

LMS Solutions Guide

LMS Test.Lab Structures

LMS Test.Lab Structures

Setting New Standards for Structural Engineering



Structural testing used to be a long and complex process. Not anymore. With LMS Test.Lab and the latest transducer innovations, technicians can perform large-scale modal surveys in less than a day. LMS is renowned for its modal testing experience - from impact testing of small structures to campaigns using many shakers and hundreds of measurement channels. LMS Test.Lab Structures extends that tradition.

From troubleshooting to virtual prototyping...

Structures are test-characterized for many different reasons using methods of varying sophistication and complexity. You may need to quickly pinpoint and correct a vibration problem. This may be done by simply identifying structural resonances and dominant forcing mechanisms or by plotting the structural deformation pattern at a specific frequency. When in-depth understanding of the structural dynamics is required, responses to measured force inputs are characterized using Modal Analysis. These modal models can be used to validate and update Finite Element models or used directly as the basis for design modification studies. Ultimately, the modal test results can be combined with pure numeric simulations in hybrid models. This modern approach enables cost effective and rapid simulation of a new assembly or configuration.

...covered in one product family

LMS Test.Lab Structures has been designed keeping the broadest scope of applications in mind. It offers complete solutions to the various needs of today's mechanical industries and personnel, reducing required test time and optimizing operator efficiency. It has also been designed for efficient operation by the widest range of users. Experts will enjoy the rich functional content and depth of each component. Less seasoned users will cherish the embedded application knowledge base that guides basic use of each module to a successful conclusion with valid results.

Making Testing Easy

Testing guided step-by-step

Whether you are an occasional user or a modal expert, making good structural measurements requires care and attention to detail. The LMS Test.Lab Workbook clearly shows how each step should be taken. Where possible, the software suggests values or takes action for you.

- Worksheets guide users through the entire measurement process
- No control parameters hidden by icons or buried in menu bars
- Meaningful on-line display layouts automatically generated
- System suggests valid test setup parameters

Simplify testing by specifying company-specific measurement procedures in Test.Lab Templates, lowering the threshold for technicians and occasional users, guaranteeing measurement consistency.

Minimal test preparation time

In high channel-count structural tests, the actual measurement time is short compared to specimen preparation effort. Support fixturing, shaker setup, attachment and calibration of transducers, wiring verification and wire-frame model generation can be time consuming. That's why special attention has been paid to efficient preparation of the setup.

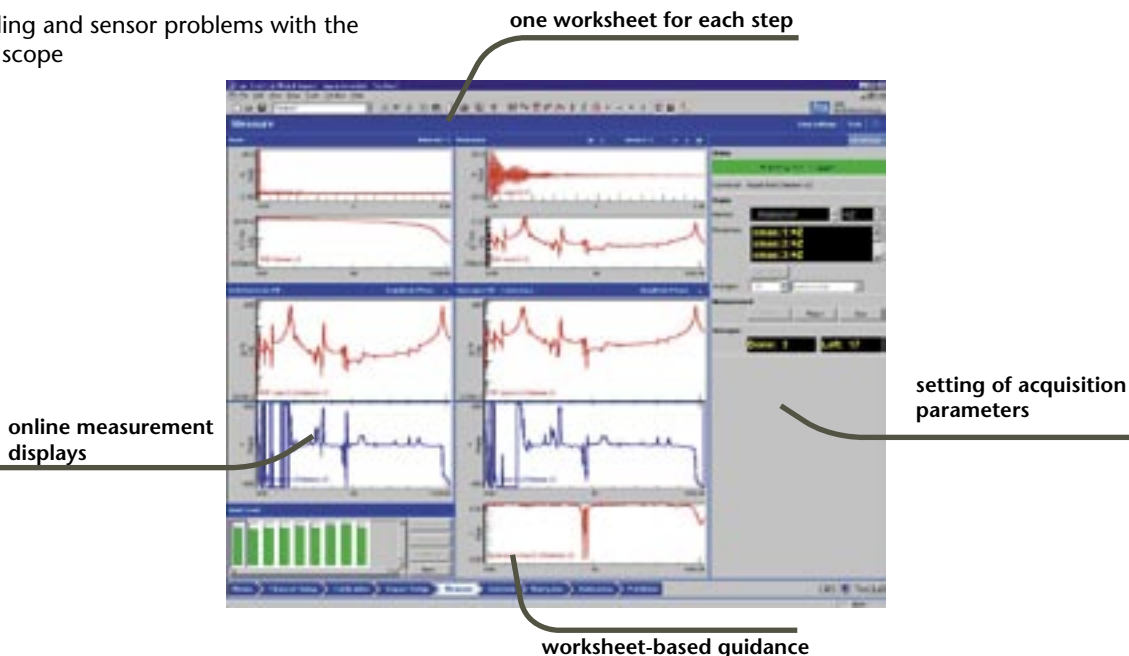
- System can read data from a TEDS (Transducer Electronic Data Sheet) enabled sensors
- Force and response sensors may be connected freely to any input channel
- Intelligent multi-transducer calibration allows one man to calibrate all sensors in a rapid walk-around
- System warns if any ICP channel exhibits an open-circuit condition
- Troubleshoot cabling and sensor problems with the integrated digital scope

Rapid geometry definition

Correct wire frame models are required to provide realistic and informative animated displays of mode shapes. LMS Test.Lab offers different ways to create these wire frame models.

- Enter point coordinates in Excel like tables. Mouse-click and drag to define connections and surfaces
- Import geometry from a UFF file, LMS CADA-X, your CAD or FEA model
- Copy/paste geometry information from Excel®
- Create model from stored TEDS transducer geometry information

Measuring geometric coordinates was once a tedious job. With Test.Lab you don't have to use a ruler! Pointing a hand held probe tip at the required point location, triggers the measurement by pushing a button on the probe. Move to the next point and measure the complete geometry model at a speed of over 10 points/min. In case of the photogrammetric method, just take digital photographs of your test object from different viewing angles, watch Test.Lab process the pictures into coordinates and the job is done.



Get the Best out of Your Data

Operator feedback

High-quality impact measurements result when you can concentrate on hitting right: striking the right point, in the right direction, not too hard, not too soft.

LMS Test.Lab can't swing the hammer for you, but does make the job as comfortable as possible while you concentrate on impacting properly in all those hard-to-reach locations.

- Audio feedback on triggering, overload or completed measurement
- Automatic overload and double impact rejection
- Autosave of valid measurements
- Auto increment of measurement point ID
- Optimized default online displays

For shaker tests including MIMO FRF measurements, simply push the start button and watch as the system does the rest.

Measurements you can trust

Before you start moving transducers or tearing down the test setup, you need to be sure that all measurements gathered were correct and complete. With Test.Lab Structures you will minimize the risk of "doing it twice".

The Test.Lab Data Validation worksheet lets you inspect large sets of measurement data very efficiently:

- Comprehensive, nicely organized tabular overview of measurement functions
- Selected functions are automatically loaded into the display while the corresponding measurement points are highlighted on the geometry
- Geometry highlights missing points and points with input overload during testing

Test.Lab provides complete data annotation, for maximum traceability:

- Complete measurement setup is stored with the measured results
- Attach digital pictures of the setup details to the measured data
- Add your notes and observations made during the experiment

No barriers between acquisition and analysis

Analysis Worksheets like Test.Lab Operational Deflection Shapes or Test.Lab Modal Analysis can be inserted into the acquisition Workbook providing preliminary modal results while the test evolves. This can have decisive impact on the final quality of your results.

Animation of a mode immediately reveals missing measurements, an inverted sensor direction or an accelerometer that fell off.

Preliminary mode shapes can show where additional measurement points are required for better resolution, or point on the need for different or additional excitation sites.

Upon loading any of these analysis worksheets, the test data will automatically be retrieved for analysis, without any user interaction required.

- Seamless integration, no need to switch between applications
- Worksheets share data, eliminating store and recall operations
- Quick analysis available within seconds after the latest measurement



Modal Analysis Made Easy...

Follow the guide...

Modal analysis is being adopted as a standard structural engineering technique. It is no longer the exclusive activity of dedicated experts, but a common tool used by all structural engineers. LMS has brought its industry-leading modal technology to the occasional user without diluting the power available to the expert, in a format that provides unique benefits for both and increases the synergy between them.

The once-arcane process of modal analysis has been translated into a logical sequence of experience-proven steps, each embedded in a dedicated worksheet. The LMS Test.Lab Modal Analysis workbook will guide your way from the capture of test data, through calculation of modal parameters, to the validation of the analysis. You will have better modal results faster and easier than ever before.

- Worksheets guide users through each step of the modal analysis process
- Smart defaults minimize user interaction
- Numerous validation tools reduce operator errors

Mode shapes in only a few steps

The three main steps of a modal analysis run in automatic sequence with minimum user interaction. After the software automatically collects all relevant test data, a frequency range is selected for analysis. At a single mouse-click, the poles of the system are found by curve-fit in that frequency range. Each pole is converted to a natural frequency and damping factor. The mode shapes associated with all physically significant poles are calculated, including the global residues and all modal coefficients. At each step, results of selections and calculations are available in online displays.

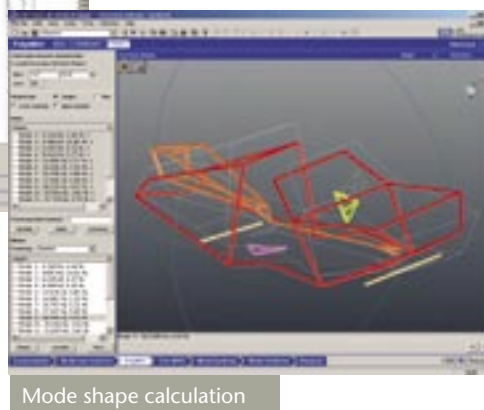
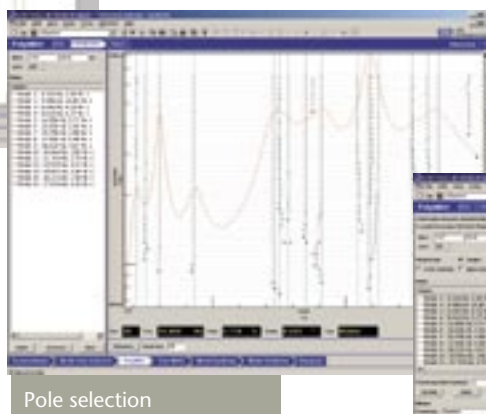
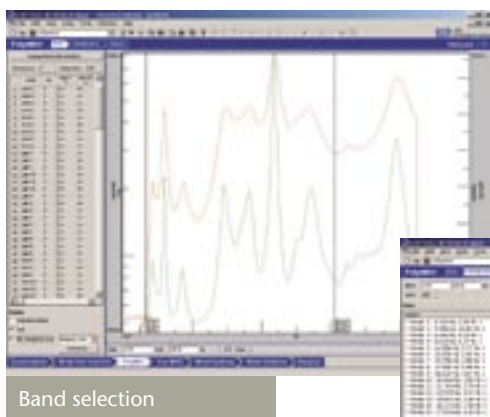
- Full and seamless integration of acquisition and analysis
- Minimum operator intervention
- Maximum user feedback in all steps of the analysis procedure
- State of the art Modal Parameter estimation methods

... Reap the rewards

Results of this quality have never been so easy to obtain. You select the measurements, run the analysis and view the results. It's no more difficult than turning the pages of a book. Your confidence in the results will be immediate. A single page summary of all curve-fits provides verification that those smoothly animated shapes and precisely identified frequencies and damping factors accurately reflect your structure.

The quality of the modal coefficients may be verified by viewing the Modal Assurance Criterion. Model quality may be further verified by comparing the measured FRFs to FRFs that are synthesized from the modal estimation.

- Automated input data gathering
- Concise view of all input data
- Concise summary of all analyses
- Easy and complete data validation
- Comparison of measured and modeled FRFs, comparison with different calculations and data sets



... Without Compromises for the Expert

Flexible processing - advanced validation

An arsenal of state-of-the-art parameter estimators offer solutions to all your structural analysis needs, even when the structure chooses not to cooperate in exposing its nature.

Least Squares Complex Exponential is the standard (time-domain) pole-fitting method for both single and poly-referenced (MIMO) application. LSCE is a proven algorithm that deals with a broad range of structures, providing needed efficiency when high modal density is encountered.

PolyMAX, a new modal parameter identification algorithm, revolutionizes the modal analysis process of highly damped structures and noisy data. The outstanding stabilization properties result in a very straightforward modal identification, appealing both to new users and to modal analysis experts. PolyMAX is available for operational as well as experimental modal analysis.

Modal amplitudes are determined by the Least Squares Frequency Domain (LSFD) fitter, which extracts residues on a global rather than local basis, assuring a consistent model.

Advanced validation techniques include MAC (auto and cross), FRF synthesis and calculation of modal mass, stiffness and damping for physical correlations.

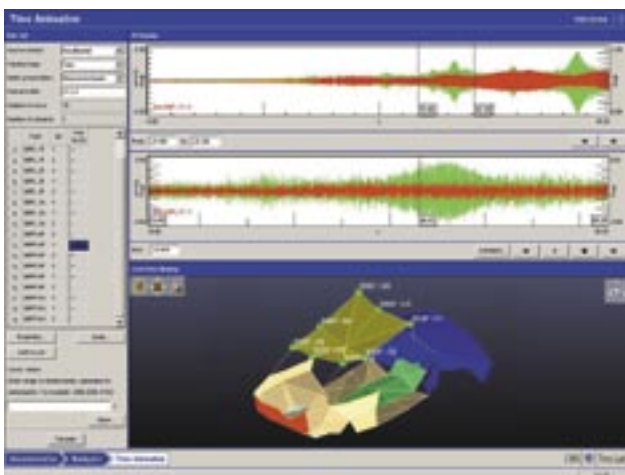
Mastering masses of data

LMS Test.Lab was conceived to handle massive amounts of data effortlessly. Investigating large and complex structures may lead to a multi-test process. All related measurements are automatically gathered so that selecting relevant data and creating a consistent modal model of the whole structure is done easily.

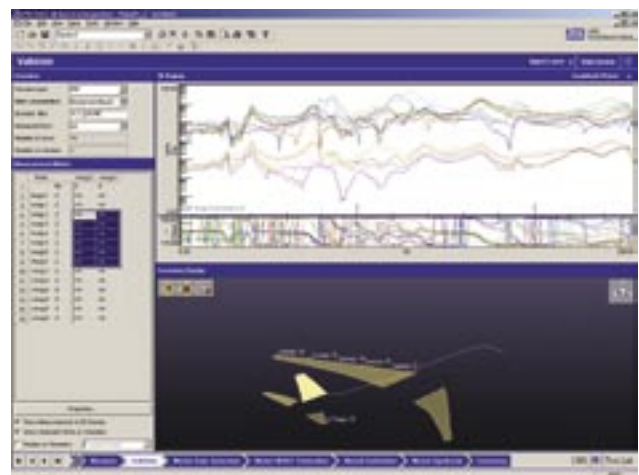
You won't be overwhelmed by the enormous scope of answers, either. Analysis results are automatically structured, just as measurements are.

Throughout the problem-solving process, dedicated data management assures that input FRFs, processing parameters and analysis results remain properly related, minimizing risk of subsequent misinterpretation.

- Supports data acquisition in multiple patches
- Dedicated data organization for traceability and consistency
- Integrated access to CADA-X data and several external data formats
- Multi-run Modal Analysis allows dedicated processing of modal test data, obtained through different sets of measurements



3D animation of time data provides increased engineering insight in transient vibration behaviour.



Stationary data are brought to life by animating the geometry immediately after the run, to visualize what is really happening.

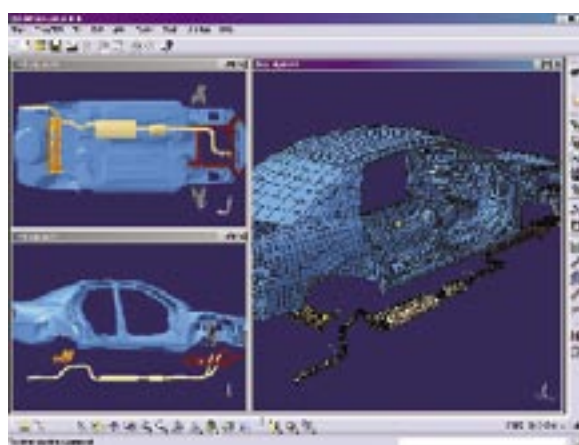
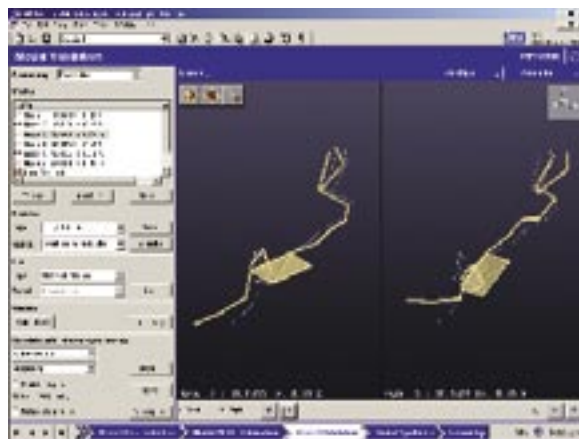
Insights that Make Virtual Simulation Work

Using test data in hybrid modeling implies new and more challenging requirements. Not only must a broader scope of test parameters be provided, all data must exhibit the highest degree of consistency.

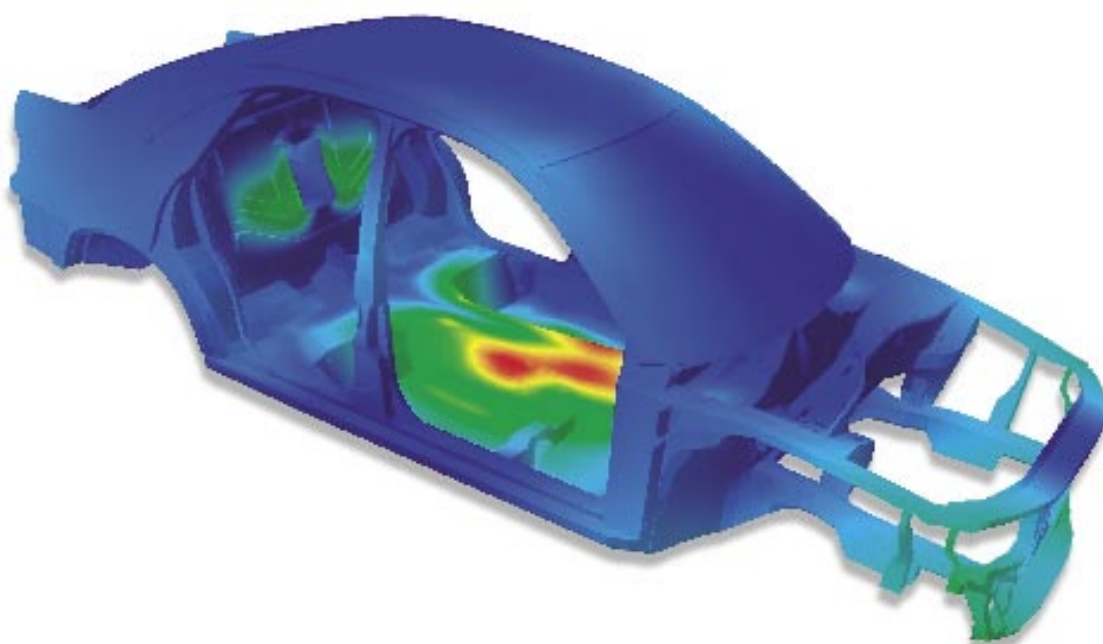
LMS Test.Lab Structures is designed to master both challenges. It provides for rotational degrees-of-freedom, rigid body modes and other realistic factors essential for an accurate dynamic model. It is designed to provide consistent modal sub-models, each the probable result of multiple tests, reflecting proper scaling, reciprocity and completeness.

LMS Test.Lab provides the tools to validate the resulting hybrid model, including cross-MAC comparisons with experimental observations, orthogonality checks and comparison of computed model responses with those of actual hardware subjected to motion-controlled shaker tests.

Virtual prototyping has just received an injection of reality, one that will promote faster, more accurate simulations earlier in the design cycle than ever before experienced.



LMS Virtual.Lab uses validated test models and loads for system-level vibration predictions.



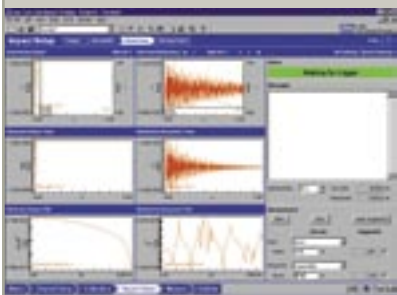
LMS Test.Lab Structures Overview

	12 Channel Impact Modal Analysis TL-STR-MT-IMPACT	20 channel MIMO Modal Analysis TL-STR-MT-MIMO-01	60 channel MIMO Modal Analysis TL-STR-MT-MIMO-02	20 channel Tracked Operational Deflection Shape Analysis TL-STR-ODS-ROT	20 channel Stationary Operational Deflection Shape Analysis TL-STR-ODS-STAT	20 channel Operational Modal Analysis TL-STR-OMIA-01	96 channel Operational Modal Analysis TL-STR-OMIA-02
LMS SCADAS III Hardware							
LMS SCADAS 305 SCSI - Master frame with 5 slots, 2 DAC, AC/DC power and SCSI interface		1		1	1	1	
LMS SCADAS 310 - Master frame with 10 slots, AC power and SCSI interface	1						
LMS SCADAS 316 - Master frame with 16 slots, AC power and SCSI interface			1				1
LMS SCADAS 317 - Slave frame with 17 slots for I/O Modules, AC powered							1
PIC 34-0 - 0.4m Parallel Interface for Master/Slave Configuration							1
QDAC - 4 channel Digital-to-analog Source Signal Output Module			1(O/1)				
SP92-B - 4 channel 24-bit DSP Signal Processor Module	3	5	15	5	5	5	24
PQA - 4 channel Programmable V/ICP® Signal Conditioner	3	5		5	5	5	
PQFA - 4 channel floating V/ICP®/TEDS Signal Conditioner	O	O	15				24
V12A - 12 channel Programmable V/ICP®/TEDS Conditioner			O				O
PDT - Programmable Dual Tacho Input Module for Analog and TTL Signals							1
LMS Test.Lab Software							
LMS Test.Lab Desktop	•	•	•	•	•	•	•
LMS Test.Lab SCADAS 305 Driver		•		•	•	•	
LMS Test.Lab SCADAS 316 Driver			•				
LMS Test.Lab SCADAS 310 Driver	•						
LMS Test.Lab SCADAS III Driver (Full-Master/Slave)							•
LMS Test.Lab SCADAS III Smart Transducer TEDS support	O	O	•				•
LMS Test.Lab Spectral Acquisition Workbook					•	•	•
LMS Test.Lab Modal Impact Workbook	•	•	•				
LMS Test.Lab Modal Shake Workbook		•	•				
LMS Test.Lab Time Recording During Spectral Acquisition					•	•	•
LMS Test.Lab Geometry Workbook	•	•	•	•	•	•	•
LMS Test.Lab Modal Analysis Workbook	•	•	•				
LMS Test.Lab PolyMAX		•	•			•	•
LMS Test.Lab Operational Modal Analysis Workbook						•	•
LMS Test.Lab Operational Deflection Shapes Workbook	•	•	•				
LMS Test.Lab Operational Deflection Shapes & Time Animation Workbook				•	•	O	O
LMS Test.Lab Signature Testing Workbook				•			
LMS Test.Lab Time Recording during Signature Testing				•			
LMS Test.Lab Run Data Averaging & Comparison Organizer		O	O				
LMS Test.Lab Batch Reporting - Organizer	O	O	O	O	O		
LMS Test.Lab Multi-run Modal Analysis		O	O				
LMS Test.Lab Throughput Validation & Processing Host				O	O		
LMS Test.Lab Signature Throughput Processing				O	O		
LMS Test.Lab External File Access	O	O	O				

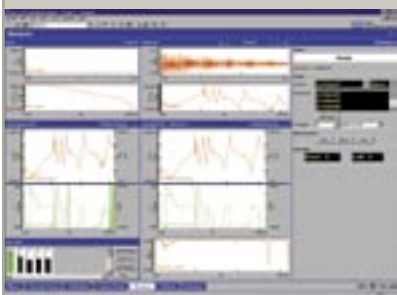
• = standard
O = optional



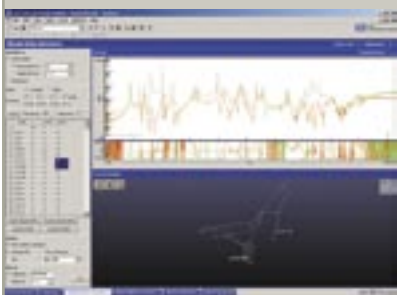
Hammer impact testing provides a complete modal testing solution, from measuring the frequency responses up to performing modal analysis.



Built in application knowledge allows to automatically and quickly define the acquisition parameters.



Auto accepting averages enables the operator to take measurements without keyboard interaction, while having a complete view on all data.



Seamless integration with the analysis applications provides immediate feedback to validate the correctness of the data.

LMS Test.Lab 12 Channel Impact Modal Analysis

System for hammer impact testing

LMS Test.Lab Impact Modal Analysis provides a complete modal testing solution using impact hammer Frequency Response Function Measurements for up to 11 simultaneous response channels referenced to the hammer input force. All channels support ICP® transducers or any Voltage signal.

The Geometry workbook allows fast generation of wireframe and full 3D visualization of test and analysis results. The Modal Impact workbook provides embedded expert guidance for trigger parameter setting and FFT-window selection, with immediate feedback showing the effect of parameter changes on the last measurement. It supports automatic active channel detection for one-man calibration functionality. The auto-acceptance function and audio feedback, providing information on overloads and ready-for-next-average signal, enable the operator to take measurements without keyboard interaction. A handheld PDA can be used for measurement status feedback, visualization of measured signals and entry of the next run's node identifiers (optional).

The Operational Deflection Shapes add-in provides immediate feedback to validate the correctness of FRF (transducer position, orientation, calibration, SNR, etc.) by on-the-spot animation of the geometry model.

The Modal Analysis workbook offers various fast and accurate single or multiple reference parameter estimation algorithms, and a complete set of modal model validation tools, such as MAC and FRF synthesis. It is available as a standalone analysis environment or as add-in to the Modal Impact workbook, which allows on-the-spot analysis.

Features	Benefits
<ul style="list-style-type: none"> • Embedded expert system for impact parameter settings • Point Mobility & on-line dynamic stiffness with reference curves • Parallel measurement functions (FRF, coherence, spectra, etc.) • Robust, accurate Modal Parameter extraction algorithms • Immediate visualization of FRF measurements on 3D geometry • Advanced Data & Model validation toolset 	<ul style="list-style-type: none"> • Reduced test setup time • Minimal training required • Immediate validation of measurement and analysis quality – reliable base data and resulting model • Minimized test item reservation through on-the-spot analysis and validation • Easy traceability through full documentation, data management and reporting
Solution Pack Content	Solution Pack Options
<p>LMS SCADAS III Hardware</p> <ul style="list-style-type: none"> • LMS SCADAS 310 - Master frame with 10 slots, AC power and SCSI interface • 3 x PQA - 4 channel Programmable V/ICP® Signal Conditioner • 3 x SP92-B - 4 channel 24-bit DSP Signal Processor Module <p>LMS Test.Lab Software</p> <ul style="list-style-type: none"> • Desktop • LMS SCADAS 310 Driver • Modal Impact Workbook • Geometry Workbook • Modal Analysis Workbook • Operational Deflection Shapes Workbook 	<p>LMS SCADAS III Hardware</p> <ul style="list-style-type: none"> • PQFA - 4 channel floating input and V/ICP/TEDS IEEE 1451.4 signal conditioning module i.s.o. PQA <p>LMS Test.Lab Software</p> <ul style="list-style-type: none"> • Batch Reporting – Organizer • External File Access • SCADAS III Smart Transducer TEDS support (requires PQFA hardware option)

LMS Test.Lab 20 Channel MIMO Modal Analysis

System for multi-shaker or hammer excitation

The entry-level LMS Test.Lab MIMO system provides a complete modal testing solution supporting single or dual shaker and impact hammer Frequency Response Function Measurements for up to 20 simultaneous channels, all supporting ICP® transducers or any Voltage signal.

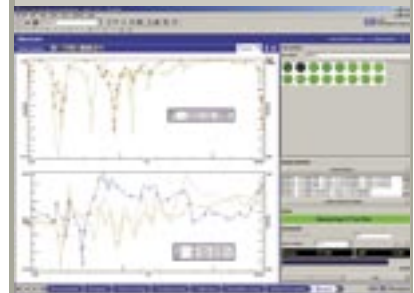
The Geometry workbook allows fast generation of wireframe and full 3D visualization of test and analysis results. The Modal Shake workbook provides dedicated test setups for a dual shaker FRF test, including excitation level balance checks and input force de-correlation validation. The Modal Impact workbook offers embedded expert guidance for trigger parameter setting and FFT-window selection, with immediate feedback showing the effect of parameter changes on the last measurement. Both modal workbooks support automatic active channel detection for one-man calibration functionality. The Operational Deflection Shapes add-in gives immediate feedback to validate the correctness of FRF (transducer position, orientation, calibration, SNR, etc.) by on-the-spot animation of the geometry model.

The Modal Analysis workbook offers various fast and accurate single or multiple reference parameter estimation algorithms, and a complete set of modal model validation tools, such as MAC and FRF synthesis. With the crystal-clear stabilization diagrams from the LMS PolyMAX parameter estimation algorithm, the analysis process is significantly simplified and operator-dependency of the resulting modal model (typical for complex, highly damped structures) is eliminated.

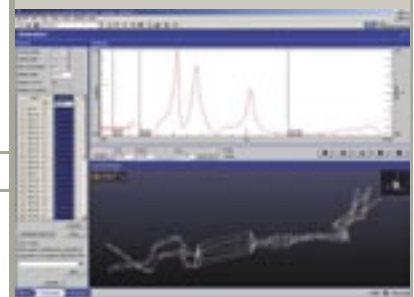
The Modal Analysis Workbook is available as a standalone analysis environment or as add-in to the data acquisition workbooks, allowing on-the-spot analysis.



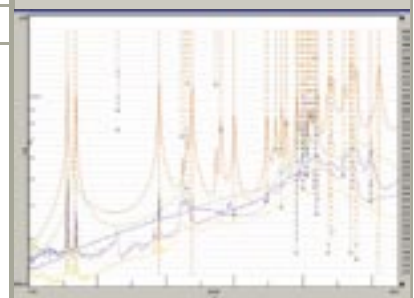
MIMO testing allows single or dual shaker and impact hammer FRF measurements.



During the measurements, all required functions are displayed online.



Inspect the deflection shapes of your structure right after the test.



LMS PolyMAX allows fast, easy and user independent modal parameter estimation.

Features	Benefits
<ul style="list-style-type: none"> • Embedded expert system for impact parameter settings • On-line de-correlation check of excitation inputs • Parallel measurement functions (FRF, coherence, PCA, spectra, etc.) • Driving Point FRF, Point Mobility & dynamic stiffness checks using on-line reference curves • Immediate visualization of FRF measurements on 3D geometry • LMS PolyMAX state-of-the art modal parameter estimation technology 	<ul style="list-style-type: none"> • Reduced test setup time • Minimal training requirement • Minimized Test item reservation through on the spot analysis & validation • Immediate validation of measurement and analysis quality – reliable base data and high quality modal model • Effectively deals with highly damped structures and non-linear materials • Yields user-independent results • Easy traceability with full documentation, data management and reporting
Solution Pack Content	Solution Pack Options
<p>LMS SCADAS III Hardware</p> <ul style="list-style-type: none"> • LMS SCADAS 305 SCSI - Master frame with 5 slots, 2 DAC, AC/DC power and SCSI interface • 5 x PQA - 4 channel Programmable V/ICP® Signal Conditioner • 5 x SP92-B - 4 channel 24-bit DSP Signal Processor Module <p>LMS Test.Lab Software</p> <ul style="list-style-type: none"> • Desktop • LMS SCADAS 305 Driver • Modal Shake Workbook • Modal Impact Workbook • Geometry Workbook • Modal Analysis Workbook • LMS PolyMAX • Operational Deflection Shapes Workbook 	<p>LMS SCADAS III Hardware</p> <ul style="list-style-type: none"> • PQFA- 4 channel floating V/I/ICP/TEDS Signal Conditioner <p>LMS Test.Lab Software</p> <ul style="list-style-type: none"> • Run Data Averaging & Comparison Organizer • Batch Reporting – Organizer • External File Access • Multi-run Modal Analysis • SCADAS III Smart Transducer TEDS support (requires PQFA hardware option)

LMS Test.Lab 60 Channel MIMO Modal Analysis

System for multi-shaker or hammer excitation

This LMS Test.Lab MIMO Modal Analysis solution provides an extremely productive state-of-the-art modal testing solution supporting structural excitation by up to 4 shakers or by impact hammer. Frequency Response Functions can be measured for up to 18 tri-axial vibration transducers or 59 single axis response channels. All channels support ICP® transducers or any Voltage signal, and are IEEE-1451.4 TEDS compatible.

The Geometry workbook allows fast generation of wireframe and full 3D visualization of test and analysis results. Through TEDS support, geometry creation is further accelerated with the position information from pre-programmed transducers.

The Modal Shake workbook provides dedicated test setups for a multiple shaker FRF test, including excitation level balance checks and input force de-correlation validation. The Modal Impact workbook offers embedded expert guidance for parameter settings, with immediate feedback showing the effect of parameters changes on the last measurement. Both workbooks support automatic active channel detection for one-man calibration functionality. The Operational Deflection Shapes add-in gives immediate feedback to validate the correctness of FRF (transducer position, orientation, calibration, SNR, etc.) by on-the-spot animation of the geometry model.

The Modal Analysis workbook offers various fast and accurate single or multiple reference parameter estimation algorithms, and a complete set of modal model validation tools, such as MAC and FRF synthesis. With the crystal-clear stabilization diagrams from the LMS PolyMAX parameter estimation algorithm, the analysis process is significantly simplified and operator-dependency of the resulting modal model (typical for complex, highly damped structures) is eliminated.



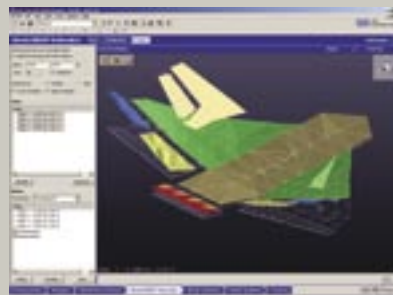
Multi shaker MIMO testing with a large number of channels provides an extremely productive modal testing solution.



Advanced geometry based techniques allow quick and easy data validation on large amounts of data.



The geometry workbook allows fast generation of wireframe and full 3D visualization of test and analysis results of large models.



Mode shape animation provides better insight in the vibration behavior of the structure.

Features

- Excitation by up to 4 shakers in parallel
- Online level and de-correlation check of all excitation inputs
- Parallel measurement functions (FRF, coherence, PCA, spectra, etc)
- Driving Point & on-line dynamic stiffness checks using online reference curves
- Immediate visualization of FRF measurements on 3D geometry
- LMS PolyMAX state-of-the art modal parameter estimation technology
- Advanced Data & Model validation toolset

Benefits

- Reduced test setup time
- Minimal training required
- Reduced test execution time & minimized test item reservation through high channel count, multiple excitation DOF and on-the-spot analysis and validation
- Immediate validation of measurement and analysis quality – reliable base data and high quality modal model
- Effectively deals with highly damped structures and non-linear materials
- Yields user-independent results
- Easy traceability with full documentation, data management and reporting

Solution Pack Content

LMS SCADAS III Hardware

- LMS SCADAS 316 - Master frame with 16 slots, AC power, SCSI interface
- 1 x QDAC - 4 channel digital-to-analog source signal output module
- 15 x PQFA - 4 channel floating V/ICP®/TEDS Signal Conditioner
- 15 x SP92-B - 4 channel 24-bit DSP Signal Processor Module

LMS Test.Lab Software

- Desktop
- LMS SCADAS 316 Driver
- LMS SCADAS III Smart Transducer TEDS support
- Modal Shake Workbook
- Modal Impact Workbook
- Geometry Workbook
- Modal Analysis Workbook
- LMS PolyMAX
- Operational Deflection Shapes Workbook

Solution Pack Options

LMS SCADAS III Hardware

- QDAC - 4 channel digital-to-analog source signal output module
- 5 x V12A - replace SP92-B and PQFA by V12A

LMS Test.Lab Software

- Run Data Averaging & Comparison Organizer
- Batch Reporting – Organizer
- External File Access
- Multi-run Modal Analysis

LMS Test.Lab 20 Channel Tracked Operational Deflection Shape Analysis

Mobile system for rotating machinery in operation

LMS Test.Lab Operational Deflection Shape Analysis provides a mobile solution to measure and visualize the structural deformation of rotating machinery in operation. The animated vibration patterns can be analyzed as time-history, at selected fixed frequencies or tracked against rotational speed or any other operational parameter. Measurements are made using a portable LMS SCADAS 305 front-end with 2 embedded tacho inputs, supporting 20 channels for ICP® and Voltage signals, including quasi-static parameters.

The user-intuitive Signature Testing workbook measures and processes tracked spectral data and enables repetitive measurements from a pre-defined template where layouts and measurement settings are specified. Narrow band spectra are acquired during run-ups, run-downs or sequences of both, at user-controlled time or rpm intervals. Online processing and visualization covers a multitude of formats, including waterfalls and order-, frequency- and octave sections. The time histories for all channels are directly written to the PC hard disk, in parallel to the online spectral processing, with a throughput performance independent of channel count, acquisition bandwidth and online processing.

The Geometry workbook allows generation of wireframe and 3D visualization of test and analysis results. All data types permit immediate analysis through animation of the geometry model: scrolling through the time axis like a slow motion camera, or along frequency, order or speed axes like a stroboscope. Any analyzed vibration pattern can be stored for detail analysis or reporting purposes.

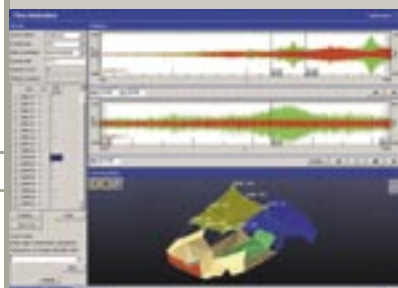
The Operational Deflection Shape Analysis workbook is available as a standalone analysis environment or as add-in to the data acquisition workbooks, allowing on-the-spot analysis.



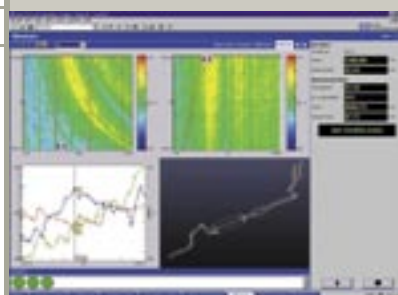
A mobile solution to measure and visualize the structural deformation of rotating machinery in operation.



The geometry workbook allows fast generation of wireframe and full 3D visualization of test and analysis results of large models.



3D animation of time data allows increased engineering insight in transient vibration behavior.



Parallel data acquisition lets you combine the convenience of narrow band spectra and online order analysis, together with the raw time data.

Features	Benefits
<ul style="list-style-type: none"> • Mobile multi-channel acquisition • On-line monitoring of spectra, waterfalls and color maps, octave displays and order sections, and measurement status indicators • Online check against reference curves • Seamless test-analysis integration, add-in analysis tools at any point in the process • "Movie" or "stroboscope" analysis for any operating condition • Saves deformation patterns at critical operating conditions for later replay, analysis & reporting 	<ul style="list-style-type: none"> • Effective & reliable field data acquisition • On-line feedback on measurement progress and quality • Reduced errors and higher productivity • Visual diagnosis using 3D animation on various data formats & data segments • Fast standard reporting, with "single button" operation • Comprehensive reporting - easy exchange of test/analysis results between OEM departments and with suppliers
Solution Pack Content	Solution Pack Options
<p>LMS SCADAS III Hardware</p> <ul style="list-style-type: none"> • LMS SCADAS 305 SCSI - Master frame with 5 slots, 2 DAC, AC/DC power and SCSI interface • 5 x PQA - 4 channel Programmable V/ICP® Signal Conditioner • 5 x SP92-B - 4 channel 24-bit DSP Signal Processor Module <p>LMS Test.Lab Software</p> <ul style="list-style-type: none"> • Desktop • LMS SCADAS 305 Driver • Signature Testing Workbook • Time Recording during Signature Testing • Geometry Workbook • Operational Deflection Shapes & Time Animation Workbook 	<p>LMS Test.Lab Software</p> <ul style="list-style-type: none"> • Throughput Validation & Processing Host • Signature Throughput Workbook • Batch Reporting - Organizer

LMS Test.Lab 20 Channel Stationary Operational Deflection Shape Analysis

Mobile system for in-operation deformation analysis

This LMS Test.Lab configuration provides a mobile solution to measure and visualize the structural deformation of any test item under operational load. The animated vibration patterns can be analyzed as time-history, or at selected frequencies for different load conditions, starting from multi-reference spectral data. Measurements are made using a portable LMS SCADAS 305 front-end, supporting 20 channels for ICP® and Voltage signals.

The Spectral Acquisition workbook offers an intuitive way to define channel parameters, acquisition parameters and multi-reference spectral processing functions. In all stages, the user gets feedback on the parameters defined, for maximum validation of the test setup before the actual testing starts. During the measurement, any processing function can be displayed and monitored on-line, including operational conditions (e.g. speed).

The time histories for all channels are directly written to the PC hard disk, in parallel to the on-line spectral processing, with a throughput performance independent of channel count, acquisition bandwidth and on-line processing. On-line processing and visualization covers a multitude of formats, including narrow-band spectra, cross-powers, octave order-, frequency- and octave sections.

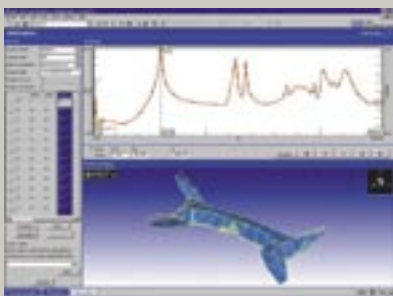
The Geometry workbook allows fast generation of wireframe and full 3D visualization of test and analysis results. The Operational Deflection Shapes and Time Animation workbook provides easy navigation and data selection. All data types permit immediate analysis through animation of the geometry model: scrolling through the time axis like a slow motion camera or highlighting behavior at specific frequencies like a stroboscope. Any analyzed vibration pattern can be stored for future detail analysis or reporting purposes.



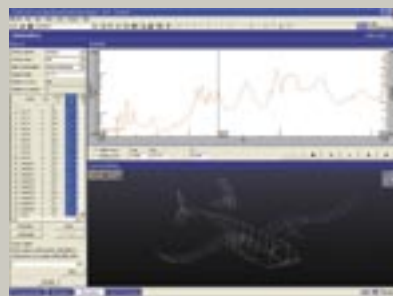
A mobile solution to measure and visualize the structural deformation under operating conditions.



On-line processing and visualization covers narrow band spectra, cross-powers and octave spectra while also acquiring the raw time data.



Immediate inspection of the deflection shapes of the structure directly after the test through animation of the geometry model.



Animation of 3D geometry from any view angle, in any format (color, lines, planes).

Features

- Real time monitoring of the acquisition progress
- Reference limits can be set to ease operator decision-making
- Comparison of on-line measurements with reference curves
- Add-in of analysis tools at any point in process
- Animation of 3D geometry from any view angle, in any format (color, lines, planes)
- Based on time "movie" or "stroboscope" analysis at fixed operating conditions: easy scroll through axes
- Saves deformation pattern at critical time for replay

Benefits

- Effective & reliable field data acquisition
- Reduced errors and faster productivity
- Visual diagnosis using 3D animation on various data formats & data segments
- Fast standard reporting, with "single button" operation
- Comprehensive reporting - easy exchange of test/analysis results between OEM departments and with suppliers

Solution Pack Content

LMS SCADAS III Hardware

- LMS SCADAS 305 SCSI - Master frame with 5 slots, 2 DAC, AC/DC power and SCSI interface
- 5 x PQA - 4 channel Programmable V/ICP® Signal Conditioner
- 5 x SP92-B - 4 channel 24-bit DSP Signal Processor Module

LMS Test.Lab Software

- Desktop
- LMS SCADAS 305 Driver
- Spectral Acquisition Workbook
- Time Recording during Spectral Acquisition
- Geometry Workbook
- Operational Deflection Shapes & Time Animation Workbook

Solution Pack Options

LMS Test.Lab Software

- Batch Reporting – Organizer
- Throughput Validation & Processing Host
- Signature Throughput Processing

LMS Test.Lab 20 Channel Operational Modal Analysis

Mobile system for identification of modal models from real-life data

LMS Test.Lab Operational Modal Analysis provides a mobile testing solution for the identification of modal parameters (resonance frequencies, damping and mode shapes), starting from user-selected segments of time data measured on a structure in operating conditions. The time histories are measured using a portable LMS SCADAS 305 front-end, supporting 20 channels for ICP® and Voltage signals and 2 tachometer inputs. Any subset of these channels can be used as reference for the operational modal analysis.

The Spectral Acquisition workbook gives feedback on the defined parameters, with maximum validation of the test setup before the actual testing starts. During the measurement, any processing function can be displayed and monitored on-line, while additional information such as rotational speed can also be checked.

The time histories for all channels are directly written to the PC hard disc, simultaneously to the on-line spectral processing, with a throughput performance independent of channel count, acquisition bandwidth and on-line processing.

The Geometry workbook allows fast generation of wireframe and full 3D visualization of test and analysis results. The Operational Modal Analysis workbook offers a powerful method for extracting modal parameters from the time measurements (time data or multi-reference cross powers) and a complete set of modal model validation tools, data re-synthesis and mode shape visualization.

Through the Strip-Chart display, the workbook offers a convenient overview on all input time histories, and allows easy selection of specific data segments for detailed analysis. With the crystal-clear stabilization diagrams from the LMS PolyMAX parameter estimation algorithm, the analysis process is significantly simplified and operator-dependency of the resulting modal model (typical for complex, highly damped structures) is eliminated.



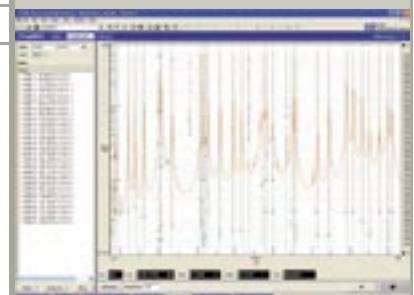
A mobile testing solution for the identification of modal parameters of a structure in operating conditions.



Starting from user-selected segments of time data, the time histories are processed into cross powers for parameter estimation.



Operational modal analysis delivers additional information on modes that are significant in operating conditions.



Through crystal clear stabilization diagrams the analysis process is significantly simplified.

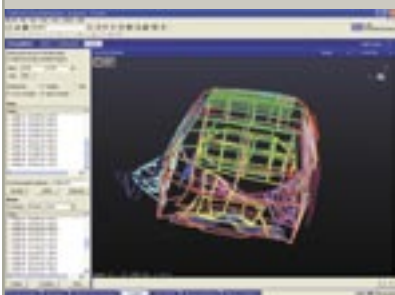
Features	Benefits
<ul style="list-style-type: none"> • Cross-spectra and time data acquisition and analysis • Embedded test setup definition • On-line spectral analysis while recording continuous time data • Parameter estimation on any user-selected data segment • LMS PolyMAX state-of-the art modal parameter estimation technology 	<ul style="list-style-type: none"> • Immediate validation of throughput measurements in Stripchart Display. • Minimal training required • 'Operational' modal parameters deliver extra information on modes that are significant in operating conditions • Deals with highly damped structures and non-linear materials • Yields user-independent results • Minimized test item reservation through on the spot analysis & validation • Easy traceability with full documentation, data management and reporting
Solution Pack Content	Solution Pack Options
<p>LMS SCADAS III Hardware</p> <ul style="list-style-type: none"> • LMS SCADAS 305 SCSI - Master frame with 5 slots, 2 DAC, AC/DC power and SCSI interface • 5 x PQA - 4 channel Programmable V/ICP® Signal Conditioner • 5 x SP92-B - 4 channel 24-bit DSP Signal Processor Module <p>LMS Test.Lab Software</p> <ul style="list-style-type: none"> • Desktop • LMS SCADAS 305 Driver • Geometry Workbook • Spectral Acquisition Workbook • Time Recording During Spectral Acquisition • Operational Modal Analysis Workbook • LMS PolyMAX 	<p>LMS Test.Lab Software</p> <ul style="list-style-type: none"> • Operational Deflection Shapes & Time Animation Workbook



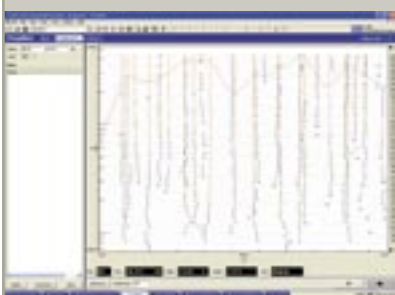
High channel count operational modal analysis allows detailed testing of large structures under operational loads.



The display offers a convenient overview on all time histories and allows easy data selection for multi reference cross power processing.



Mode shape visualization gives immediate insight in the root cause of the vibration or acoustical problem of the structure.



LMS PolyMAX allows getting operator independent modal parameters of large, complex and highly damped structures.

LMS Test.Lab 96 Channel Operational Modal Analysis

High channel count system for modal modeling from real-life data

The LMS Test.Lab Operational Modal Analysis solution identifies modal parameters, starting from user-selected segments of time data measured on a structure in operation. The 96 Channel LMS SCADAS 316 Master-Slave front-end embeds 96 IEEE-1451.4 TEDS compatible channels, supporting ICP® and Voltage signals. Any subset of these channels can be used as reference for the operational modal analysis. The hardware configuration is tuned for the testing of large objects such as bridges, buildings, airplanes, etc.

The Spectral Acquisition workbook gives feedback on the defined parameters, with validation of the test setup before the actual testing starts. During the measurement, any processing function can be displayed and monitored on-line, while additional information such as rotational speed can also be checked.

The time histories for all channels are directly written to the PC hard disc, simultaneously to the on-line spectral processing, with a throughput performance independent of channel count, acquisition bandwidth and on-line processing.

The Geometry workbook generates wireframe and full 3D visualization of test and analysis results. Through TEDS support, geometry creation is further accelerated with the position information from pre-programmed transducers.

The Operational Modal Analysis workbook extracts modal parameters from response time measurements (time data or multi-reference cross powers) and further provides a set of modal model validation tools, data synthesis and mode shape visualization. With the crystal-clear stabilization diagrams from the LMS PolyMAX parameter estimation algorithm, the analysis process is significantly simplified and operator-dependency of the resulting modal model (typical for complex, highly damped structures) is eliminated.

Features	Benefits
<ul style="list-style-type: none"> • High channel count – high performance • Cross-spectra and time data acquisition and analysis • On-line spectral analysis while recording continuous time data • Parameter estimation on any user-selected data segment • Simultaneous processing from multiple acquisition runs • LMS PolyMAX state-of-the art modal parameter estimation technology 	<ul style="list-style-type: none"> • Immediate validation of throughput measurements • Minimal training required • Deliver extra information on modes that are significant in operating conditions • Reduced test execution time & minimized test item reservation through high channel count, and on the spot analysis & validation • Deals with highly damped structures and non-linear materials • Yields user-independent results • Easy traceability with full documentation, data management and reporting

Solution Pack Content

LMS SCADAS III Hardware

- LMS SCADAS 316 - Master frame with 16 slots, AC power, SCSI interface
- LMS SCADAS 317 - Slave Frame with 17 Slots for I/O Modules, AC powered
- 1 x PDT - Programmable Dual Tacho input module for analog and TTL signals
- 24 x PQFA - 4 channel floating/V/ICP/TEDS Signal Conditioner
- 24 x SP92-B - 4 channel 24-bit DSP Signal Processor Module
- 1 x PIC 34-0 - 0.4m Parallel Interface for Master/Slave Configuration

LMS Test.Lab Software

- Desktop
- LMS SCADAS III Driver (Full-Master/Slave)
- Geometry Workbook
- Spectral Acquisition Workbook
- Time Recording During Spectral Acquisition
- LMS SCADAS III Smart transducer TEDS support
- Operational Modal Analysis Workbook
- LMS PolyMAX

Solution Pack Options

LMS Test.Lab Software Option

- Operational Deflection Shapes & Time Animation Workbook

LMS SCADAS III Hardware

- 8 x V12A - replace SP92-B and PQFA by V12A

LMS Test.Lab Structures – Options

LMS SCADAS III Hardware

QDAC - 4 channel Digital-to-analog Source Signal Output Module

Output signals with ultra-low distortion and noise are ensured by the use of 24-bit digital to analog bit stream converters, analog and digital reconstruction filters and up-sampling digital filters with noise shaping. The four channel Quad Digital to Analog Converter (QDAC) module includes firmware to support sine, random, burst sine or random, chirp and arbitrary signal generation.

- 24-bit signal generation
- 20kHz bandwidth
- $\pm 5V$ output voltage
- Short circuit protected

PQFA - 4 channel Floating/V/ICP®/TEDS Signal Conditioner

The PQFA adds a number of features to the basic PQA concept. Floating inputs eliminate the risk of ground loops, and an analog programmable high pass filter removes unwanted low frequency components. Smart transducers (TEDS) can be connected directly to the PQFA module. It helps users to drastically reduce the setup time and even more important, to avoid cabling errors, which can possibly call for a rerun of the measurement.

- Input range $\pm 100mV$ to $\pm 10V$
- Floating / single ended inputs
- 4mA ICP® supply
- 5 to 75Hz programmable high pass filter
- TEDS support IEEE1451.4

V12A - 12 channel programmable V/ICP®/TEDS conditioner

The V12 is a twelve-channel voltage and ICP® conditioning and data acquisition module that triples your conventional channel count in a SCADAS III frame. Because of its high channel density, the V12 is ideally suited for connecting triaxial accelerometers. AC, DC and ICP® coupling is supported, as well as reading out smart sensors. The V12 is a one-board solution, incorporating 24 bits ADC's with a maximum sample rate of 51.2kHz. A high performance on-board DSP allows real time embedded processing such as decimation, order tracking and 1/3rd octave filtering.

- Input range $\pm 1V$ to $\pm 10V$
- 4mA ICP® supply
- TEDS support

LMS Test.Lab Software

Run Data Averaging & Comparison Organizer

The worksheet provides a comprehensive view on all available 2D data (order sections, frequency sections, octave spectra or octave sections, ...) and is designed to compare and average results from various tests very quickly, for validation and/or processing. Selected data are immediately displayed via powerful display filling modes in user defined screen layouts. Embedded navigation supports fast scrolling across functions or measurement points. Individual measurements are included or excluded from automatic average and envelope calculations by tick-box selection. Averages and envelopes can be stored in a project database.

Batch Reporting - Organizer

Facilitates organized printing of large quantities of data according to multiple pre-defined plot formats, created in Microsoft Office applications, including Active Pictures. Absolute scale - printing to printer and electronic documents are supported.

Multi-run Modal Analysis

This add-on to the LMS Test.Lab Modal analysis workbook provides dedicated processing of modal test data that were obtained through different sets of measurements. This acquisition technique is widely used when a limited set of accelerometers is used, that needs to be relocated to measure all response point of the structure. In such case, FRF inconsistencies (e.g. frequency shifts because of mass-loading) could affect the quality of the modal parameter estimation. Multi-run Modal Analysis automatically accounts for potential data inconsistency between runs when extracting modal frequencies and damping, and during the subsequent mode shape calculation.

Operational Deflection Shapes & Time Animation Workbook

Deflection shapes of structures in operational conditions can be analyzed starting from either time or frequency domain. Deformation patterns extracted from order and frequency sections, FRF or Cross-Power measurements in stationary operating conditions, highlight behavior at specific frequencies just like a stroboscope. Additionally, the user can investigate deformation shapes starting from time recordings and animate the structural deformation scrolling through the time axis like a slow motion camera. Depending on the selected analysis function, a comprehensive view is given on all available data. The user can select a range wherein the animation will automatically scroll, with the possibility to pause and restart the animation at all times. The workbook also includes features to selectively animate at peaks of the function, looks for maxima between 2 cursors, etc. Any analyzed vibration pattern can be stored for future detail analysis or reporting purposes.

LMS SCADAS III Smart Transducer TEDS support

A smart transducer is a sensor with programmable read/write memory called TEDS (Transducer Electronic Data Sheet). Part of the TEDS memory is user definable and contains relevant transducer and measurement point characteristics such as point ID, calibration value, position coordinates and Euler angles. These characteristics are retrieved from the transducer through the LMS SCADAS III PQFA modules. The retrieved information is easily inserted in the channel list of all LMS Test.Lab acquisition applications. This automatic matching of transducers and input channels significantly reduces setup time and highly reduces the risk of wiring problems when a high number of sensors are used. Additionally, the geometric information can be read in the LMS Test.Lab Geometry workbook.

Throughput Validation & Processing Host

This worksheet offers a convenient Strip Chart Display overview of time histories, including zoom-in, immediately after completing a measurement using the parallel throughput functionality, without leaving the data acquisition workbook. It also provides "Processing Data Set" definition functionality, organizing and combining recordings from different measurements for batch processing. A "Quick Spectral Map" provides insight in spectral contents of the displayed time histories to guide the selection of appropriate processing parameters.

Signature Throughput Processing

Signature Throughput Processing offers efficient processing of multiple throughput files with a common set of processing parameters. Tracking channels (e.g. tacho) can be used to control the selection of segments of time data to be processed. It supports trial processing on a limited number of channels and includes batch processing with auto-saving of results, which can be interrupted at any time. The module also offers convenient pre-view of processing results with auto switching of the display depending on the type of results.

External File Access

This option extends the browse, search, sort and access functionality of the LMS Test.Lab Desktop to genuine SDF, UFF and Matlab file formats, making data from external applications accessible for use in LMS Test.Lab without the need for file conversion.

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