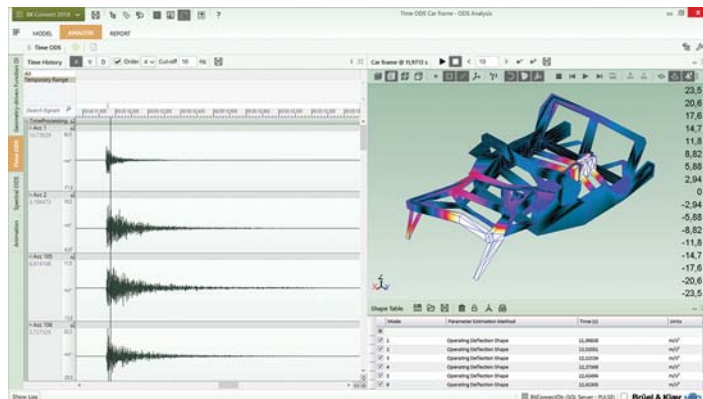


BK Connect™ Structural Dynamics

BK Connect ODS Analysis – Spectral and Time ODS

Operating deflection shapes (ODS) analysis is used for determination of the vibration pattern of a structure under given operating conditions. This type of structural dynamics analysis provides a better understanding of the vibration pattern of a structure under actual operating, boundary and environmental conditions, which is essential to improve the structure's vibration and noise behaviour. With ODS, you can visualize the vibration pattern to give a better understanding of the problem. And, unlike modal analysis, no model of the structure is created. Consequently, there are no assumptions of a linear and time-invariant model, or on the characteristics of the input forces. ODS analysis, can, therefore, be used in situations where modal analysis (classical or operational) is not possible.



In BK Connect, two types of ODS analysis are supported:

- Time ODS – where the vibration pattern for an analysed frequency range is determined as a function of time
- Spectral ODS – where the vibration pattern is determined for specific frequency or order components

The modular structure of BK Connect software allows you to build the ODS solution that is best for you. You can, therefore, make the most of the software's powerful, modern and integrated interface to measure, observe, analyse and document the dynamic behaviour of structures using a single platform.

Uses and Features

Uses

- Determination of the vibration pattern of structures under given operating conditions
- Analysis of machines running at fixed or slightly varying speeds due to changed operating conditions
- Analysis of transient phenomena such as door slams, explosions, launches and firing, and crash and drop impacts
- Analysis of non-linear systems and frequency-variant analysis such as engine run-up/down
- Analysis of civil engineering structures loaded by ambient forces

Features

- Vibration patterns shown as animated geometry models and listed as displacement, velocity and acceleration in a shape table
- Results shown with SI or imperial units
- ODS analysis can be performed using either the BK Connect ODS Analysis, Modal Analysis or Data Processing application
- Measurements can be done with or without geometry-guidance

Time ODS:

- Sweep animation
- Decimation factor to skip time samples during animation
- High-pass integration filter to remove low-frequency effects. The cut-off frequency and filter order can be set
- Selectable time range for the animation
- Shape table with ODS values at the individual degrees of freedom (DOFs) at discrete time instances

Spectral ODS:

- Frequency-based ODS
- Geometry-guided measurements
- Shape table with ODS values at the individual DOFs at discrete frequencies

With ODS, vibration measurements are performed at different points and directions on the structure and the vibration pattern can be shown as an animated geometry model of the structure and listed in a shape table. Any ODS is a combination of the forcing function acting on the structure and the dynamic properties of the structure. The forcing function depends on the operating conditions, which for machinery could be influenced by engine speed, load, pressure, temperature, flow, etc. Ambient forces from waves, wind and traffic might also apply for civil engineering structures.

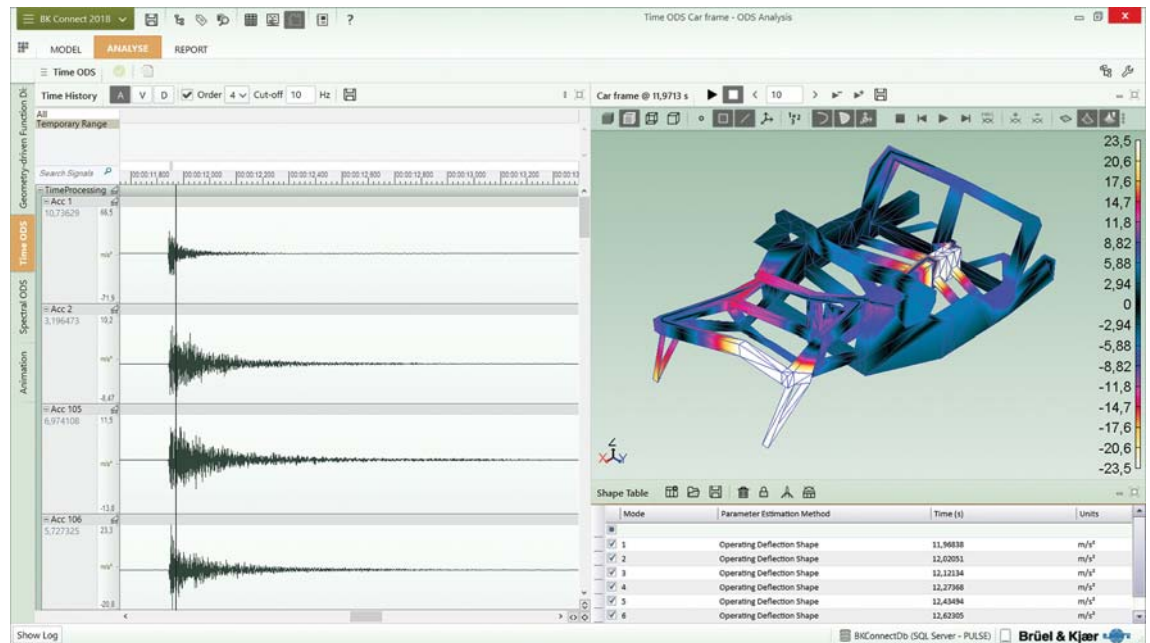
Time ODS

Time ODS is used to investigate the vibration pattern of a structure as a function of time. Time ODS includes all frequencies in the analysed frequency range and is very useful in giving an overall ODS at a given point in time whether the signal is stationary or non-stationary, such as in transient signals.

Time ODS is available as a dedicated task when you have Geometry Type 8410 and Time ODS Option Type 8410-B licences in the following applications:

- **BK Connect ODS Analysis** – when you combine Type 8410 with BK Connect Data Viewer Type 8400 you get the stand-alone ODS Analysis application. With Type 8410-B, you can import time data and perform time ODS analysis. When you add Hardware Setup Type 8401, you will be able to record data in the hardware monitor's simple recorder then immediately analyse the recording in Time ODS
- **BK Connect Modal Analysis** – go to Time ODS in the Measurement Validation sub-task to select a time range from a recording and get a shape table with ODS values at the individual DOFs at discrete time instances
- **BK Connect Data Processing** – go to Time ODS in the Measurement Validation sub-task to select a time range from a recording and get a shape table with ODS values at the individual DOFs at discrete time instances

Fig. 1
The Time ODS sub-task in BK Connect ODS Analysis



Spectral ODS

Spectral ODS is used to investigate the vibration pattern of a structure for specific frequency or order components. For frequency component investigations, FFT analysis is used and the conditions must be stationary. The ODS of different spectral components is subsequently extracted, shown in a shape table and animated.

Spectral ODS is implemented in the following applications:

- **BK Connect ODS Analysis** – a stand-alone application available when you combine BK Connect Data Viewer Type 8400, Hardware Setup Type 8401 and Geometry Type 8410 licences. Select the Spectral ODS sub-task to investigate measurement results
- **BK Connect Data Processing** – with a Type 8403 or 8404-A licence combined with a BK Connect Geometry Type 8410 licence. Here you define the measurement sequencing in the DOF Setup sub-task, measure in the Standard Measurement sub-task, and validate results in the Measurement Validation sub-task. Investigate the PAS functions by selecting DOFs using the Geometry-driven Function Display or apply displacement and peak scaling on shapes in Function Animation
- **BK Connect Modal Analysis** – with a BK Connect Geometry Type 8410 licence, you can validate results in the Measurement Validation sub-task. Investigate the phase-assigned spectrum (PAS) functions by selecting DOFs using the Geometry-driven Function Display or apply displacement and peak scaling on shapes in Function Animation

Fig. 2
Geometry-guided
spectral ODS
measurement in
BK Connect Data
Processing

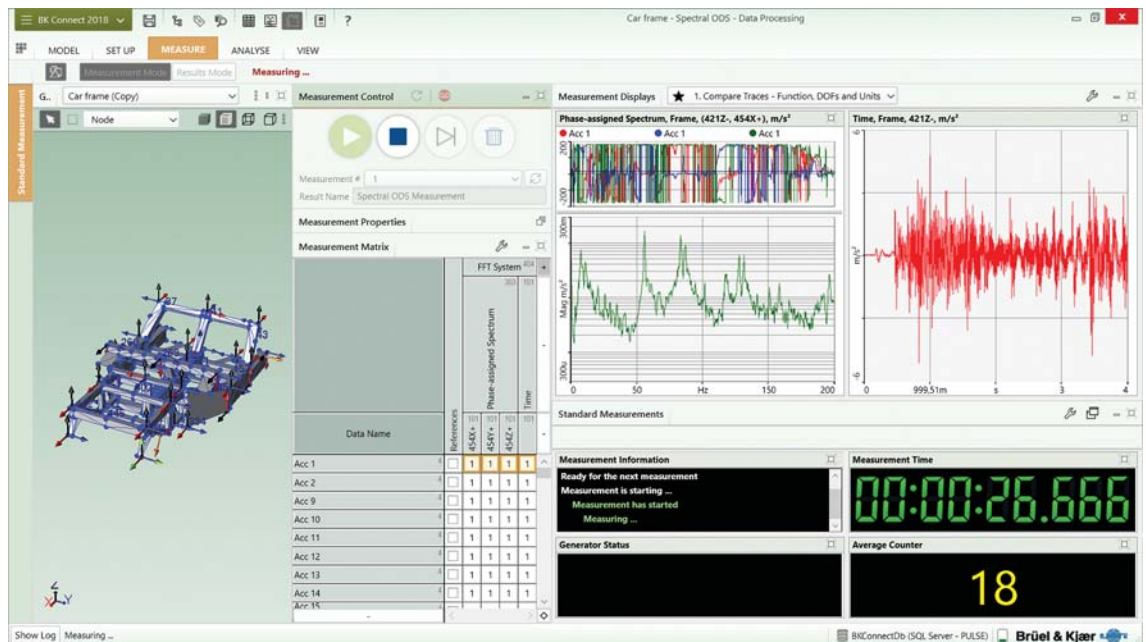
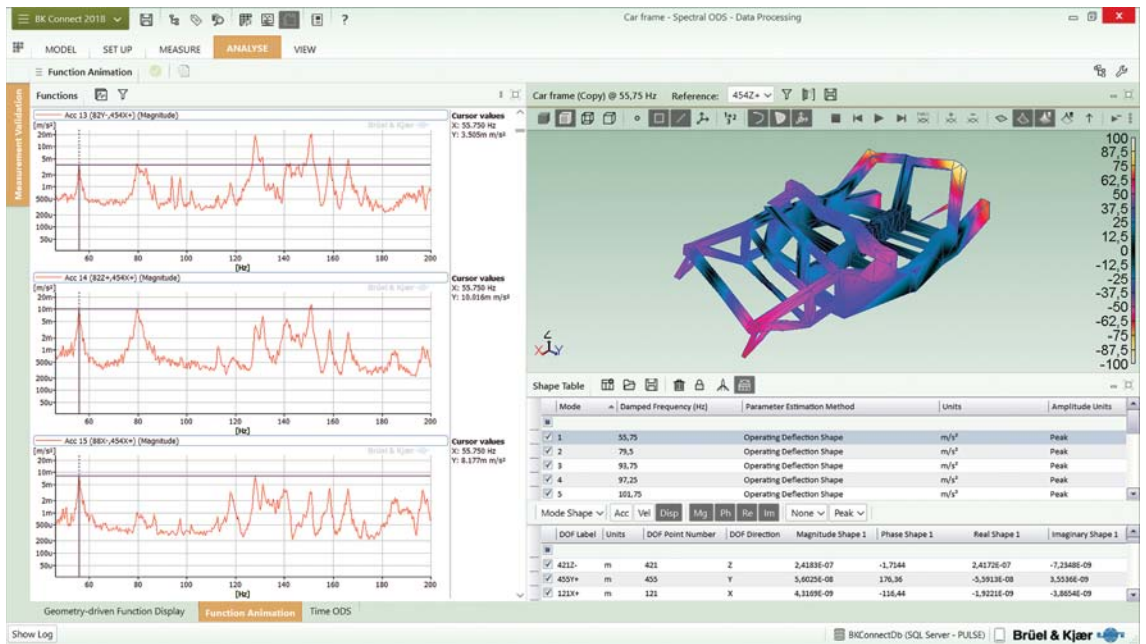


Fig. 3
Spectral ODS in
BK Connect Data
Processing



Measurement and Analysis

Measurements can be performed using real-time analysis, or time data can be recorded for later post-processing. Typically a geometry is defined and DOFs attached before the measurements are done. Measurement sequencing is set up in the DOF Setup task. Once the measurement sequencing has been defined, the Standard Measurement is used for the geometry-guided measurements.

However, in cases where no geometry is available – for example when a complex geometry is not available as a decimated finite element model and/or there is no time to draw the geometry – time data recordings can be done without a predefined geometry and the measurements can later be attached to the geometry before the ODS analysis.

Spectral ODS measurements are done as phase-assigned spectra and the results can be shown as single, overlaid, difference or side-by-side animations. A variety of animation types are supported including wire frame, surface contour, point and arrow animation. Shapes can be saved in a shape table for easy retrieval and comparison. Animate the shapes by selecting frequencies in the functions. The vibration at the various DOFs can be shown as acceleration, velocity or displacement with peak, peak-to-peak or rms scaling.

Geometry-guided OMA Measurements

The DOF Setup sub-task used for measurement sequence generation supports definition of multiple reference transducers, for example, by selecting several uniaxial accelerometers and/or one or more triaxial accelerometers as Fixed. This is often used in operational modal analysis (OMA) measurements to handle closely-coupled modes. You can then perform geometry-guided measurements in the Standard Measurements sub-task using the simple recorder in the task to make recordings. These .bkc recordings can then be exported as .uff files for import into PULSE OMA.

System Requirements

SOFTWARE REQUIREMENTS

- BK Connect 2018.1 or later
- The following BK Connect applications are needed to support a dedicated ODS solution:

Configuration for Time ODS Measurement and Analysis	Configuration for Spectral ODS Measurement and Analysis*	Configuration for Spectral and Time ODS Measurement and Analysis*
Data Viewer Type 8400	Data Viewer Type 8400	Data Viewer Type 8400
Hardware Setup Type 8401	Hardware Setup Type 8401	Hardware Setup Type 8401
Geometry Type 8410	Geometry Type 8410	Geometry Type 8410
Time ODS Option Type 8410-B	Data Processing Type 8403	Data Processing Type 8403
		Time ODS Option Type 8410-B

* Also supports OMA measurements

For more information on core BK Connect applications like Data Viewer, Hardware Setup and Data Processing, see product data [BP 0005](#). For more information on the Modal Analysis and Geometry applications, see product data [BP 1523](#)

PC REQUIREMENTS

- Microsoft® Windows® 10 Pro or Enterprise (x64) with either Current Branch (CB) or Current Branch for Business (CBB) servicing model; or Windows® 7 Pro, Enterprise or Ultimate (SP1) (x64) operating systems
- Microsoft® Office 2016 (x32 or x64) or Office 2013 (x32 or x64)
- Microsoft® SQL Server® 2014 Express (SP2) (included in installation), SQL Server® 2014 (SP2), SQL Server® 2012 R2, SQL Server® 2008 or 2008 R2 Express Edition SP1

Geometry Support

Requires BK Connect Geometry Type 8410

GEOMETRY CREATION AND EDITING

- Basic geometries using nodes, tracelines, triangle and quad elements
- Geometries based on built-in CAD models:
 - Curves: Circle, Circular Arc, Ellipse, Elliptical Arc, Hyperbolic, Parabolic, Line, Polyline, Interpolation Spline and Control Points Spline

- Surfaces: Circular, Circular Arc, Ellipse, Elliptical Arc, Hyperbolic, Parabolic, Triangular, Rectangular, Polygon, Interpolation Spline and Control Points Spline
- Solids: Cylinder, Hemisphere, Sphere, Box, Cone and Conical Frustum

GEOMETRY IMPORT FORMATS

UFF data set types 15, 18, 82, 2411 or 2412, Microsoft® Excel® (*.csv), UFF, Nastran (MSC, NX, NEi), Ansys and Abaqus FE models (requires Type 8400-D/E/F)

GEOMETRY EXPORT FORMATS

UFF data set types 15, 18, 2412 or 82, and Microsoft® Excel® (*.csv)

GEOMETRY VIEWS

- Single, Side-by-Side, Top-Bottom and various Quad views
- Definition of front, back, left, right, top and bottom view axis
- Isometric view
- Perspective, orthographic and stretched projections of geometry
- Hidden lines and transparency
- Pan, zoom and rotate options for viewing geometries
- Symbols for shaker, impact hammer, force transducer and accelerometer positions shown on geometry with customized colours and sizes

ANIMATION

- Deformed and undeformed animation with Max. Deformation
- Single, overlaid and difference animation
- Wireframe, contour (solid/solid edge), points and arrow animation
- Animation of non-measured DOFs using interpolation equations
- GIF and AVI file generation with selectable codec

Measurement and Analysis

See table above for measurement and analysis configuration requirements:

- With a **Time ODS Measurement and Analysis Configuration**, time ODS measurements can be done using the HW Setup Table for DOF definition and the Monitor's recorder for data acquisition. Time files can be imported in BKC or UFF. The Time ODS task is available for analysis
- With a **Spectral ODS Measurement and Analysis Configuration**, geometry-guided spectral ODS (FFT-based) and OMA measurements can be done using the DOF Setup for measurement sequence generation and the Standard Measurement task for the measurements. PAS functions for the ODS measurements and time recordings for OMA measurements. ODS results can be displayed in the Measurement Validation task, whereas the OMA measurements are exported to PULSE OMA for subsequent modal analysis
- With a **Spectral and Time ODS Measurement and Analysis Configuration**, all of the above functionality is available

Ordering Information

SOFTWARE FOR ODS ANALYSIS

Type 8400-X* **BK Connect Data Viewer**
Type 8410-X* **BK Connect Geometry**
Type 8410-B-X* **BK Connect Time ODS Option**

ADDITIONAL SOFTWARE FOR MEASUREMENTS

Type 8401-X* **BK Connect Hardware Setup**
Type 8403-X* **BK Connect Data Processing** (for geometry-guided measurements)

* 'X' = license model, either N for node-locked or F for floating.

MAINTENANCE AND SUPPORT AGREEMENTS

M1-8400-X* Agreement for Type 8400
M1-8401-X* Agreement for Type 8401
M1-8403-X* Agreement for Type 8403
M1-8410-X* Agreement for Type 8410
M1-8410-B-X* Agreement for Type 8410-B

OPTIONAL SOFTWARE

Type 8404-A-X* **BK Connect Data Processing Specialist** (advanced)
Type 8420-X* **BK Connect Modal Analysis**

Brüel & Kjær and all other trademarks, service marks, trade names, logos and product names are the property of Brüel & Kjær or a third-party company.

Brüel & Kjær Sound & Vibration Measurement A/S
DK-2850 Nærum · Denmark · Telephone: +45 77 41 20 00 · Fax: +45 45 80 14 05
www.bksv.com · info@bksv.com
Local representatives and service organizations worldwide

Although reasonable care has been taken to ensure the information in this document is accurate, nothing herein can be construed to imply representation or warranty as to its accuracy, currency or completeness, nor is it intended to form the basis of any contract. Content is subject to change without notice – contact Brüel & Kjær for the latest version of this document.

Brüel & Kjær 

