configuration (for KiNOVA Pro and XL), roving excitation vs responses setup, setting trigger levels
Test setup	Selection of frequency range and resolution, no. of averages, triggers; live and automatic determination of trigger level and gain settings, live and automatic determination of response and excitation windowing; live visualization of response signal (time and frequency) and coherence
Data capture	Live visualization of response signals, averages, and coherence during measurement
Results and reports	Visualization of component and node responses (time, frequency, and coherence), peak detection, half-power damping estimation; comparison with other data sets, export and Word reporting function

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Complementary packages for KiSUITE	Type/Mat. No
• KiNOVA Lite Portable data acquisition hardware	5809A10
• KiNOVA Pro Versatile data acquisition hardware	5809A20A…
• KiNOVA XL (Plus) Versatile data acquisition hardware	5809A3…
• KiNOVA Capture Basic data acquisition software	2840A40
• KiNOVA Acquisition Advanced data acquisition software	2840A50
• Maintenance and support	
• KiNOVA/KiSUITE training	
• KiNOVA hardware calibration	

(Each software package is inclusive of a license dongle)

Ordering key	Type
KiSUITE Analysis	2840A60
KiSUITE HITS	2840A10
KiSUITE NVH module	2840A20
KiSUITE SCA module	2840A30
KiSUITE Acoustics module	2840A110
KiSUITE Structural Animation module	2840A90
KiSUITE Rotating Machinery module	2840A70

For further information and questions on the KiNOVA product line and Kistler sensors, please visit our website or contact us at kinova@kistler.com.

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