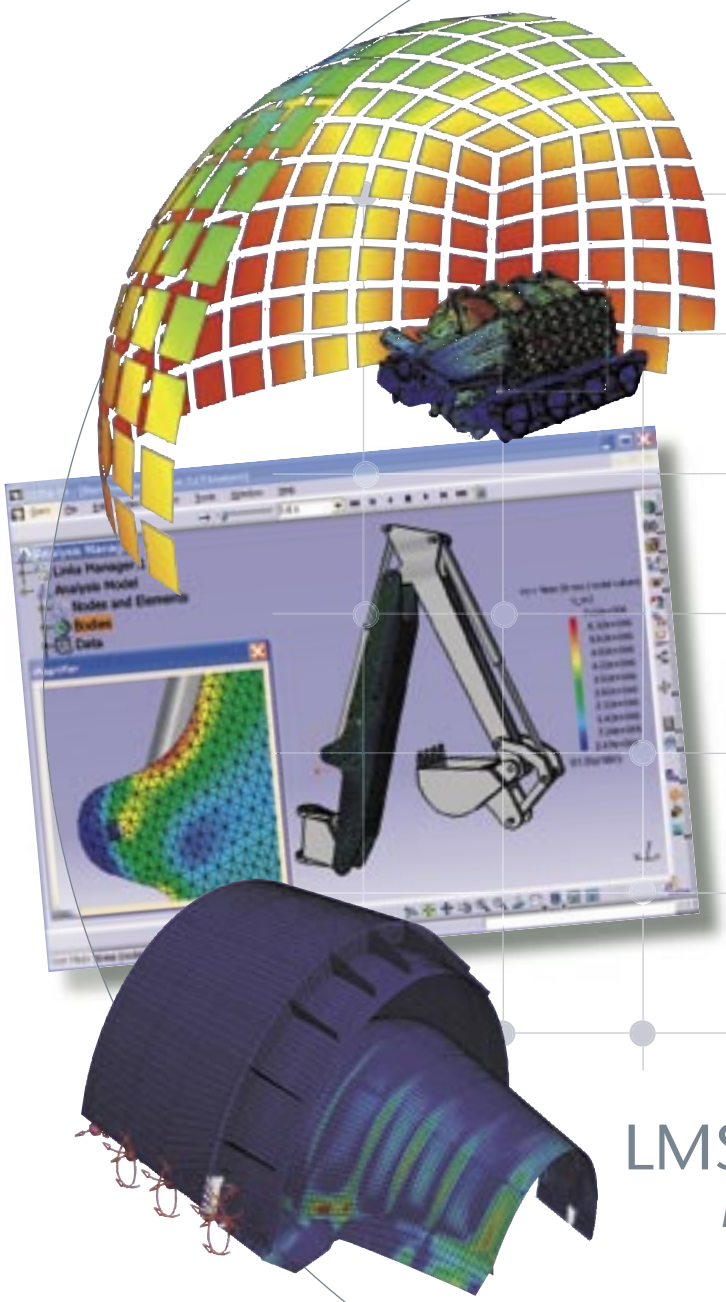


LMS Virtual.Lab Designer

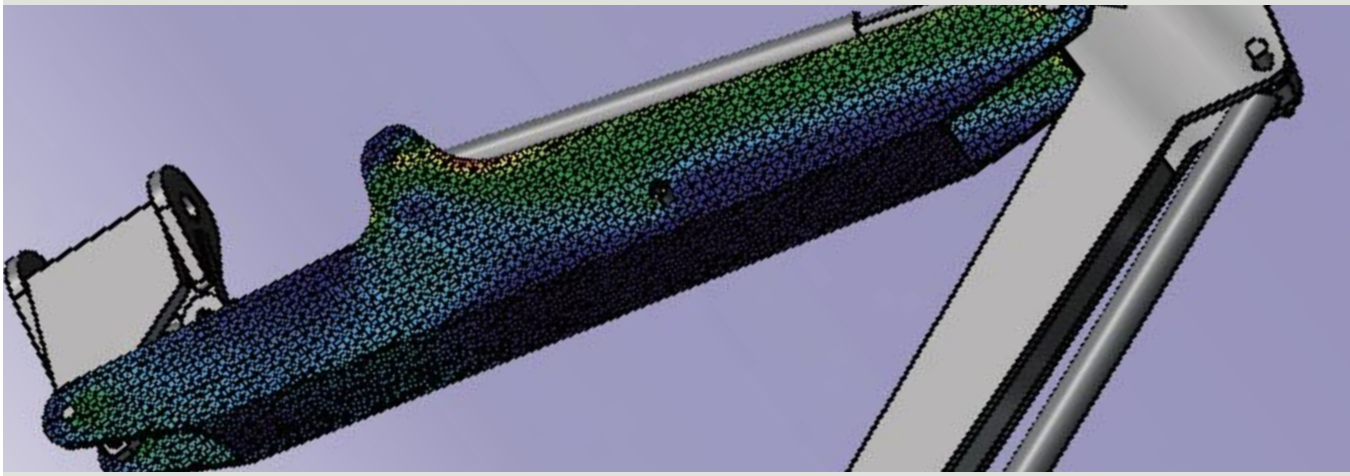
Performance Simulation in CATIA V5

LMS INTERNATIONAL

Empowering Engineering Innovation

LMS Virtual.Lab Designer

A Scalable Simulation Solution Integrated in CATIA V5



LMS Virtual.Lab Designer, a CATIA V5 add-on software suite, provides users direct access to dedicated simulation solutions for general FE-processing, system dynamics, acoustics, fatigue-life and durability. In addition to these solutions, LMS Virtual.Lab Designer delivers mesh-based design capabilities that allow designers and analysts to quickly modify FE simulation models and to efficiently analyze multiple design variants. LMS Virtual.Lab Designer is fully embedded in the CATIA V5 environment, and enables CATIA V5 users to quickly analyze the performance of systems and parts up-front in the design process, without the need to leave their preferred PLM solution.

Leverage your V5 PLM investment

LMS Virtual.Lab Designer enables designers and CAE engineers to virtually test the static and dynamic strength of their designs, their system dynamics, acoustic behavior and fatigue-life performance, all from within one single CATIA V5 session. LMS Virtual.Lab Designer provides direct access to a broad range of simulation capabilities for structural analysis using ELFINI, Nastran, ANSYS and others. The CATIA V5-embedded simulation capabilities eliminate time-consuming data transfers and conversions, guarantee full associativity between the CAD designs and simulation processes, and greatly facilitate the analysis of multiple design variants.

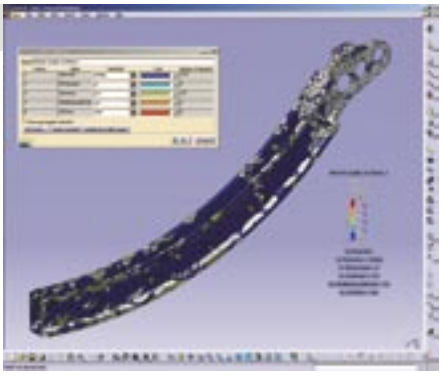
A scalable solution for functional performance engineering

LMS Virtual. Lab Designer can be extented with the award-winning LMS Virtual.Lab software suite for functional performance engineering, and upscaled with the extensive simulation capabilities and broad range of engineering disciplines available in LMS Virtual.Lab. This allows CATIA V5 users to supplement their simulation capabilities with advanced functionality and industry-specific vertical simulation applications, and to gradually extend their installation as the scope and diversity of their simulation needs evolve. LMS Virtual.Lab Designer therefore represents a truly scalable solution that fully leverages initial investments in customers' preferred PLM solutions.

LMS Virtual.Lab Designer Products

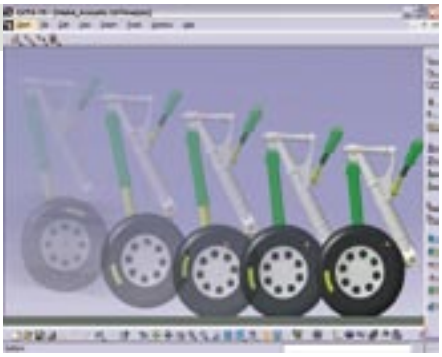
LMS Virtual.Lab Designer Structures

LMS Virtual.Lab Designer Structures provides a solution for general FE pre-processing and post-processing using industry-standard FE solvers, such as ELFINI, Nastran, ANSYS and others. It enables designers and analysts to simulate the structural characteristics and performance of components and subsystems, all in one single session and within a fully geometry-associative environment.



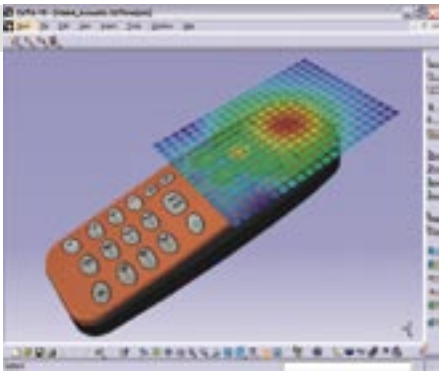
LMS Virtual.Lab Designer Motion

LMS Virtual.Lab Designer Motion is a complete and integrated solution to simulate realistic motion and loads of mechanical systems. It permits design engineers to quickly analyze and optimize the real-world behavior of the mechanical design and to guarantee that it performs as expected, before committing to expensive physical prototype testing.



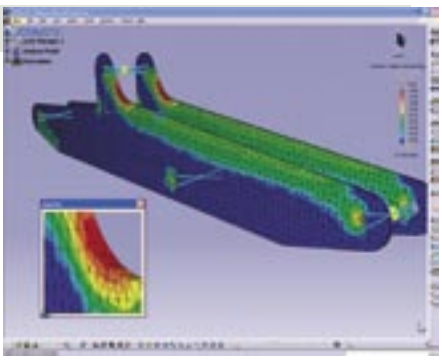
LMS Virtual.Lab Designer Acoustics

LMS Virtual.Lab Designer Acoustics is an easy-to-use acoustic simulation solution for predicting and improving sound and noise performance of a broad range of systems. With the straightforward models and embedded solver technology, engineers can receive their results more quickly, without compromising accuracy.



LMS Virtual.Lab Designer Fatigue

LMS Virtual.Lab Designer Fatigue provides a solution for companies that want to check and improve the fatigue and strength performance of mechanical systems. It improves simple stress analysis by the application of varying load time histories, to identify stress peaks and durability problems already early on in the design stage.



LMS Virtual.Lab Designer Structures

LMS Virtual.Lab Designer Structures provides a solution for general FE pre-processing and post-processing using industry-standard FE solvers, such as ELFINI, Nastran, ANSYS and others. It enables designers and analysts to simulate the structural characteristics and performance of components and subsystems, all in one single session and within a fully geometry-associative environment. LMS Virtual.Lab Designer Structures is integrated in the CATIA V5 environment and is completely complementary to CATIA GPS, FMS, GAS, etc. Its simulation capability complements the functionality scope that is currently covered by the CATIA V5 CAD-based simulation environment, and extends it further with dedicated mesh-based simulation functionalities, interfaces and drivers, etc. When using these mesh modification extensions, the associative link with CAD geometry is consequently retained, which contributes significantly to the efficiency of design efforts.

With the Mesh Based Design tools of LMS Virtual.Lab Designer Structures, designers and analysts are able to modify or extend existing meshes from CATIA CAE, or even import and manipulate orphan meshes. With the same ease, users can define loads and restraints directly on the geometry or mesh, or reuse loads and restraints that are already defined.

LMS Virtual.Lab Designer Structures offers the capability to intuitively define and automatically drive external FE solvers from within the CATIA environment, without requiring expert users to set up and run specific ANSYS or Nastran jobs. Among its comprehensive post-processing solutions, LMS Virtual.Lab Designer Structures is capable of indicating extreme values or hot spots, or displaying results in dedicated 2-dimensional graphs.

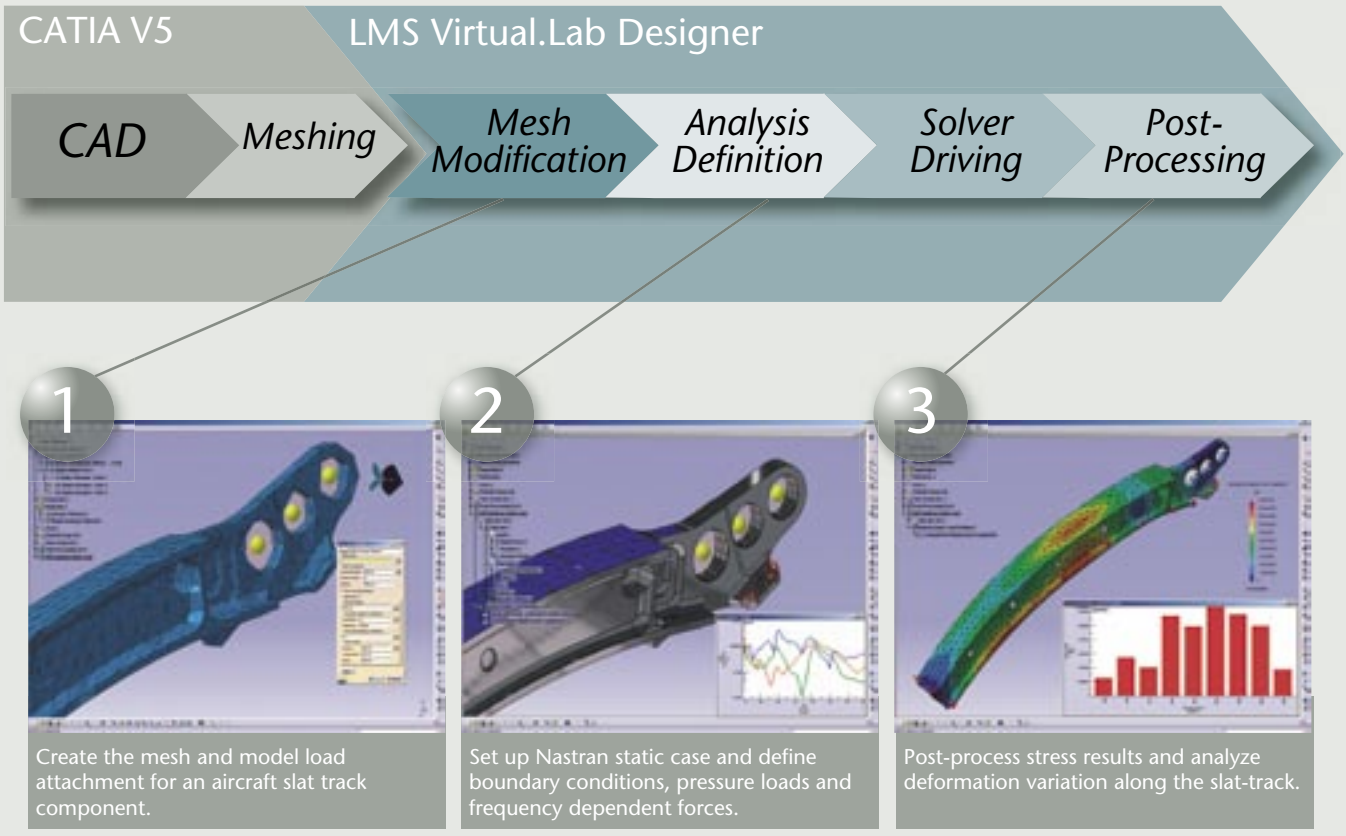
Overall, the functionality of LMS Virtual.Lab Designer Structures includes:
- Intelligent interface (mesh, loads, restraints, etc.) that allows working with orphan mesh parts.
- Extensive mesh-based design capabilities
- A driver offering an associative link to any external solver or structural analysis package

Features

- Fully geometry-associative environment
- Extensive range of pre-processing and post-processing features that are integrated in CATIA V5 and are complementary to its simulation offering
- Intelligent interface (mesh, properties, loads, restraints, FEM model checks, FEM grouping, etc.) that also allows working with orphan mesh parts
- Availability of general analysis cases and integrated drivers to well-known analysis solvers

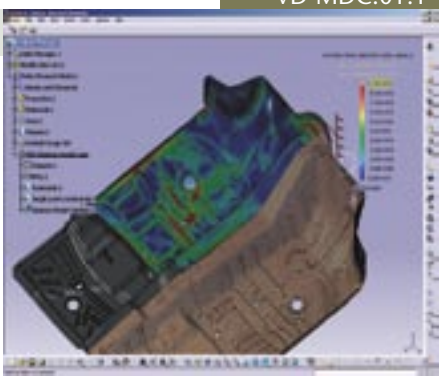
Benefits

- Leverage the general FE pre-processor and post-processor capability available in the CATIA V5 environment
- Drastically speed up the execution of engineering iterations, and significantly increase productivity by using the integrated FE-mesh manipulation and editing solutions
- Perform analyses much earlier in the development process in order to reliably assess the impact of specific design variant characteristics
- Increase and leverage the consistency of analysis results by sharing the same environment and analysis codes for general and specialist assessments
- Improve teamwork across companies by facilitating the data exchange between OEMs and suppliers



VD-MDC.01.1

LMS Virtual.Lab Designer Structures for Nastran

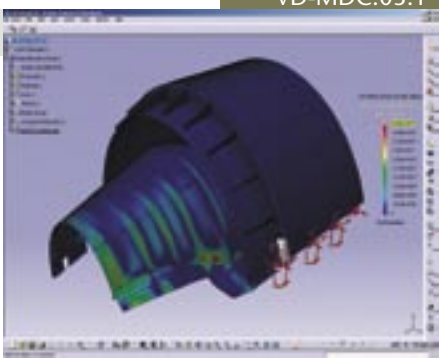


LMS Virtual.Lab Designer Structures for Nastran provides a solution for general pre-processing and post-processing using Nastran. This solution supports the following general analysis cases:

- Static linear and non-linear analysis
- Real and complex modal analysis
- Dynamic response analysis (modal or direct)
- Transient analysis
- Heat transfer analysis

VD-MDC.03.1

LMS Virtual.Lab Designer Structures for ANSYS

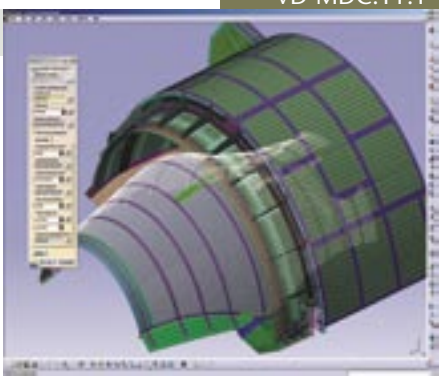


LMS Virtual.Lab Designer Structures for ANSYS provides a solution for general pre-processing and post-processing using ANSYS. This solution supports the following general analysis cases:

- Modal analysis
- Static analysis
- Dynamic response analysis

VD-MDC.11.1

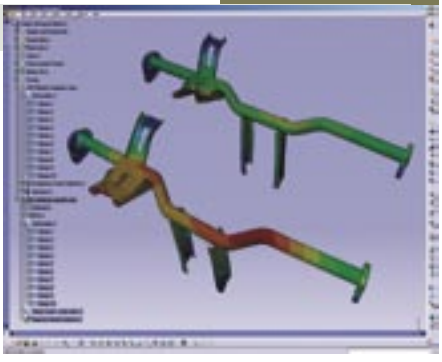
LMS Virtual.Lab Designer Mesh Based Design



LMS Virtual.Lab Designer Mesh Based Design offers mesh modification capabilities that complement the CATIA V5 pre-processor and post-processor, which are embedded in the CATIA V5 Analysis products. The Mesh Based Design solution includes pre-processing functionality that enables users to manually adapt FE-meshes before detailed analysis and modification starts. Its offering comprises mesh modification, mesh quality check, grouping, renumbering and property editing capability. These integrated FE-mesh manipulation and editing solutions drastically speed up the execution of engineering iterations, which in turn, significantly increase productivity.

VD-MDC.12.1

LMS Virtual.Lab Designer Interfaces and Drivers



LMS Virtual.Lab Designer Interfaces and Drivers includes intelligent interfaces and drivers to Nastran or ANSYS. The offered solutions enable users to import mesh parts along with their load and restraint information and analysis setup. Meshed geometries can also be exported to any preferred solver format, including the analysis setup applied. LMS Virtual.Lab Designer - Interface and Driver also offers the capability to intuitively define and automatically drive solvers from within the CATIA environment, without requiring expert users to set-up and execute specific ANSYS or Nastran jobs. This makes it possible to define loads and restraints directly on the geometry or mesh, or to reuse loads and restraints that are already defined.

LMS Virtual.Lab Designer Motion

LMS Virtual.Lab Designer Motion offers a complete and integrated solution that predicts the dynamic motion and internal loads of mechanical systems. It enables design engineers to quickly analyze and optimize the real-world behavior of CATIA V5 mechanism assemblies before committing to physical prototype testing.

LMS Virtual.Lab Designer Motion extends the kinematics capabilities of the CATIA V5 Mechanism Simulation 2 (MS2) configuration by offering efficient means to model system dynamics characteristics. It is also capable of predicting how mechanisms with multiple degrees of freedom will operate under real-life loading conditions, such as gravity, friction and contact.

Starting from the CATIA V5 kinematics mechanism, the model can be easily enriched with dynamic elements, such as springs, friction and contact forces, and an extensive list of motion constraints and initial conditions. The integrated robust dynamic solver processes the equations of motion accurately and timely in order to compute all displacements, velocities, accelerations and forces for all bodies in the simulated mechanism. 3D animations of the CATIA assembly and synchronized cursor animation on 2D plots help engineers easily identify and solve the root causes of problems. Additionally, users can efficiently detect part collisions, analyze motion envelopes and evaluate force vector animations. Parametric analysis allows efficient analysis of different design variants. The main advantage is that the multibody simulation model is completely associative with the CATIA geometry, making geometry design changes immediately verifiable after re-running the analysis in the motion simulation workbench.

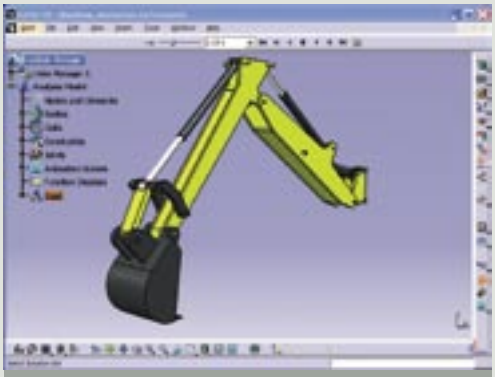
For more advanced dynamic simulation options such as CAD contact and flexible bodies are also available for LMS Virtual.Lab Designer Motion. The Flexible Bodies option uses CATIA V5 GPS finite element data to account for component deformation during mechanism motion and predicts dynamic stresses on all flexible parts.

Features

- A complete library of kinematic joints and motion drivers for predicting the idealized kinematic motion of CATIA V5 assemblies
- An extensive library of force connections, including springs, dampers, friction, bushings, beams and contact forces
- Accurate definition of part inertia properties by using the CATIA V5 solid geometry (and material density for dynamic simulation)
- The integrated LMS DADS solver guarantees fast, accurate and stable dynamic, kinematic, static and pre-load analyses
- A wide range of simulation results, including forces, displacements, velocities and accelerations

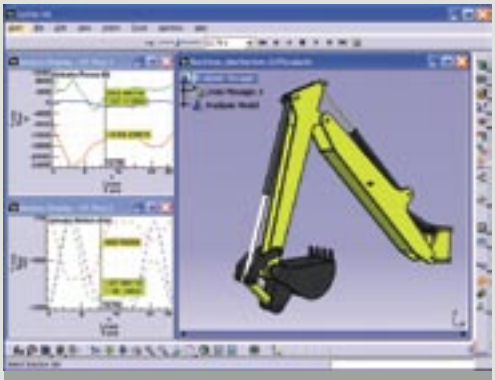
Benefits

- Gain insights into the dynamic performance of designs from force vectors and component stresses displayed in mechanism animation sequences
- Dimension motors and actuators
- Obtain accurate component loads for use in CATIA V5 GPS stress prediction and LMS Virtual.Lab Designer Durability simulation.
- Identify and optimize the parameters that most significantly impact the real-life motion performance of designs.
- Use CATIA V5 GPS based flexible bodies to increase the accuracy of dynamic system simulation
- Explore design safety limits without putting people or expensive equipment at risk

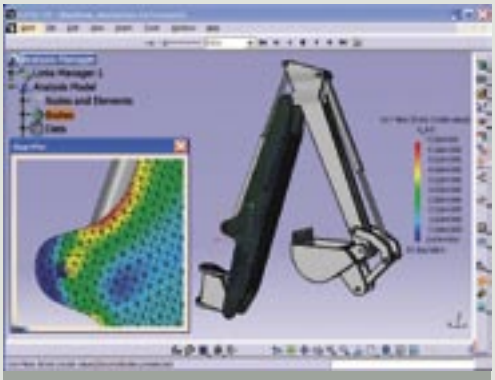


Extend CATIA V5 assemblies with joints, forces, motion drivers and gravity.

Create motion envelopes of the moving mechanism.



Synchronized animation and graphing of motion and force results.

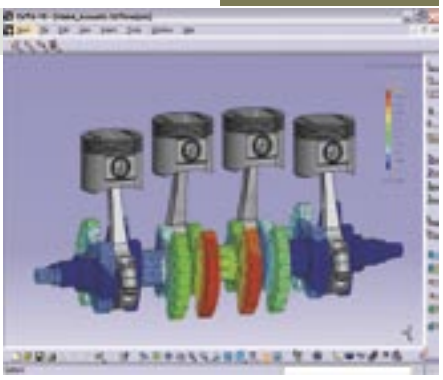


Visualize components deformation and stresses during mechanism motion.

LMS Virtual.Lab Designer Motion - Options

VD-MOT.70.2

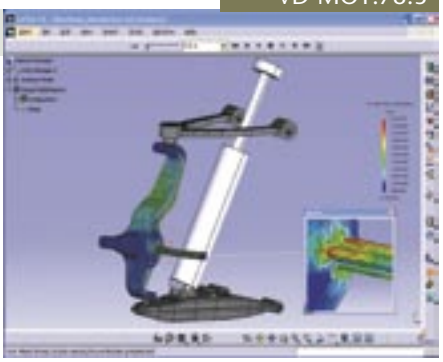
Flexible Bodies



Flexible Bodies provide a very efficient way to represent structural flexibility for even the most complicated geometry. The method is based on an advanced numerical algorithm using “modes” – based on either FEA or test measurements. The flexible behavior for any number of parts in the simulation can be represented and visualized by graphing and animating the results. The collection of flexible body modes for each part are used to define the total deformed shape, velocity and acceleration. The resulting mode amplitudes can be used to define time varying stress, durability fatigue life, and even acoustic radiation from the surface of the parts.

VD-MOT.78.3

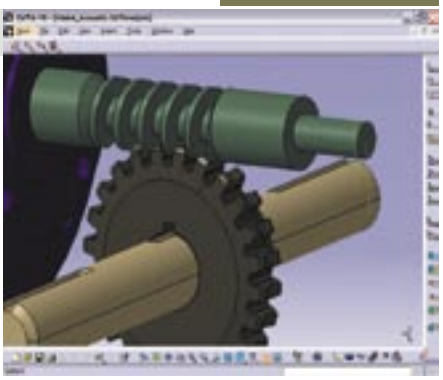
Stress Recovery



This functionality allows to visualize the stress field of a part undergoing dynamic motion. When using the dynamic solver, the resulting stresses are the dynamic stresses that take all vibrations and transients into account. You can animate the flexible body in the mechanism with color contours of stress and graph stress values at specific nodes for each time step. A summary plot of the highest stress that occurred during the entire mechanism motion shows the critical stress hotspots.

VD-MOT.18.2

CAD Contact



The CAD Contact option allows users to model and simulate non-permanent contact between bodies with arbitrary geometry. The contact area and penetration depth are computed based on exact Solid Modeling.

VD-MOT.11.2

Swept Volume

Swept volume traces the envelope of motion by combining the geometric surface shape from the solid model, with the displacement from the multi-body dynamic solution process. These features provide a way to visualize the full space consumed when the system moves through its range of motion. The envelope surface can be exported in different geometric formats.

LMS Virtual.Lab Designer Acoustics

LMS Virtual.Lab Designer Acoustics is an easy-to-use acoustic simulation solution for predicting and improving sound and noise performance of a broad range of systems. With its straightforward models and embedded solver technology, users can receive results faster, without compromising simulation accuracy. With LMS Virtual.Lab Designer Acoustics, designers and analysts can prepare the acoustic model starting from CATIA CAE models, apply the acoustic sources, run the embedded acoustic solvers and post-process the results, all in a geometry-associative process.

The product range of LMS Virtual.Lab Designer Acoustics covers multiple acoustic solvers. The solver can be based on the Boundary Element Method or the Finite Element Method. The Boundary Element Method (BEM) effectively reduces complex 3-dimensional geometries to 2-dimensional surface dimensions. The 2-dimensional surface mesh can either be obtained through CATIA CAE products (GPS or FMS), the optional Mesh Coarsening module of LMS Virtual.Lab, or external CAE packages. With BEM, only the surface areas of the structural systems that are vibrating or emanating sound need to be modeled. The BEM model sizes are typically consisting of multiple thousands of elements, resulting in relatively small models that are easy to create, verify and handle. The Boundary Element method is most suitable for acoustic radiation problems (exterior acoustics).

With the Finite Element Method (FEM), the acoustic space is modeled by 3-dimensional solid acoustic elements. By using these acoustic elements, the properties of the fluid medium, such as air or noise-absorbing materials or objects (e.g. car seats) can be modeled accurately. The acoustic FEM mesh can be generated by CATIA CAE modules (GPS, FMD), which retains the associativity with the underlying geometry, or can be provided by external CAE solutions. The acoustic FEM approach is very successful in predicting and solving interior acoustics problems.

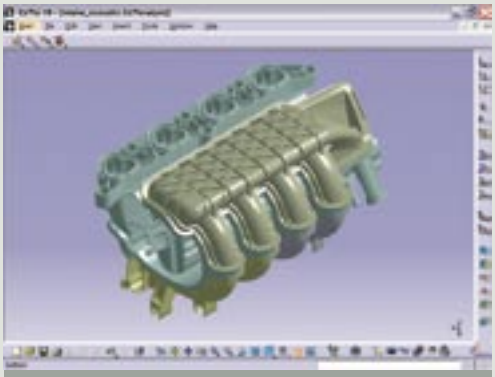
Acoustics results are presented through relevant 2-dimensional charts, which typically include SPL with dB weighting and (1/3) octave plotting. The post-processing capabilities of LMS Virtual.Lab Designer Acoustics comply with today's best practices in acoustic engineering, and can be easily tuned to specific needs of acoustic design and engineering teams.

Features

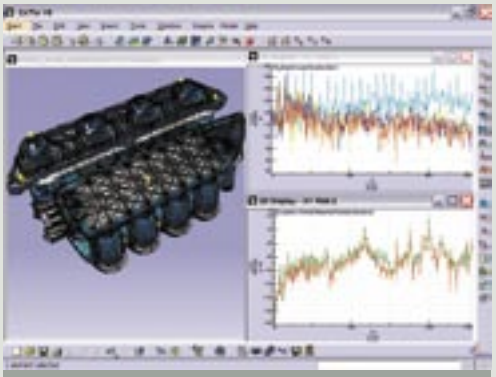
- Indirect and direct BEM
- Plotting and 3-dimensional imaging, including SPL, RMS, dB weighting and (1/3) octave
- Boundary Conditions, including surface vibrations, pressures and acoustic sources

Benefits

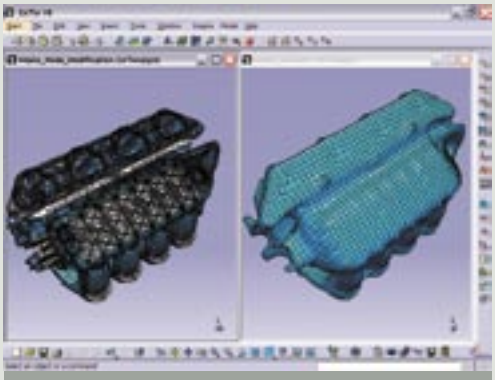
- Find the cause of noise problems quickly, while reducing the modeling efforts and retaining the associativity with the underlying geometry
- Predict acoustic performance of products accurately and reduce design risks significantly
- Mesh Coarsening and High-Speed BEM options are available to further speed up the process



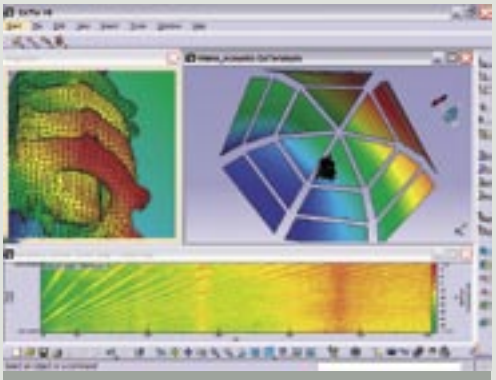
CAD representation of an enigne intake model created by CATIA Mechanical Design.



Create dedicated 2D plots of noise levels.



Acoustic coarsened mesh is generated automatically starting from structural mesh.



Create 3D acoustic images and analyze noise radiation patterns on the fly.

LMS Virtual.Lab Designer FE Coarsening

LMS Virtual.Lab Designer FE Coarsening is a specific modeling solution that is capable of creating a coarsened, regular surface mesh on the basis of a CAD geometry. The software starts with the conversion of the CAD geometry into tessellation triangles, thereby offering the flexibility to adapt the quality of the tessellated mesh. After this, the wrapper creates a regular surface mesh on the envelope of the structure. This surface mesh can then be used for a variety of different simulation applications, including exterior noise (using an acoustic BEM model), CFD and crash. By creating a surface mesh directly on CAD geometry, designers and analysts can avoid the use of structural FEM meshes, which typically only become available much later in the process. Obtaining an acoustic mesh without requiring a structural mesh significantly accelerates the surface meshing process.

In case a structural FEM mesh from CATIA CAE (GPS, FMD, FMS) or from external FE software packages (e.g. Nastran) is available, LMS Virtual.Lab Designer FE Coarsening can create a coarsened surface mesh on the basis of the structural FEM mesh. Coarsened surface meshes, which are used in support of acoustic simulations, typically do not include complex features. Therefore, LMS Virtual.Lab Designer FE Coarsening provides all capabilities to remove unwanted features and optimize the mesh quality.

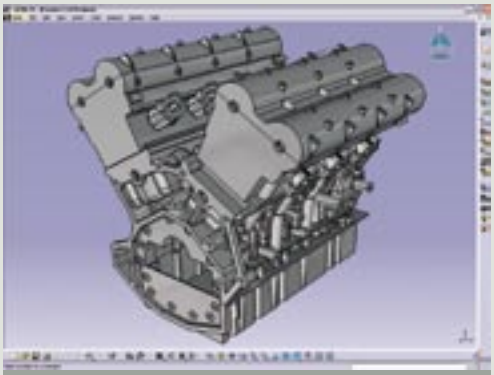
These revolutionary approaches can be compared to wrapping up a structure with a rubber sheet: the small surface features are smoothened while the features that are responsible for the final response (acoustic or others) remain in place. They also represent efficient solutions, which allow regular coarsened surface meshes to be created in hours instead of weeks, even for very large and complex models to be generated directly on CAD geometry.

Features

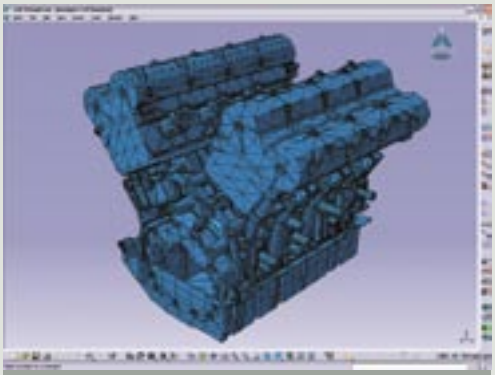
- TRIA meshes created directly on CAD geometry
- Fully parametric tessellation mesher
- Regular QUAD meshes created on the basis of TRIA tessellated meshes, on CATIA meshes or on imported meshes from external CAE packages
- For acoustic applications, mesh quality can be set beforehand in function of analysis frequency
- De-featuring meshes: removing detected ribs and filling holes

Benefits

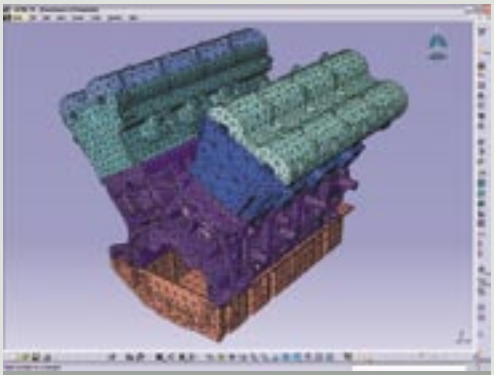
- Create regular QUAD surface meshes that are optimized for a variety of applications
- Drive the automatic re-creation of surface meshes through the built-in CAD geometry associativity
- Save weeks of modeling time by using the integrated innovative wrapper



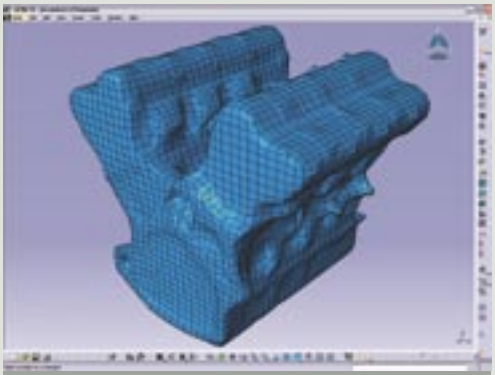
CAD model of an engine assembly created by CATIA Mechanical Design.



Easily create tesselated representation of engine assembly from geometry.



Structural FE mesh of engine assembly created using CATIA GPS / GAS.



Coarsened surface mesh created from tesselated representation or from structural FE mesh.

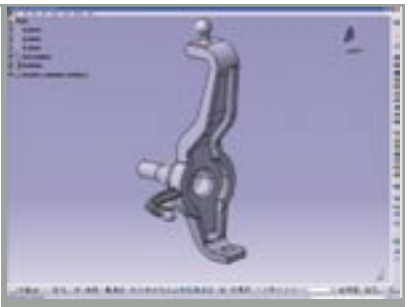
LMS Virtual.Lab Designer Fatigue

LMS Virtual.Lab Designer Fatigue is an easy-to-use fatigue life prediction solution for predicting and improving Fatigue performance of a broad range of systems. It is applicable to a wide range of industry segments, including automotive, aerospace, white goods and other mechanical industries.

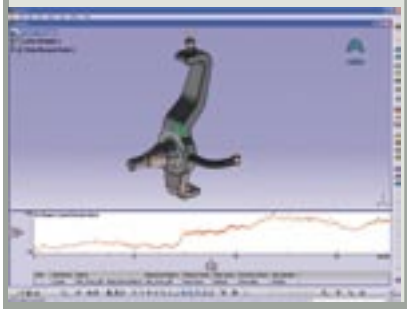
With LMS Virtual.Lab Designer Fatigue, designers and analysts start from static or dynamic stresses predicted using CATIA CAE models, apply varying load time histories to the component models, run the embedded fatigue life prediction solver and post-process the results, all in a completely geometry-associative process. This solution drastically improves simple stress analysis as it allows the identification of dynamic stress peaks and fatigue problems very early on in the design stage.

LMS Virtual.Lab Designer Fatigue offers different fatigue-life analysis capabilities, including assessment of low-cycle fatigue (strain-life approach), high-cycle fatigue (stress-life) and infinite life (Dang Van). Fatigue material parameters are estimated using the uniform material law or based on the embedded fatigue material parameter library. As the fatigue life prediction solver supports both proportional as non-proportional loading conditions real-life loading conditions can be simulated. Dedicated durability post-processing functionalities including dynamic stress animation, hotspot detection and local time series analysis allow to quickly zoom in on the critical areas and to derive the root cause of fatigue problems.

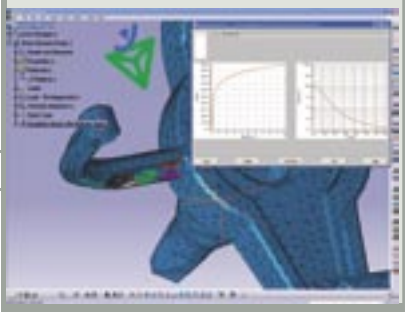
The CATIA V5-based associativity concept of LMS Virtual.Lab Designer offers users the capability to automatically execute consecutive simulation runs, which enable different design options and and/or load cases to seamlessly flow through the complete analysis process. Evaluating a new design only involves plugging in the modified structure, upon which the analysis is automatically restarted – avoiding tedious redefinitions of load input points, constraints and other parameters. These capabilities support design teams in their efforts to experiment with multiple design options and identify the best solutions before physical prototyping starts.



Starting from a component designed in CATIA V5...



...users interactively define the load case to be applied to the component.



LMS Virtual.Lab Designer runs the fatigue analysis within CATIA V5 and identifies the critical regions.

Based on the analysis results, users can change their design and evaluate the impact on the fatigue resistance.

Features

- Seamless access to structural FE meshes and stresses from CATIA CAE
- Direct access interfaces to ASCII and LMS time history formats
- Stress analysis and varying loads (proportional and non-proportional, uni-axial and multi-axial), including
  - Graphic animation
  - Creation, analysis and export of local stress tensor histories
  - Hot spot analysis of critical regions
- Fully featured, fast and accurate Fatigue analysis
  - Stress-life
  - Strain-life
  - Dang Van
  - Stress-gradient correction
  - Combination of events
  - Static and Modal superposition

Benefits

- Reduce the time that is required to perform a complete Fatigue analysis
- Perform fatigue life prediction analyses quickly and accurately, based on realistic loading conditions
- Get immediate feedback on critical fatigue areas
- Explore multiple design options and optimize the fatigue performance of your designs
- Work error-free by using a solution that is tightly integrated in CATIA CAE

LMS Virtual.Lab Designer(1)

		Structures for Nastran VD-MDC.01.1	Structures for ANSYS VD-MDC.03.1	Nastran Interface and Driver VD-MDC.11.1	ANSYS Interface and Driver VD-MDC.12.1	Mesh Based Design VD-MDP.01.1	Motion VD-MOT.00.1	Fatigue VD-DUR.02.1	Acoustics* VD-ACM.01.1	FE Coarsening VD-MDC.10.1
CATIA V5 Prerequisites										
CATIA - General Part Structural Analysis 2 (GPS)		✔	✔	✔	✔	✔	✔	✔	✔	✔
CATIA - Mechanism Simulation 2 (MS2)							✔			
Options										
Flexible Bodies	VD-MOT.70.2	—	—	—	—	—	O	—	—	—
↘ Stress Recovery	VD-MOT.78.3	—	—	—	—	—	O	—	—	—
Swept Volume	VD-MOT.11.2	—	—	—	—	—	O	—	—	—
CAD Contact	VD-MOT.18.2	—	—	—	—	—	O	—	—	—
Acoustic Harmonic BEM Solver	VD-ACM.21.2	—	—	—	—	—	—	—	✘	—
Acoustic Harmonic FEM Solver	VD-ACM.23.2	—	—	—	—	—	—	—	✘	—

* requires BEM or FEM Solver ✔ prerequisite for installation ↘ Product with prerequisite ✘ one of the options required

O available as an option — not applicable

(1) Any option from the equivalent LMS Virtual.lab configuration can be added to these configurations.
Prerequisite: the LMS Virtual.lab Desktop needs to be licenced to enable adding-on LMS Virtual.lab options.

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LMS is an engineering innovation partner for companies in the automotive, aerospace and other advanced manufacturing industries. LMS enables its customers to get better products faster to market, and to turn superior process efficiency to their strategic competitive advantage. LMS offers a unique combination of virtual simulation software, testing systems and engineering services.

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