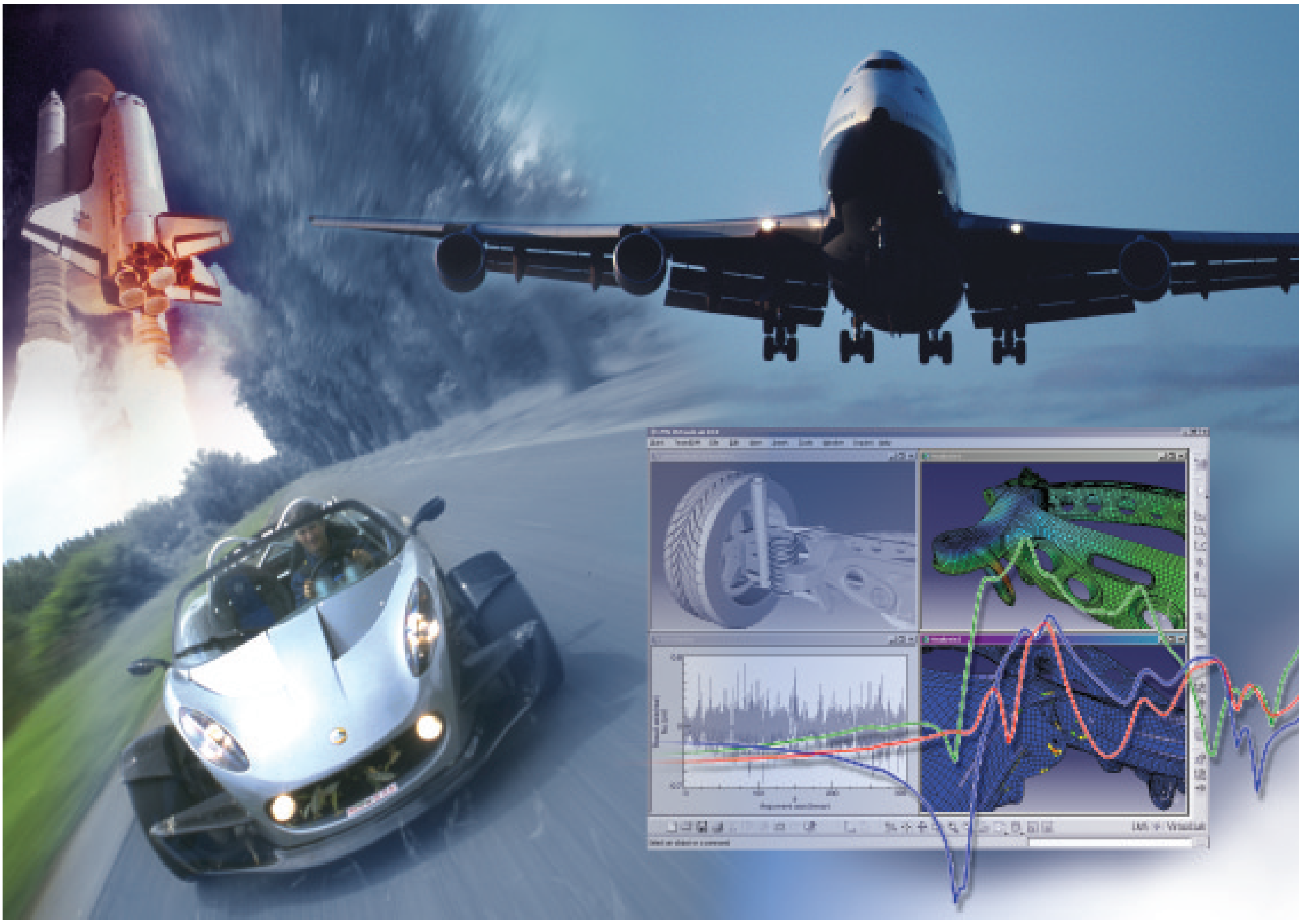
LMS Virtual.Lab ™

The Integrated Environment for Functional Performance Engineering



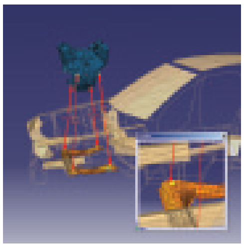
LMS Virtual.Lab™

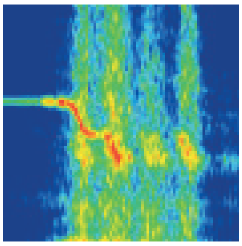
LMS INTERNATIONAL

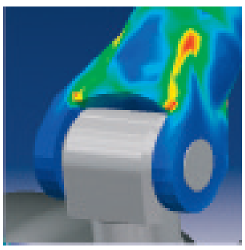
Empowering Engineering Innovation


LMS VirtualLab
LMS OPTIMUS Software
LMS SYSNOISE Software

LMS Virtual.Lab, the Integrated Environment for Functional Performance Engineering







LMS Virtual.Lab is the world's first integrated software environment for the functional performance engineering of critical design attributes such as noise and vibration, ride and handling, comfort, safety, crash, durability, and others. An open environment with seamless links to the CAD, CAE and Test worlds, Virtual.Lab provides everything the multidisciplinary engineering team needs to get better products to market faster than before. It should double the time available for value-added engineering and reduce the overall engineering process time by 30 to 50%.

Virtual.Lab enables a novel engineering approach where critical product qualities are designed-in and then refined throughout the development process. It means using upfront analysis at the concept stages; refinement and cross-disciplinary product optimization using virtual models not just at the component level but also at the system level where most performance problems occur; and in-depth testing of a reduced number of physical prototypes.

LMS Virtual.Lab implements a unique "hybrid simulation" approach. By combining the best of the physical test and virtual simulation disciplines, the new engineering process is not only faster, but is also more accurate and robust, as test-based validation is built in. The return on investment can therefore be measured not only in terms of faster time to market and reduced development cost, but also in terms of improved product quality and a reduction in the number of expensive product recalls.

Virtual.Lab automatically links to leading CAD, CAE and Test tools and, by eliminating unnecessary file transfers and data redundancies, doubles the time available for value-added engineering. Virtual.Lab captures and automates the process flow to provide a very efficient parametric analysis capability. With Virtual.Lab any design change can be rippled through the analysis sequence in minutes. Such speed breakthroughs will allow companies to take weeks off the product development process, to reduce uncertainty and minimize the reliance on physical prototypes.

The LMS Vision for a Radical Breakthrough in Functional Performance Engineering

Every manufacturer is acutely aware of the need to reduce time to market and to slash overall development costs. Yet at the same time, market forces are demanding better, more refined products - often with many variants of the same platform to suit niche applications. Engineering teams are therefore faced with more work but less time and fewer resources than ever. Clearly there is a conflict, and cutting corners in the development process has led to a surge in warranty costs and product recalls over recent years. Can this paradox be solved? What would be needed to reduce development time by at least a third - but at the same time guarantee product quality and safety?

To overcome the limitations of virtual prototyping at the system level, LMS has pioneered a hybrid simulation approach – one where test-based models and loads are combined with virtual simulation.

Functional performance engineering is a bottleneck

Most manufacturing companies have made great advances in adopting an all-digital development environment for the form and fit stages of the design process – they know what a product will look like and how it will be manufactured. However getting the design to perform as expected for functional performance attributes, such as noise and vibration, ride and handling, comfort, safety and durability, is still a major process bottleneck. Engineering such critical performance attributes forms a very important part of the development process - and it's not an easy task. Despite the massive investment in virtual prototyping technologies, most design problems at the system level are only discovered late in the development cycle.

Why has CAE not yet delivered on its promise?

In the past, virtual prototyping technologies simply did not deliver the right answers in time to impact the ongoing design process. Very often, CAE has been used for design verification and has run almost outside the process - not as a proactive design optimization tool. Raw processing speed has not been the real bottleneck. The fundamental problem lies with the lack of accurate system-level prediction technologies and with the sheer number of different software tools that are in use at many companies today. A lot of time is lost in non value-added engineering effort – dealing with many barely compatible software tools for just one attribute at a time, transferring data from one environment to another, rebuilding models, remeshing,….. Clearly something has to change! Integration and technology breakthrough is the only solution.

From component-level to system-level engineering

Early users of virtual prototyping systems have realized that while the prediction of responses at the component level gives good results, the prediction of performance at the full-assembly level – where most problems occur - is quite complicated. Extensive prediction models do not necessarily produce results that match with reality. Functional performance attributes are invariably functions of the final system. And it's very hard to model. Time and time again experience shows that just using ever larger models is not the answer. A new approach to system-level modeling is vital.

Often 80% of a 'new' design is actually just the modification of an existing platform. So, if digital models can combine validated data from existing components with simulated data of new components, the engineering cycle can be reduced by reusing a lot of information and quickly executing a parametric exercise rather than by starting again from scratch each time. The key to this is to be able to combine the test and simulation worlds into a "hybrid simulation" world that gets the best out of both.

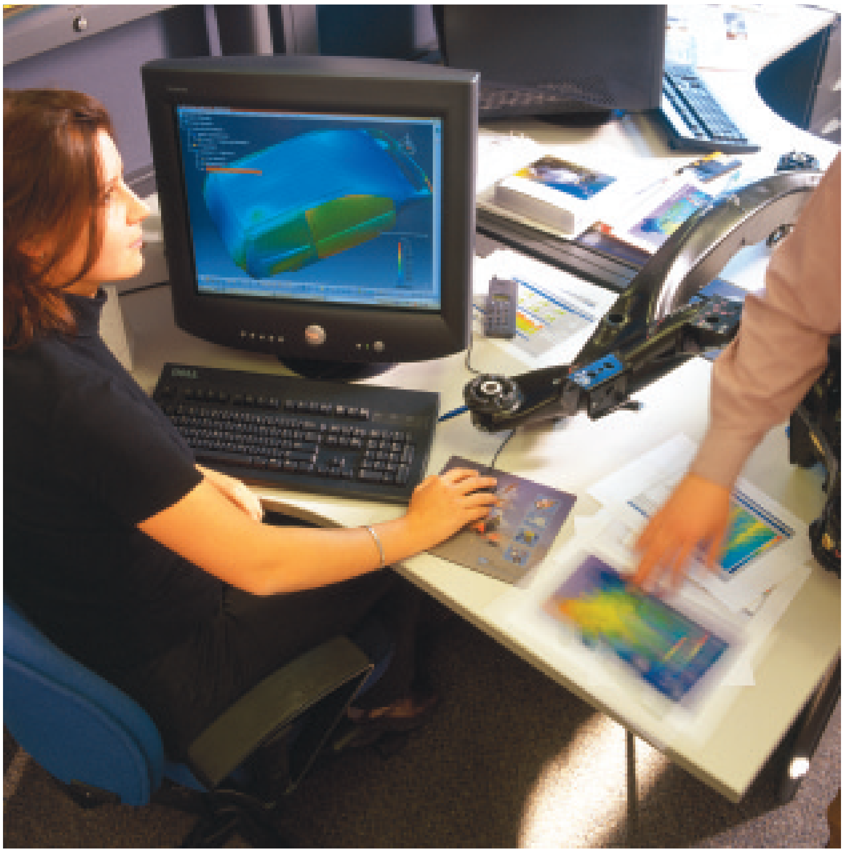
A focus on the application, rather than the technology

Today a lot of the current CAE tools, such as Finite Element Analysis, or Multibody Simulation are generic enabling technologies – they do not take into account specific attribute or subsystem engineering issues. What is needed is a vertically integrated solution, one where the essential solver technologies run in the background and act in support of tools that are used to explore, refine and optimize the design space for a specific performance attribute. Only then can the stage be set for the ultimate goal, a unified solution that enables the engineering team to trade off between multiple and often conflicting attributes such as safety, crash, noise and vibration, and durability.

Towards a function-driven engineering process

Forward-thinking manufacturers are talking of radical process breakthroughs and development cycles in terms of months rather than years. They want their people to move to a knowledge-driven collaborative working environment. They want their digital development pipeline to encompass more than the form and fit stages of the design process – they also want product performance and certification to be "right-first-time". LMS Virtual.Lab supports their vision. It fulfils all of the above requirements, it is proven, and it is going to change how engineering will be done in the future.

Being able to quickly and reliably explore functional performance before committing to prototype building is the missing link that is needed to turn the digital enterprise vision into a real competitive advantage.



LMS Virtual.Lab: Integrating Mission Critical Applications

Virtual.Lab eliminates much of the non-value added time from the typical engineering process. It will remove the barriers between CAD, CAE and Test; re use models rather than rebuilding them for each application; remove the barriers between different CAE tools; eliminate unnecessary data transfers and translations; and enable collaborative engineering across the extended enterprise.

Integration with your preferred structural analysis solvers

Virtual.Lab seamlessly imports models and analysis results from the leading FE codes, such as MSC.Nastran, ANSYS, ABAQUS, I-DEAS and CATIA Structural Analysis. Fully analysis associative, any changes to the CAE model will be automatically flagged to downstream users. Models and data from these packages can then be visualized and manipulated in the one environment - you can compare your MSC.Nastran models with a reduced model being used by a supplier, for example. The various solver codes are integrated into the analysis sequence and run in the background; Virtual.Lab takes care of all the data management and file conversions. At a stroke, one of the biggest bottlenecks in the entire process is eliminated!

Virtual.Lab is open to complementary third parties wanting to integrate their solvers, and users will be able to link to their own codes as well. It is truly an open Engineering Desktop.

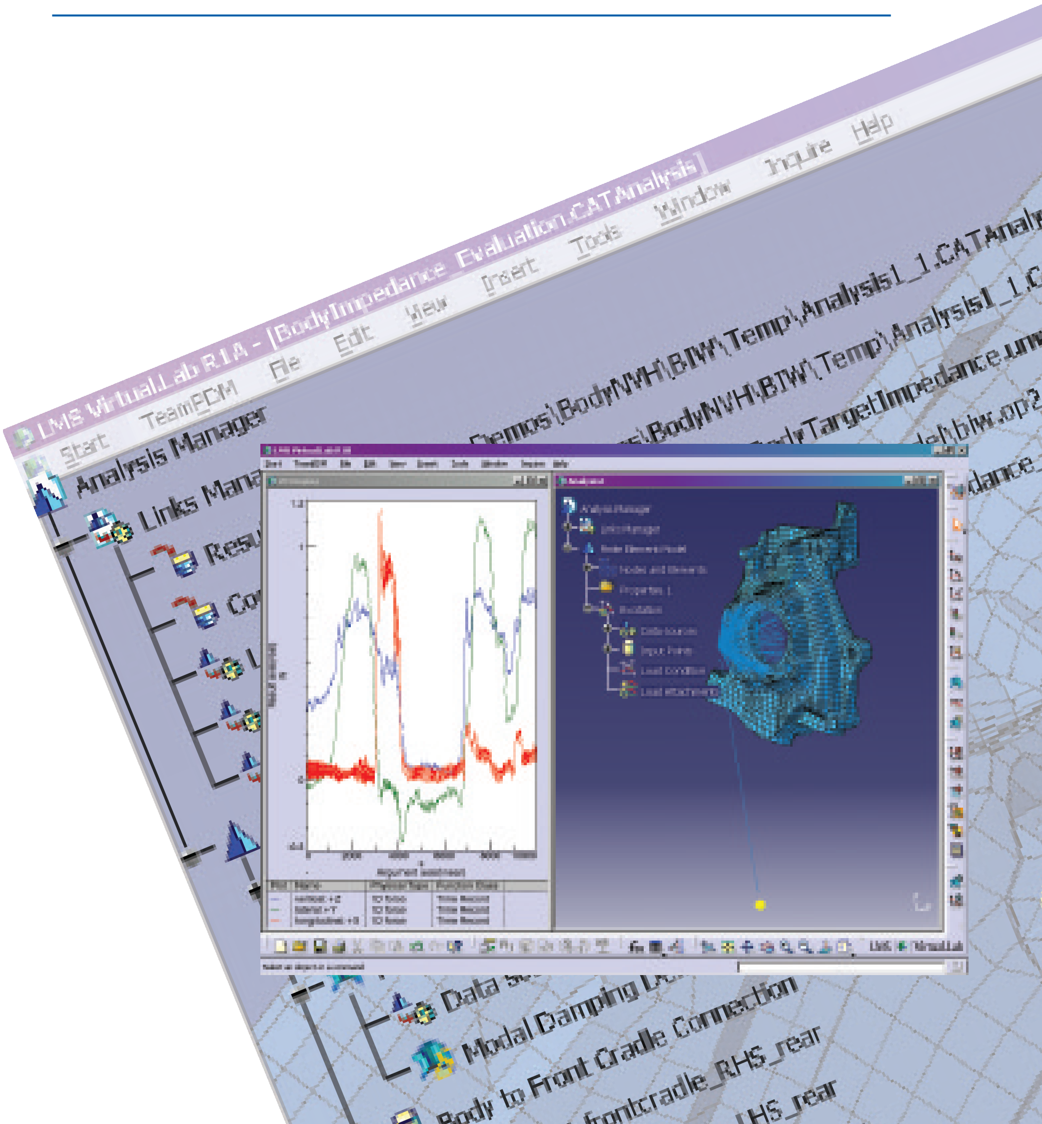
Integration of CAE and Test

As you would expect from LMS, Virtual.Lab links into the Test world and provides everything you need to visualize and interpret test data - from graphs, through colormaps and waterfalls, to response animations. You can apply measured loads to simulation models for more realistic analyses, and even incorporate test-based models into hybrid simulations that make system level prediction possible.

Integration with design

Virtual.Lab maintains seamless links with the geometry from any of the leading CAD systems such as CATIA, I-DEAS, ProEngineer and Unigraphics . Again, everything is fully design associative, which is essential for geometry-driven simulations, such as multibody analyses.

By capturing and organizing the analysis process, Virtual.Lab can be used to drive subsequent analysis sessions.



Introducing Parametric Analysis and Multi-Attribute Optimization

Capturing simulation processes

Not everyone is an expert - and no one enjoys dull repetitive tasks. Virtual.Lab can capture your simulation process. It can automatically remember the particular engineering tools and workflow used in a task and make them all available again the next time. Processes can be standardized, shared with others, and executed again with the minimum of fuss.

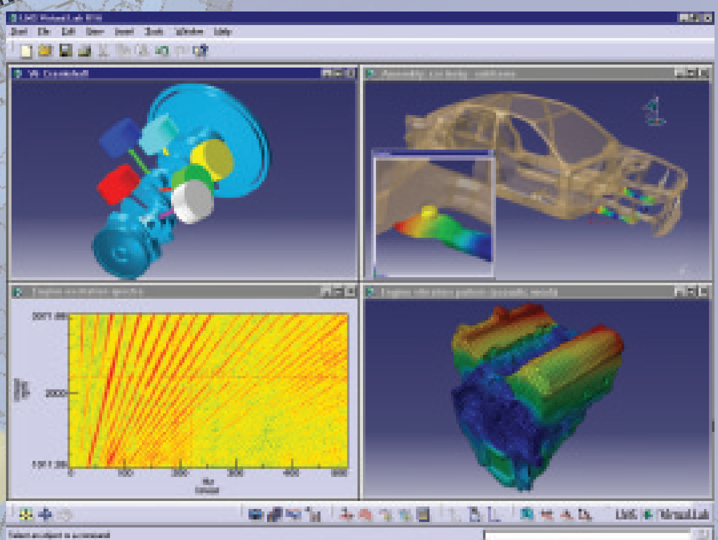
Enabling exploration of the full design space

Should a change in any parameter be flagged, such as a spring stiffness in a suspension unit, the engineer can set up a new run in seconds that will automatically ripple through the analysis sequence – the multibody simulations and MSC.Nastran batch jobs will be launched, the new operating forces calculated and the resulting change in fatigue-life predicted.

For years engineers have used their CAE tools to predict the performance at a single point in the design space. By capturing and organizing the engineering process, Virtual.Lab can be used to drive subsequent analysis sessions. The linked models and data sets may be changed and an analysis rerun automatically, giving a tremendous gain in efficiency, and making design space exploration possible.

Balancing attributes and achieving overall targets

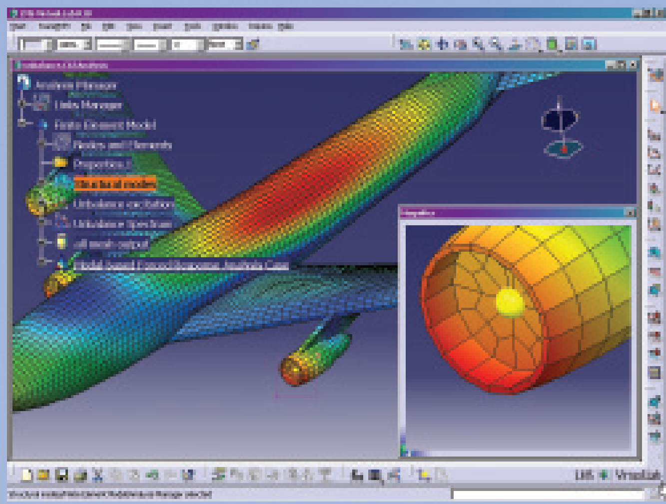
Being able to explore the design space for a given attribute already provides critical insights into the dynamics of an engineering problem. But Virtual.Lab can do more. It can intelligently find the optimum point in the design space, giving a leap forward in productivity. By a close integration of mission-critical applications, engineers will also be able to trade off multiple and possibly conflicting attributes to balance the overall design.



LMS Virtual.Lab: Delivering the Engineering Breakthrough

Pioneering process-centric engineering

With Virtual.Lab you gain more than a black box solver. You are investing in an environment for functional performance engineering that has been shaped by over twenty years of LMS know-how and practical experience. Computer-Aided Engineering is taken to a higher level: the various specialist solvers can be combined and sequenced to complete a specific attribute task – e.g. flexible body analysis, multibody simulation and fatigue-life prediction to perform a complete durability evaluation of a suspension unit. Virtual.Lab doesn't just visualize an analysis result – it provides the data interpretation tools that give you an insight into what is really happening. So you're able to identify the phenomena that caused it. You're able to calibrate, improve, and certify analytical models and the underlying design assumptions. You can cascade system targets down to the component level, make well-informed concept-level decisions, examine more candidate designs, and avoid the flawed concept altogether.



Virtual.Lab accurately predicts vibration levels on the aircraft for given excitation from the engines.

Combining components into system-level models

Virtual.Lab provides a range of interactive system assembly tools to help you quickly combine components into system-level models - because that's where most problems occur. Analysis connections can be defined between components and subsystems, based on the corresponding geometry or analysis model.

Using the defined analysis connections, Virtual.Lab manages the system assembly, including assembly constraints. The connections can be specified to have a technological representation that is appropriate for the assembly purpose - be it noise and vibration, durability, ride and handling or crash.

Component models can be any combination of FE and Test. For example, an FE suspension model can be combined with test-derived body-noise FRFs measured on a trimmed body to build a vehicle road noise model. The unique system synthesis tools will then predict the overall performance of the combination.

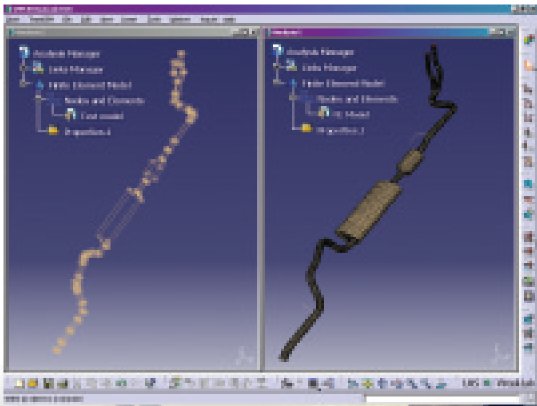
Integrating best of class attribute engineering

Virtual.Lab integrates the advanced technologies from the current generation of LMS products – LMS SYSNOISE, the de facto market leader for acoustic prediction; LMS Gateway for noise and vibration refinement; LMS FALANCS the first fatigue package to allow for multiaxial durability analysis; and LMS DADS, the multibody simulation code that introduced flexible body analysis into a previously rigid world. In many cases it adds breakthrough technologies, such as acoustic meshing and patented ATV-based acoustic predictions - all of which will help engineers perform their tasks more effectively and much more quickly.

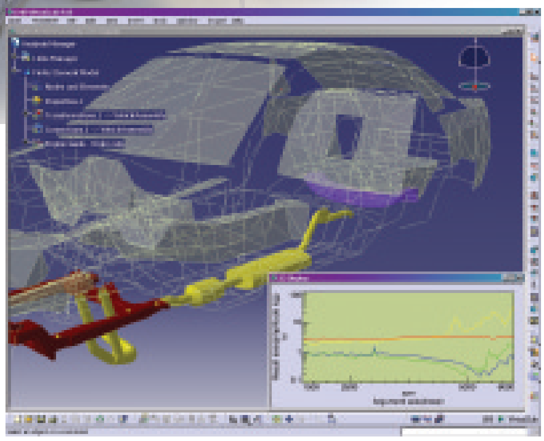
Adding the real world through hybrid simulation

Experience shows that modeling assumptions such as system linearity, model complexity, subassembly interaction or the actual loading environment become critical factors as systems are assembled. And it is unlikely that virtual system-level models will bear much resemblance to reality the first time around - no matter how large the model. To overcome this problem, Virtual.Lab enables a hybrid simulation approach – one where test-based component models and loads are combined with virtual component simulations and synthesized loads to build up more accurate system models.

Test data from early workhorses and existing components will be used initially to provide rough and ready models for concept evaluation. As simulation data for each of the components becomes available, the early system models can be refined and used for target cascading and deeper analysis. Finally, the feedback from the first physical prototype tests is used to calibrate early assumptions, to provide updated models, and make a strong foundation for design optimization. It is a pragmatic and very effective approach, and therefore represents the key to successful system level modeling. In one customer trial, an engineer took less than a day to choose which of three alternator brackets would provide the best isolation for a proposed engine design.



The hybrid simulation capabilities of Virtual.Lab make use of the most reliable model and load data at any time throughout the process.



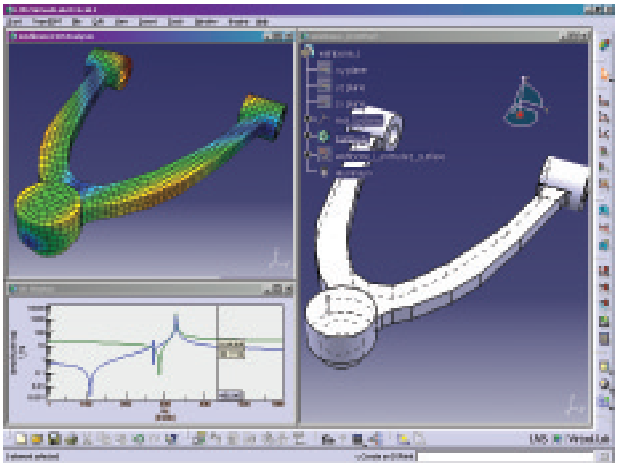
The LMS Virtual.Lab Engineering Desktop

A common workplace for engineers across the enterprise

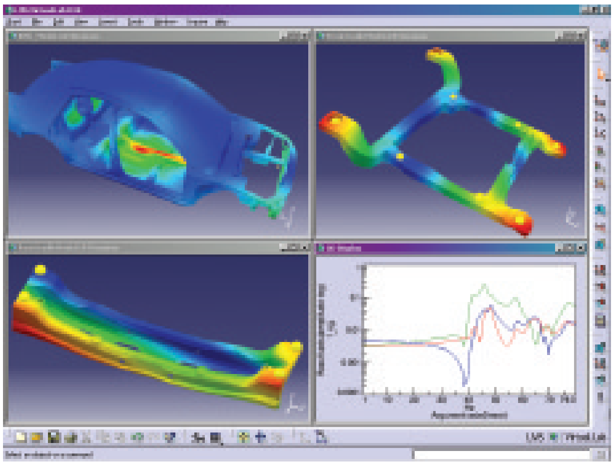
The central point of interaction with LMS Virtual.Lab is the Engineering Desktop. It unifies the graphics, user interface and data structures for the various applications - and therefore flattens training curves and enables better cross-disciplinary teaming.

Through the Engineering Desktop, the user has seamless access to models and data of leading CAD and CAE codes, and to test data - avoiding any unnecessary data translation between applications that are used throughout the digital enterprise. Consistency with the data is maintained during the analysis process through the concept of active links to data sources - at the same time avoiding any unnecessary replication of huge amounts of data.

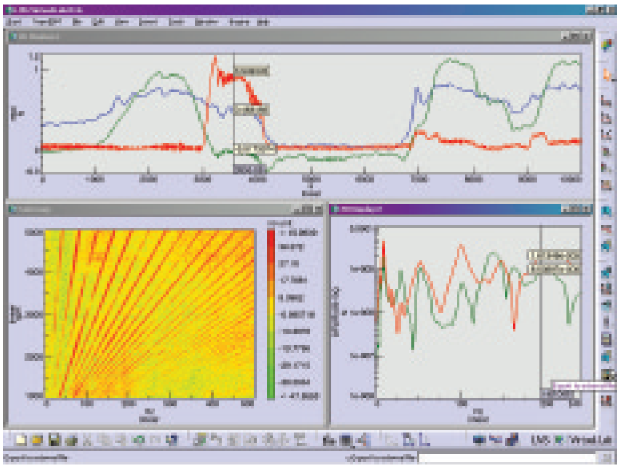
LMS Virtual.Lab then provides a complete visualization environment for part and assembly geometry, functional performance engineering data, time and frequency functions, and much more. Built to be completely open, LMS Virtual.Lab can even host and extend the capabilities of complementary third-party software products.



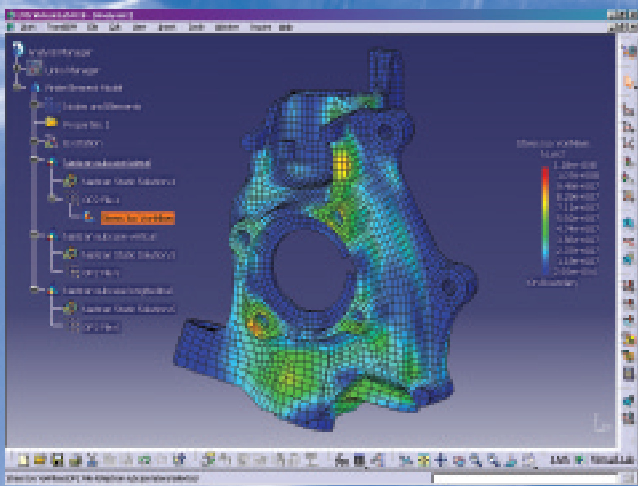
The Virtual.Lab Desktop provides seamless access to all models and related results throughout the entire analysis chain. A single display window can vizualize CAD geometry, finite element meshes, mechanical loads and vibration response data.



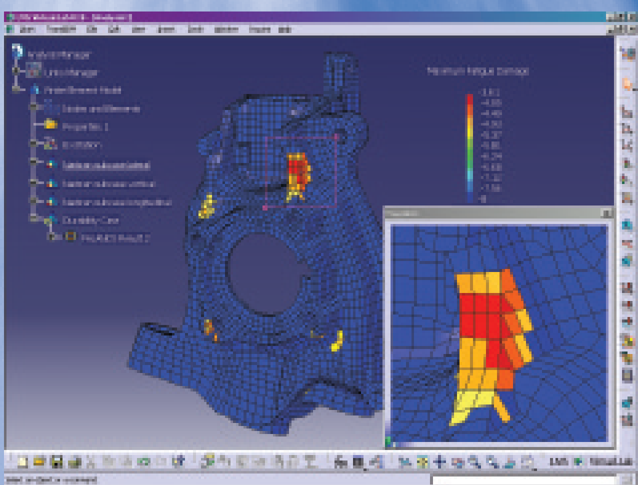
Thanks to multi-document capabilities, you are not limited to accessing data on a single model. Now you can visualize the vibration modes of each of the subsystems that make up a full-system model - or compare the vibration response for subsequent design.



The Virtual.Lab Desktop provides a wide range of function displays for the visualization of time and frequency dependent loads and response data. The Desktop also delivers a number of attribute-specific displays, such as waterfall display to visualize acoustic power as function of engine speed.



Virtual.Lab offers post-processing capabilities for stress results from a MSC.Nastran static analysis case. The Virtual.Lab specification tree offers extremely easy navigation through all the various load cases, and allows you to define how you want to see the data.



With the magnifier window you can zoom in on a particular part of the model for a more detailed scrutiny of the analysis results. With a minimum number of mouse clicks, you can exactly fit your visualization needs.

LMS Virtual.Lab Noise and Vibration: Introducing the World's First System-Level Solution

While it is relatively easy to predict performance at the component level, most noise and vibration problems are only discovered at the full system level. But experience shows that making extensive prediction models is a tedious and difficult process, which does not necessarily produce results that match with reality. How can system-level models be assembled quickly, reliably, and in time to benefit the ongoing development process? How can you use your MSC.Nastran results to predict Noise and Vibration performance?
Virtual.Lab Noise and Vibration embeds proven technologies first deployed in LMS CADA-X, LMS Gateway and LMS SYSNOISE - and builds in breakthrough techniques to create the world's first solution for modeling and refinement at the system level. It's proven, its performance stuns the most experienced experts, and it's available today!

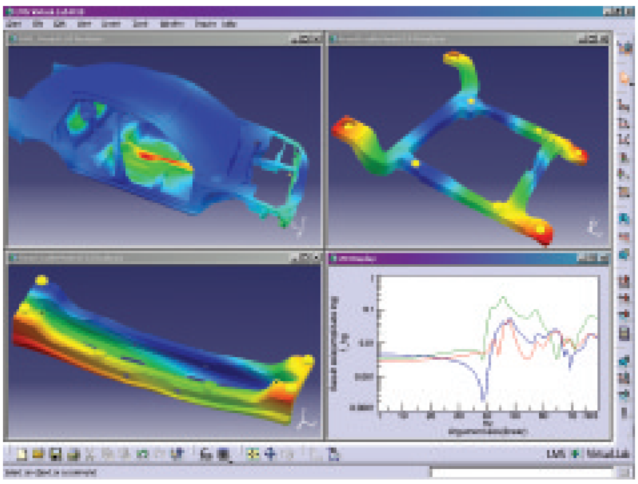
Accurate response prediction

With Virtual.Lab it's possible to accurately predict the noise and vibration response of a structure to a given load. You interactively assign loads to a model, launch the most appropriate response solver, and finally review the simulation results using dedicated post-processing tools. Virtual.Lab provides unified access to test-based loads and test-derived models enabling noise and vibration predictions to be based on real world data. The CAE-Test integration in Virtual.Lab is a key enabler for collaboration between test and simulation for functional performance engineering - combining the accuracy of test-derived loads and models with the speed of simulation.

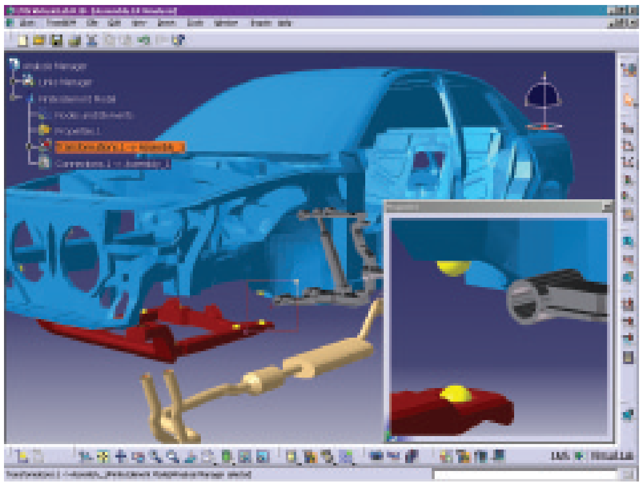
A breakthrough in system-level modeling

Virtual.Lab provides a range of interactive tools to assemble components into system-level models, to define connections, and automatically align meshes. Component models can be any combination of FE and Test. For example, an FE suspension model can be combined with test-based noise FRFs measured on a trimmed body to build a global road noise model. There is a choice of synthesis strategies - from standard FE-FE and modal approaches, through FRF-based substructuring, to an advanced Component Mode Synthesis, such as Craig-Bampton.

At one automaker, LMS Virtual.Lab took less than an hour to determine the best engine mount to optimize the interior sound.



Within LMS Virtual.Lab, you set up modal analysis cases for each individual component and launch your preferred FE solver to calculate the modes. You interactively select excitation, response or connection points, and Virtual.Lab evaluates the structural and acoustical transfer functions.

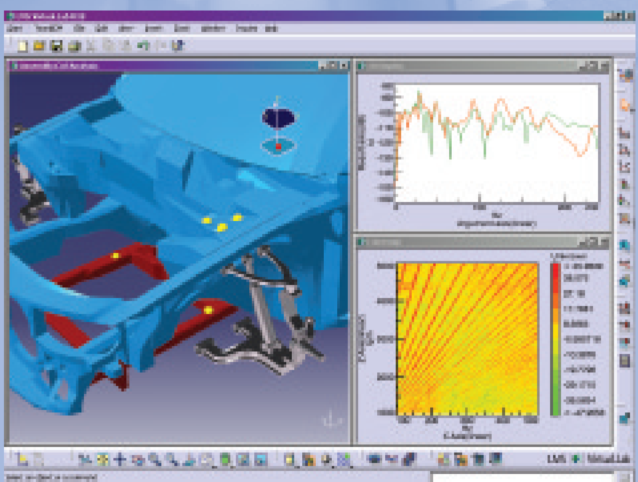


After the selection of coupling points, Virtual.Lab automatically aligns the meshes and calculates the dynamic behavior of the assembled system based on the dynamics of the individual components.

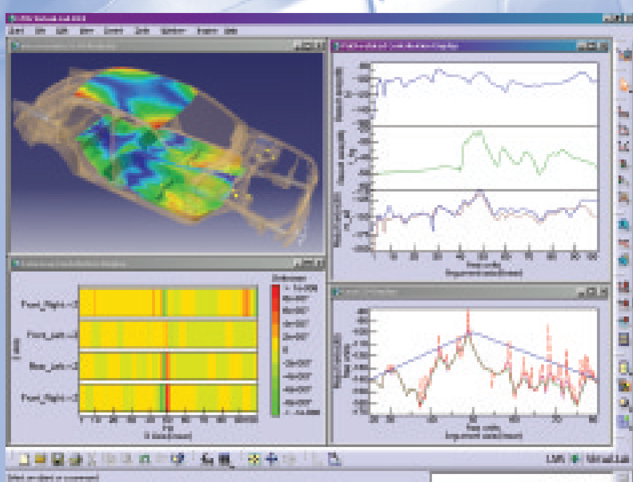
Noise and vibration refinement

Starting from the system level results you can analyze the critical path contributions to identify structure-borne and air-borne problems - such as a critical subframe mode, an engine mount which is too stiff, or annoying air intake noise. You'll be able to identify the number of contributing sources and their rank, at a given frequency, order, or rpm, and then vary the model parameters to explore the design space and eliminate the problem.

LMS Virtual.Lab allows you to assemble system models of complex structures - such as cars, aircraft, machine tools or white goods – to support a full spectrum of noise and vibration predictions.



In the next step, you define the excitation points (for example engine or suspension attachment points) and apply real-life test loads. Virtual.Lab automatically takes into account multiple load case conditions such as engine run-up spectra or engine orders.



Only Virtual.Lab delivers post-processing and refinement capabilities at the full-system level. Not only can you display and animate color maps of vibrations, but you can also carry out path contribution analysis, automatically perform subsequent analysis cases and compare actual vibration levels to target values.

LMS Virtual.Lab Acoustics: Make Sound Engineering Decisions Faster

Only a couple of years ago, predicting the sound field of even the simplest product used to take weeks, while something like an engine run-up took months. Parametric analysis and design refinement was simply not feasible given the cost and time constraints. Imagine that acoustic meshing could be performed in a couple of hours, that an engine run-up could be predicted within a day, and that any design change could be remodeled in minutes. With the breakthroughs embedded in Virtual.Lab Acoustics it has become reality.

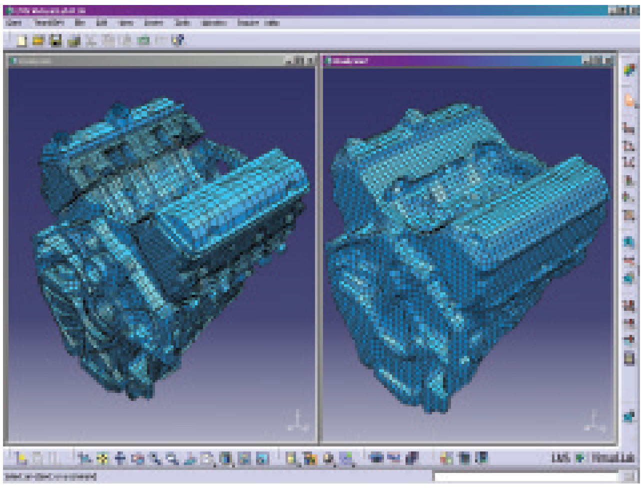
The speed of Virtual.Lab means that acoustic simulation can become part of the mainstream engineering process.

A breakthrough in acoustic meshing

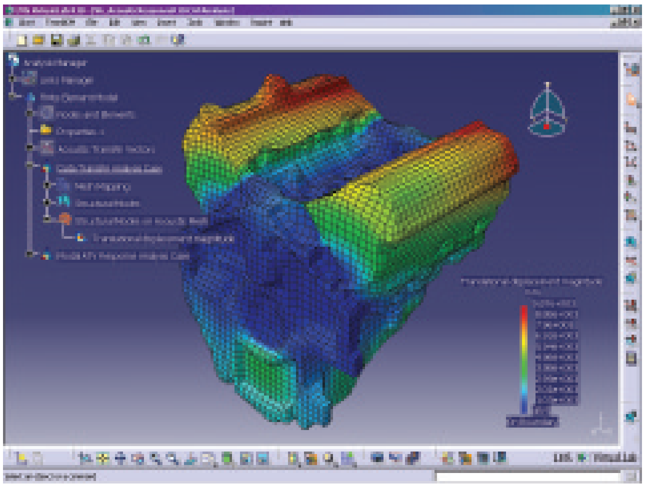
Virtual.Lab has dramatically accelerated both the cavity and exterior acoustic meshing process. For exterior meshes, the unique approach can be likened to wrapping the structure with a rubber sheet: the element size of this rubber mesh being related to the frequency range of interest. Small surface features are therefore smoothed, but those features that determine the acoustic response remain. In tests, a powertrain finite element mesh with over 150,000 elements was reduced to an acoustic mesh of 5,000 elements in just a couple of hours. Previously, it would take a couple of weeks and a lot of interactive work to create an acoustic mesh.

Patented technology speeds up acoustic prediction

Finite element structural analyses generate a lot of results, especially if there are multiple load cases - as occurs with an engine run-up. Acoustic radiation calculations from these vibrations are also complex and time-consuming, even impractical, using conventional boundary element procedures. With Virtual.Lab, the combination of patented Acoustic Transfer Vectors (ATV) and the ATV Response solution means that a complete RPM map of acoustic results can be produced in less than a day for the first run. Subsequent runs, for other loads or design iterations, literally take minutes.



Virtual.Lab easily transforms a structural mesh (left side) into an acoustic mesh (right side). Holes are filled, ribs are removed and a new frequency dependent mesh is wrapped around the structure.

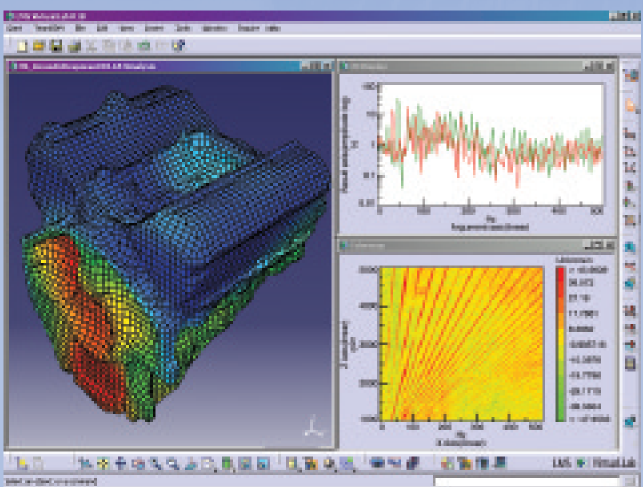


You can use your preferred FE solver to calculate the engine modes, such as the 5th engine mode shown here. In Virtual.Lab, modes are mapped onto the acoustic mesh to serve as vibration input for the acoustics calculations.

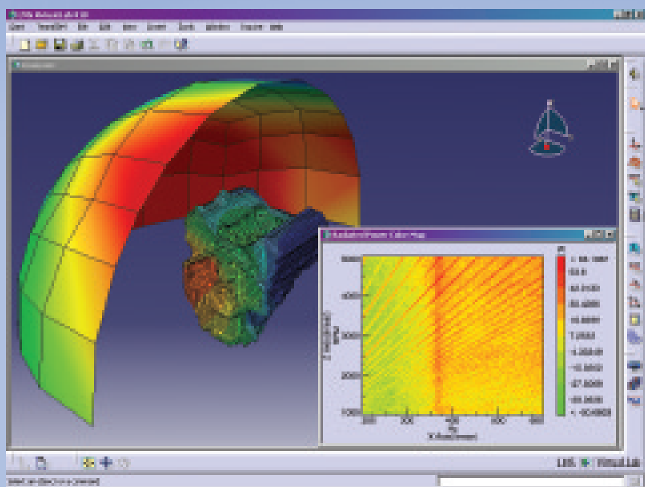
Acoustic pre-/post-processing

As well as acoustic meshing, Virtual.Lab also models the acoustic domain. Special field-point meshes can be created, for the computation of acoustic power. For post-processing, Virtual.Lab ATV Response provides many different graphical and data-extraction tools: color maps of ATVs, pressure in the field, and 2D and 3D representations of pressures and power. Results are related to the complete array of excitation data, and frequency- (or resonance-) related effects can be mapped to a speed reference.

At one automaker, Virtual.Lab took 15 minutes to generate an acoustic mesh of an engine - it previously took weeks.



Test-based excitation data, such as order or multi-rpm frequency spectra, are applied to the engine using the Virtual.Lab Forced Response module. Results showing the vibration of the engine in operation are plotted on the acoustic mesh.



The total radiated acoustic power from the engine is plotted on easy-to-interpret colormaps, taking into account multi-rpm engine load conditions. Pressure plots for critical engine speeds or frequencies are projected onto a hemisphere around the engine.

LMS Virtual.Lab Motion: Redefining Mechanical Simulation

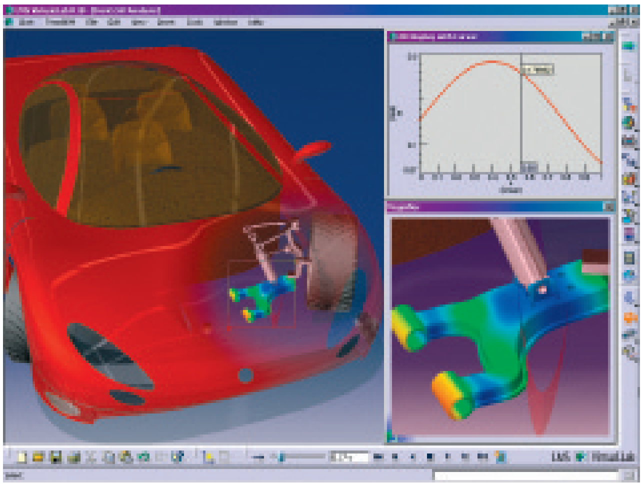
How can you guarantee that the mechanical performance of your design will match expectations before signing off to a physical test? Can you be sure that the numerous components interact and move as planned under the influence of real-life conditions such as gravity, gyroscopic, and non-linear frictional forces? It's not easy, and the kinematic simulation options of today's CAD packages usually avoid such issues. But as designs become optimized or operate at the limits of performance the accuracy of the modeling process becomes critical. This is especially true when the model results are used for downstream analyses such as durability, ride and handling, vibration comfort and acoustics... LMS Virtual.Lab Motion is a multibody simulation package that will help you to assemble and analyze the real-world behavior of dynamic mechanical systems.

A breakthrough in model creation

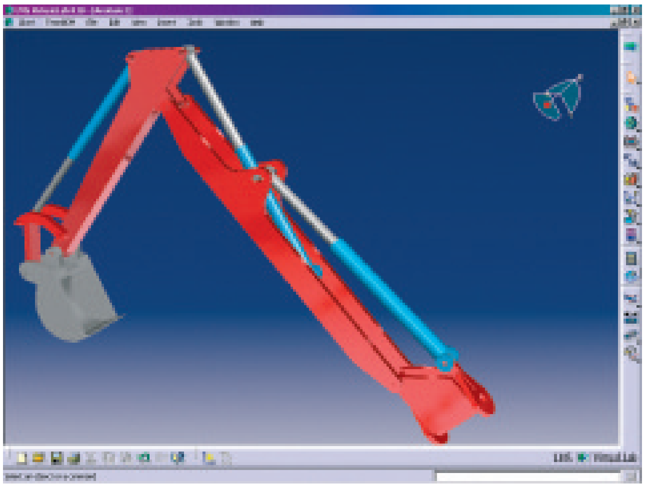
Virtual.Lab Motion is easy to set up. With its powerful solid modeling geometry capability, comprehensive library of elements and user-defined templates, it couldn't be easier for novices or experts to use! You can even parameterize the geometry as the model is built, or after the design is completed. Of course, tight integration with leading CAD systems means that you will probably just use the CAD model directly – and simply carry over all the material properties, knowledge rules, and the definition and handling of subassemblies. The physics of the joints, controls, and so on will be calculated from templates of a wide range of predefined class types – you can even define your own. At a stroke you eliminate redundant modeling, maintain model data integrity and save a tremendous amount of time!

Best solver technology

Virtual.Lab embeds the advanced technology first deployed in LMS DADS. It can effortlessly handle the simple tasks, and is ideal for the high fidelity modeling of mission-critical systems, for handling components that flex and vibrate, for systems involving large accelerations and high frequencies, for deriving loads input to be used in other analyses. The finite element solver codes run transparently in the background when needed – now you can introduce flexible body analysis into a previously rigid world and obtain much more realistic insight into what is really happening.



Virtual.Lab's flexible body analysis calculates the critical bending of each component, such as the arm in a front suspension unit as shown above. During an animation of the unit's movement, graphs are synchronized with the geometry display, giving you even more insight into the dynamics of a given maneuver.



Virtual.Lab Motion couples the mechanics of this backhoe with software that allows you to control its dynamic behavior.

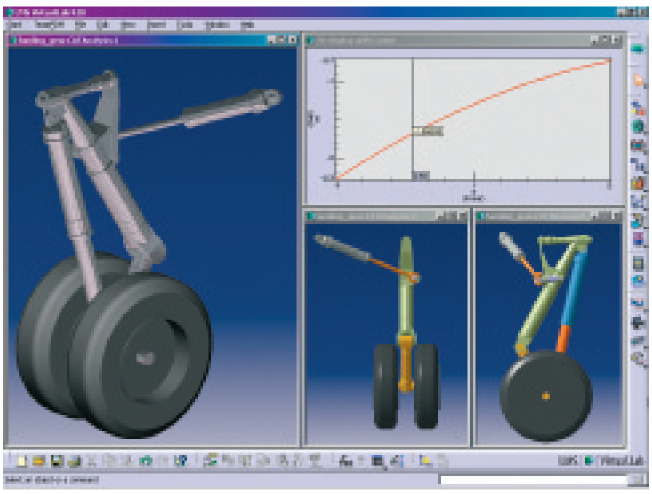
Industry specific solutions

Virtual.Lab combines different technologies into an attribute-oriented environment for functional performance engineering. Within Virtual.Lab Motion, we take a next step in terms of grouping key technologies into solutions that address specific motion problems, such as engine, suspension systems, or aircraft landing gear. Each vertical solution incorporates sub-assembly and systems knowledge, and will help the engineer to focus on solving performance problems.

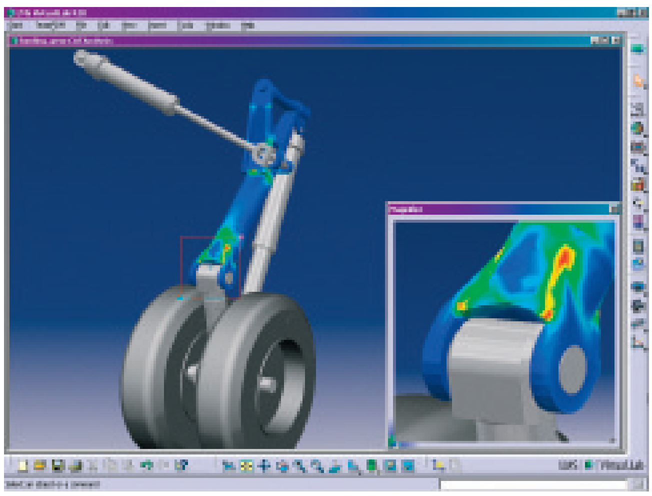
For example, the Engine Solution accurately models the non-linearities caused by deformation of flexible parts that simultaneously undergo high frequency excitation and large displacements, the clashing of spring coils and other intermittent contacts, and provides specialized tools to analyze hydrodynamic bearings, helical springs, cam timing mechanisms, combustion and flexible crankshafts… The Suspension module comprises a full range of post-processing tools for ride and handling analysis.

Seamless downstream analyses

The dynamic predictions of reaction loads that come into play are immediately and seamlessly available to any downstream analyses that require their input, such as a fatigue-life prediction. In the Virtual Test Track, the dynamic forces acting on a suspension arm can be accurately predicted only from knowledge of the suspension geometry and its properties, the road profile, and the virtual maneuvers of the car. An advanced tire model is used to predict the axle forces, flexible body analyses take into consideration the inevitable bending of each component, and the modeling output is a prediction of loads acting at any point in the suspension assembly.



You can animate the motion of landing gear after takeoff or before landing using multiple 3D views and graphs; all views are synchronized during animation, and each one of them gives you additional insight into what is really happening.



Virtual.Lab applies real world excitation data to the full assembly to reveal the critical fatigue hot spots in each component. You can define analyses and displays related to any event, such as landing or taxiing on the runway.

LMS Virtual.Lab Durability: A Dramatic Productivity Breakthrough

The drive to reduce product weight and produce many variants of the same platform means that the traditional test-based durability processes are stretched to the limit. Wouldn't it be better to evaluate durability performance on a virtual prototype - before signing it off with a physical test? You'd save time, money and get better information upfront. But how can you detect a flaw when finite element analysis gives no information at all on fatigue-life performance? And how can you account for real-life situations – not just simple components subject to a uniaxial load - but for large flexible welded bodies or complex subassemblies subject to hundreds of loads from all directions? LMS Virtual.Lab Durability will help you to predict fatigue-life performance in time to positively affect the design process.

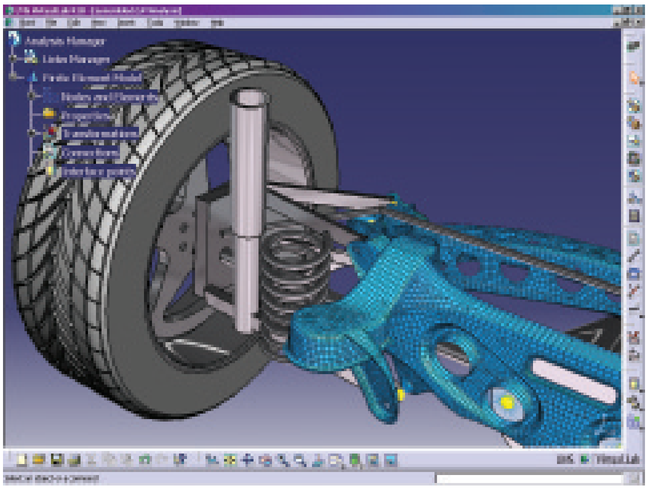
Deep integration

Virtual.Lab's deep and seamless integration with Test, CAD and CAE solvers literally cuts weeks out of the durability engineering process. The models and results from one process are immediately and transparently available to the next – saving time, tedium and eliminating errors. And the complete analysis can be automatically rerun should a parameter be changed. In customer trials, a design modification that previously would have required 28 days of rework to estimate the impact on fatigue-life was completed in less than two days!

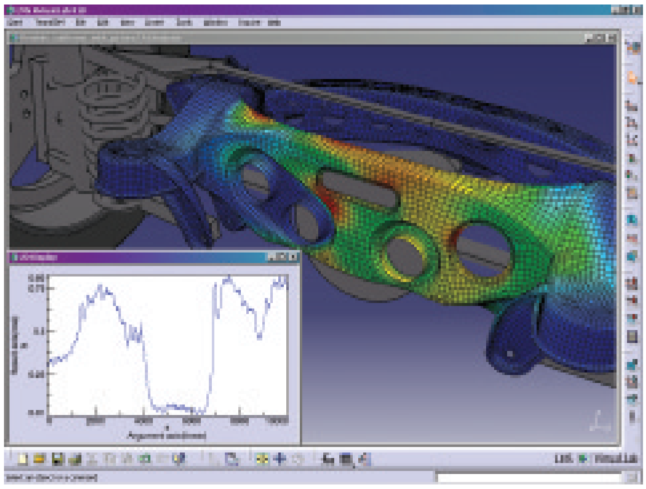
Performance where it counts

Non-experts will like the way that its built-in workflow and custom templates speed up the setup and let them see what's happening at every stage. Experts will appreciate its state of the art algorithms and its ability to handle the most complex situations – such as welded components, flexible components, and components acting as part of a larger assembly. Everyone will like the way that upfront durability design becomes not only possible but practical as well.

LMS Virtual.Lab's deep and seamless integration with Test, CAD and CAE solvers literally cuts weeks out of the durability engineering process.



You can create sub-assemblies such as these rear suspension units easily and without error. Virtual Lab's coupling functionality automates the work of incorporating flexible bodies into multibody models, virtually eliminating the need for user interaction.

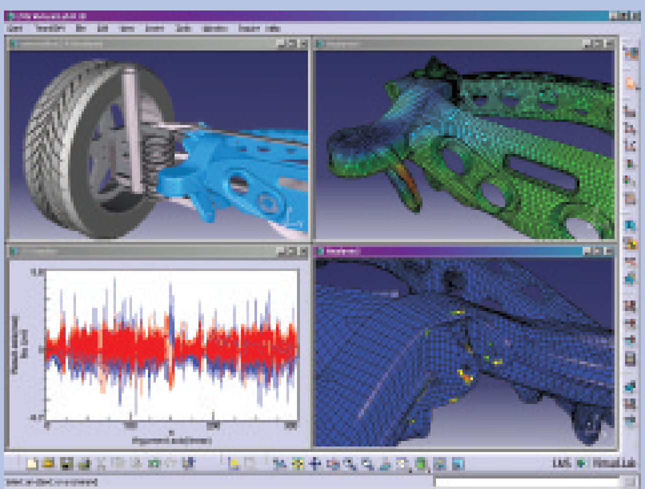


When you apply specific road profiles, such as excitation on the wheels, Virtual.Lab Motion calculates the response of each component in the subassembly. To be more exact, it calculates the deformation shape of the flexible subframe at each point in time.

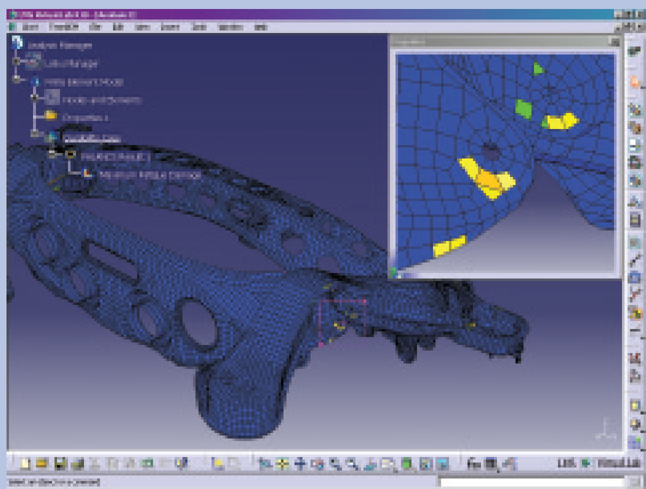
In customer trials, a design modification that previously would have required 28 days of rework to estimate the impact on fatigue-life was completed in less than two days.

The Virtual Test Track and Virtual Test Rig

Virtual.Lab integrates finite element and multibody analyses with durability predictions to provide the most advanced system-level solution. The screenshots show the suspension unit of a car being exercised on the Virtual Test Track in order to predict the fatigue-life of a subframe. An advanced tire model is used to predict the spindle forces; then a dynamic analysis in Virtual.Lab Motion predicts the dynamic forces acting on the subframe using knowledge of the suspension geometry and its properties, the road profile, and the virtual maneuvers of the car. Flexible body analyses take into consideration the bending of each component; and the output is a prediction of time history of loads acting at any point in the assembly, from which the hot spots and fatigue-life are quickly calculated. Being able to run this entire process in one integrated environment is the breakthrough that durability engineers have been waiting for!



Virtual.Lab Motion data are used as input for fatigue lifetime prediction - the subframe's modal participation factors for deformation and stresses are displayed in function of time.



While post-processing the durability results, such as fatigue damage or hot spots, Virtual.Lab automatically locates major fatigue damage areas. The magnifier function allows analysis of these hot spots in more detail.

LMS Virtual.Lab: Functional Virtual Prototyping for a Broad Range of Applications

Ground vehicles

Virtual.Lab enables accurate virtual prototyping - from the level of individual components up to the level of the full vehicle. Should you make sure that a new passenger car has a superb interior acoustic quality? Or is it rather the handling of that new sports car that you need to refine in a virtual way? And what about the impact of a rough terrain on off-highway vehicles in typical or extreme operations? You will need accurate predictions of ground engagement forces to perform reliable analyses for off-road equipment. As an environment that integrates the enabling technologies that are currently being used in the virtual prototyping of ground vehicles, Virtual.Lab allows you to do all this in a very efficient way.

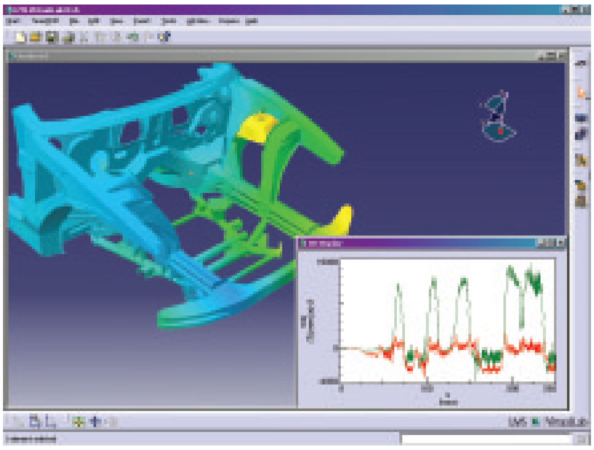
Combustion engines

With LMS Virtual.Lab engineers can analyse combustion engine and transmission designs. Crankshaft-engine block interaction, timing chains, drive belts, valve train analysis are typical applications where dynamic simulation provides the information that is needed to understand the critical design parameters.

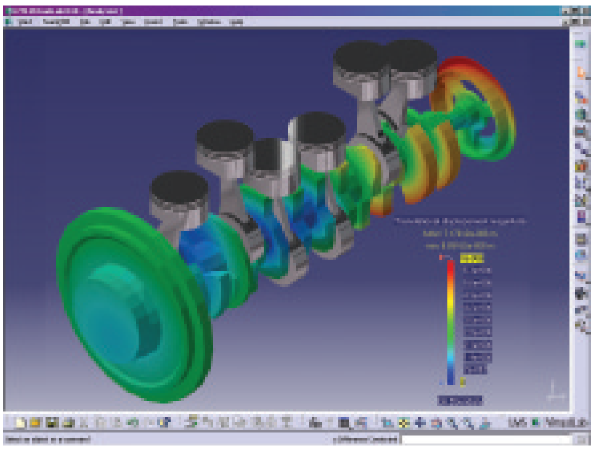
Further downstream analyses, including acoustic radiation prediction or fatigue analysis, directly recover results from the mechanical simulation.

Vehicle applications

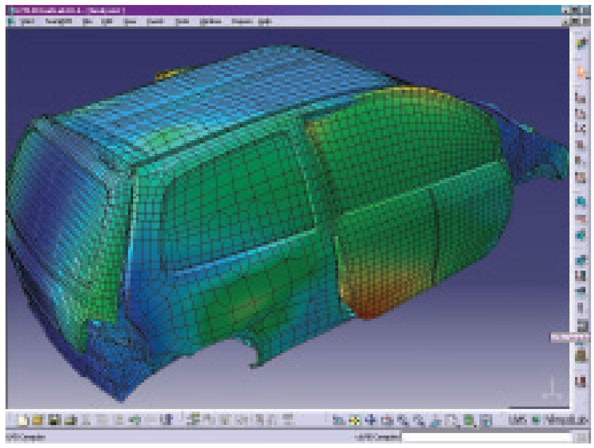
- Automotive
- Truck and Bus
- Off- Highway
- Motorcycles
- Motorsports
- Recreational Vehicles
- Specialty Vehicles
- Railway Systems



Apply measured loads to the model of a vehicle front section to predict fatigue life - and detect the most critical locations.



By coupling a flexible model of the crankshaft to the engine block finite element model through sophisticated oil film models, internal loads can be accurately predicted and used for further downstream analysis.



Virtual.Lab has all the visualization tools that engineers expect a powerful post-processor to have, and much more - supporting them in all tasks, from the most basic to the most sophisticated ones.

Aircraft

Manufacturers face continuous challenges to engineer aircraft that comply with airline industry requirements and government regulations. Of course, passengers expect to travel safely - this remains the number one critical factor for aircraft manufacturers and airlines - but also in comfort. Passengers want a spacious seat, a comfortable ride on the ground and in the air, and a pleasant, silent aircraft interior.

With Virtual.Lab you can comprehensively analyse the extension and retraction of landing gears, including control of the movement through coupling with your control systems. You are able to simulate steering and breaking maneuvres in order to determine the ground loads, keeping into account the flexible aircraft. You are able to predict the kinematics of flap systems, and to investigate the structural loads for normal operation and failure cases.

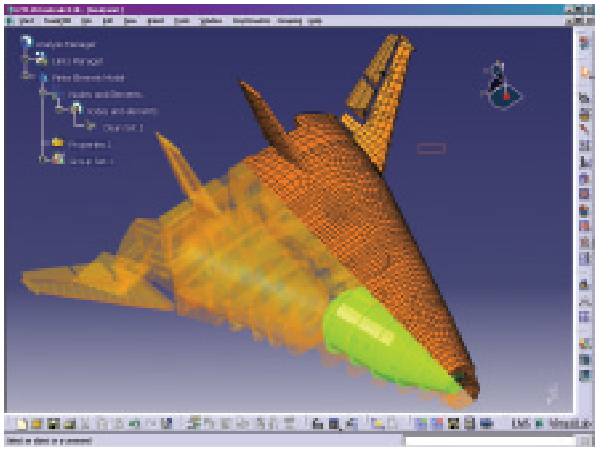
Aircraft engines

Aircraft engine manufacturers are under increasing pressure to deliver lighter, higher-performance engine designs in a shorter time frame. While manufacturers have traditionally used a test-analyze-and-fix approach, virtual prototyping technologies have become essential to reducing the time and cost of development.

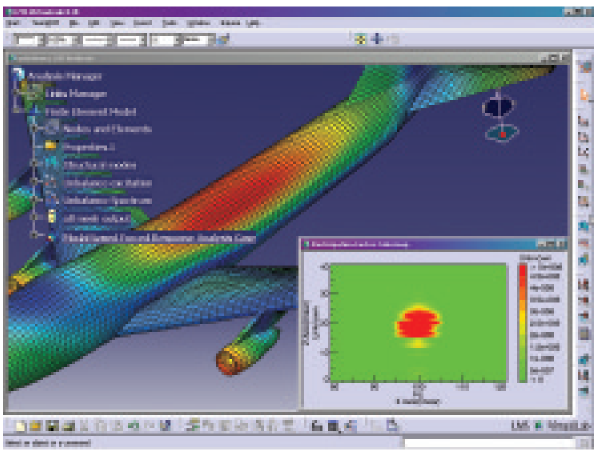
Whether the purpose is to simulate the mechanical behavior of complex subsystems such as variable stator vanes or bleed valves, or whether the concern is with the noise characteristics of a jet engine - Virtual.Lab provides working solutions.

Spacecraft

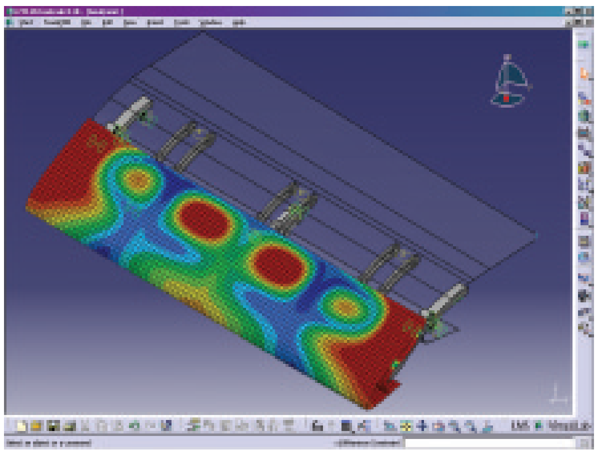
Design-right-first-time is not even an option with spacecraft development, second chances just do not exist. Virtual.Lab helps to guarantee the structural integrity of a space vehicle, even when the number of structural tests must be limited. It can ensure that solar panels survive being exposed to extremely high vibrations during the few seconds of the launch and then unfold properly in space.



State of the art visualization capabilities enable anyone in the engineering team to prepare clear and stunning reports.



An engine imbalance can give rise to excessive vibration levels inside the aircraft and eventually lead to aircraft failure.



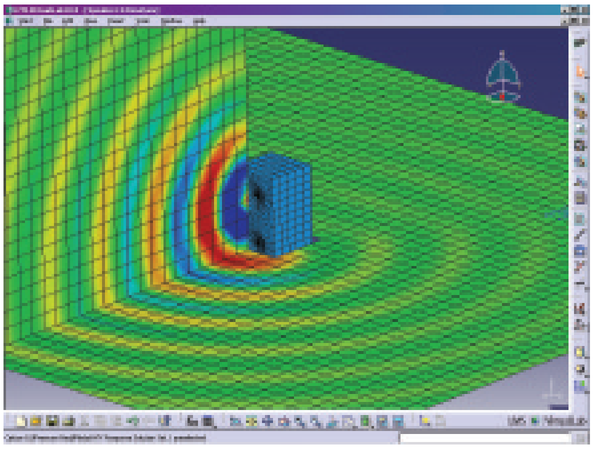
Simulate the leading edge wing slat mechanism of an airplane and take into account the critical deforming parts to further refine the design.

Industrial machinery

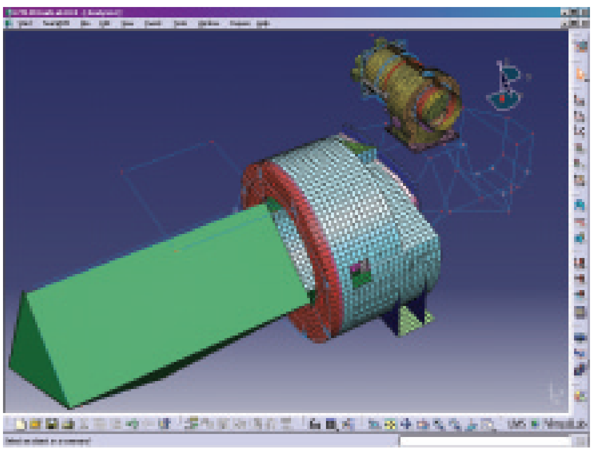
Industrial equipment manufacturers are continuously faced with product innovation challenges, bringing new products to market faster, at lower development cost, without compromising quality. Being able to reliably predict global product performance is key to this. Preferably, one or a few engineers should be able to perform the complete analysis job, within an intuitive, easy to use integrated environment. The only feasible way to get designs faster to market is Virtual.Lab.

Consumer goods

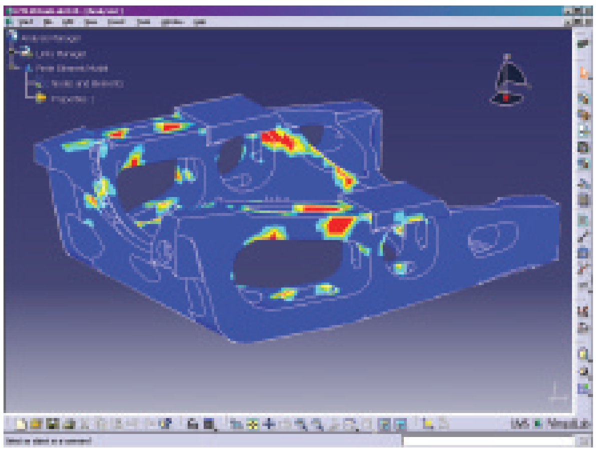
Consumer goods such as washing machines, mobile phones, computers, drilling machines, … should do more than the core job they are designed for. A dishwasher should deliver clean dishes, and in addition this should be done smoothly and silently. How to make sure this really happens? Wouldn't it be great if one engineer could take care of this? In one environment? Including the right modeling and interpretation tools to support him in making the right decisions? Using templates, to minimize repetitive work and where results are only a few mouse clicks away? Virtual.Lab is the environment that lets you focus on your product's core functionality.



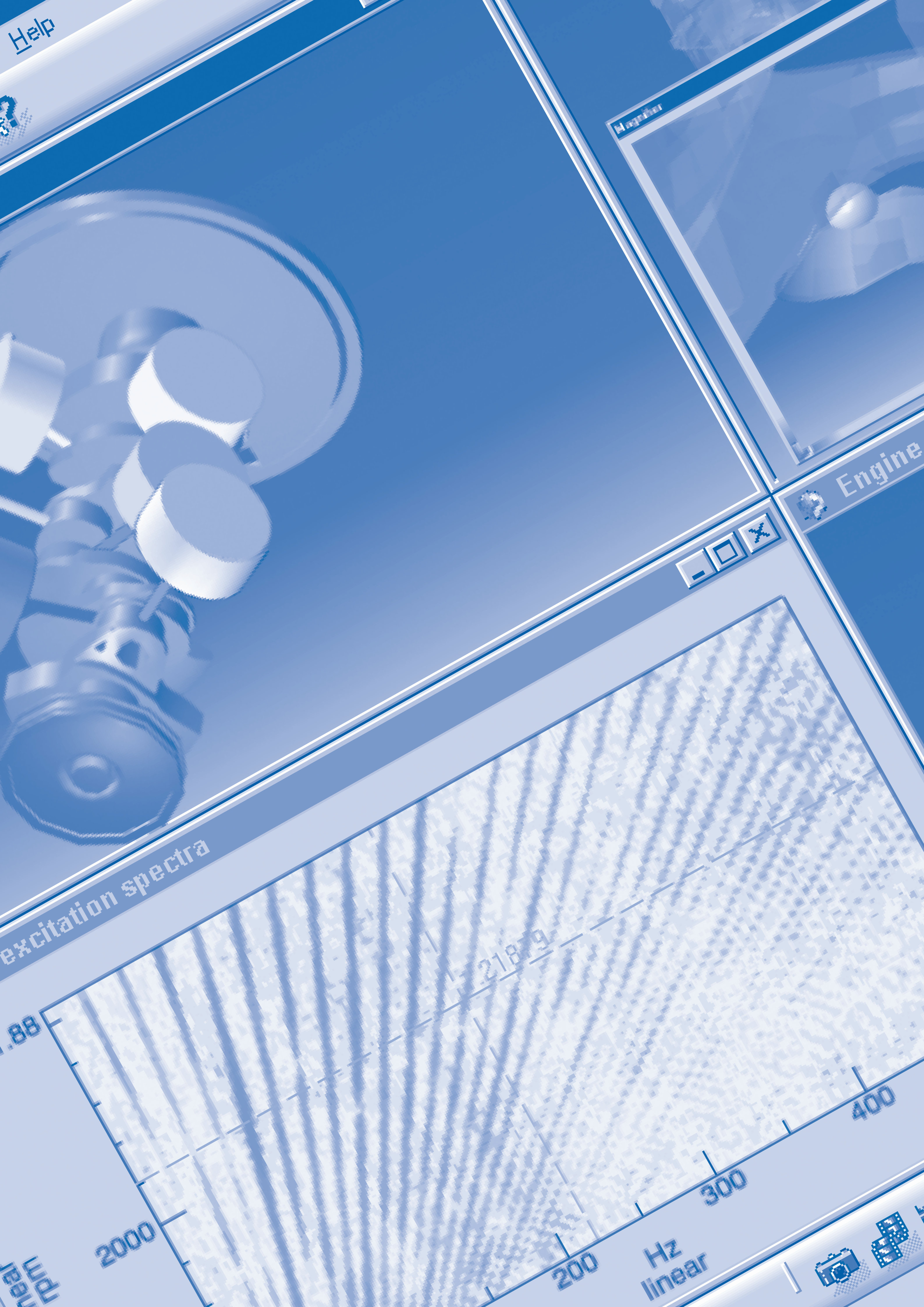
Virtual.Lab not only predicts the sound produced by loudspeakers, mobile phones or domestic appliances - it also provides a unique mix of state of the art interpretation tools to enhance engineering insight.



Using a hybrid approach, accurate system-level vibration predictions can be made early in the development process of a compressor unit - enabling a full validation and optimization of critical components.



Evaluate the damage distribution for a cast main frame of a wind turbine from a complete set of load time data provided by an aero-elastic simulation.



Help
Engine
excitation spectra
2000
200
300
400
Hz
linear

LMS INTERNATIONAL
Empowering Engineering Innovation

Interleuvenlaan 68
3001 Leuven - Belgium
Phone: +32 16 384 200
Fax: +32 16 384 350
e-mail: info@lms.be
http://www.lmsintl.com

LMS France	phone 01 69 35 19 20	fax 01 69 35 19 45
LMS Deutschland	phone (07152) 97 97 90	fax (07152) 97 97 99
LMS Italiana	phone 0321/ 622 440	fax 0321/ 622 429
LMS UK	phone (024) 7647 4700	fax (024) 7647 1554
LMS N. America		
Detroit office	phone (248) 952-5664	fax (248) 952-1610
Los Angeles office	phone (714) 891-4205	fax (714) 891-6809
LMS Japan	phone 045-476-0077	fax 045-476-0870
LMS Korea	phone 02-571-7246	fax 02-574-7321
LMS China	phone (010) 8497 3605	fax (010) 6499 3735
LMS India	phone 080-238 66 68	fax 080-238 64 11

A partner of DASSAULT SYSTEMES