LMS Imagine.Lab
Rev 12

FUEL PUMPS, HYD PUMPS, FANS

COMBUSTION CHAMBER
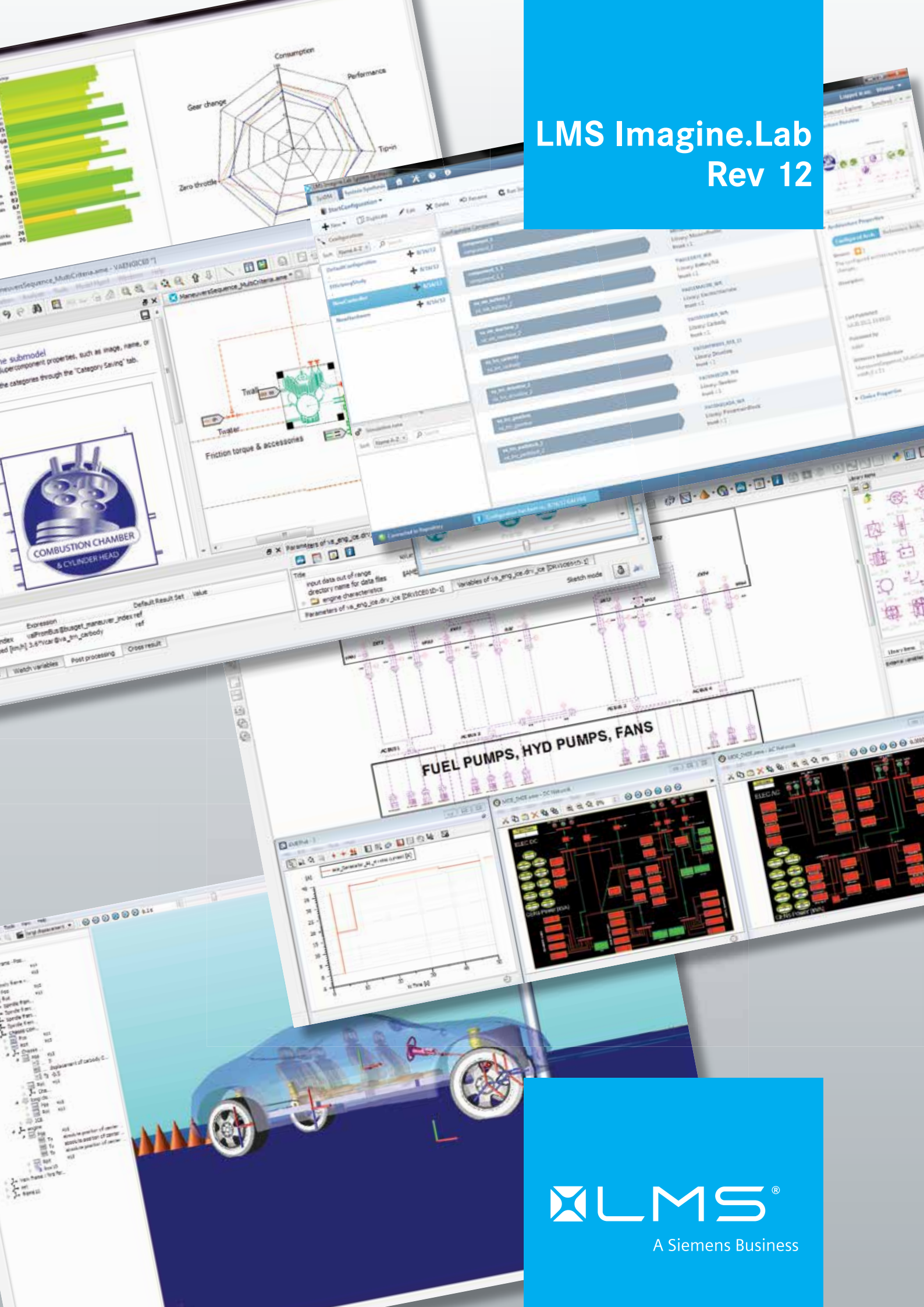& CYLINDER HEAD

LMS ®
A Siemens Business

LMS Imagine.Lab Rev 12

The innovative, open simulation platform for mechatronic system development

As with previous versions, this new release includes several remarkable new features and improvements. A particular emphasis has been placed on user efficiency, controls engineering support, collaboration and application-oriented solutions.

Designed for user efficiency
Enhancing usability for all developments and improvements

Controls engineering ready
Advanced controls validation platform

Drive vehicle & powertrain innovation
Fuel economy, performance and drivability optimization

Support aeronautics/aviation engineering challenges
New dedicated libraries of ready-to-use components

Geared towards collaboration
More efficient, open and integrated suite for collaborative work

"LMS Imagine.Lab Rev 12 is a step forward in terms of capabilities for system design and system engineering in general. Features such as its flexibility for thermal-hydraulic systems and components modeling are very valuable. Its overall capabilities, openness and robustness are key criteria for large deployment and intensive production use in system simulation."

**Dr. Lars Reichelt, Technical Information Processing
Robert Bosch GmbH**

A breakthrough for mechanical industries
Unrivalled physical libraries and components

"We are proud of the work we accomplished with the new LMS Imagine.Lab Rev 12 release. It includes an impressive amount of user-valued content. Three LMS Imagine.Lab family products, LMS Imagine.Lab AMESim, LMS Imagine.Lab SysDM, and LMS Imagine.Lab System Synthesis, have all benefited from our increased development efforts. Today, there are many new features and constant quality improvements. This release represents LMS' commitment to systems engineering and system simulation innovation for better industrial products."

**Nicolas Orand, LMS Imagine.Lab Solutions Director
LMS, A Siemens Business**

LMS Imagine.Lab AMESim
The ideal tool for physical simulation of mechatronic systems

Focused on user-efficiency

The new Apps Designer for LMS Imagine.Lab AMESim easily creates pre-processing and post-processing customization Apps and seamlessly integrates them into a model or a component. Quick and easy, this new tool allows drag and drop customization without additional codes as well as powerful data processing capabilities using Python and third-party Python libraries.

Supercomponents have been majorly enhanced so that users can organize models into assemblies better. This powerful new feature creates and modifies assemblies and connection interfaces, and stores them as sub-models for easy re-use. Supercomponents can be encrypted for industrial property protection.
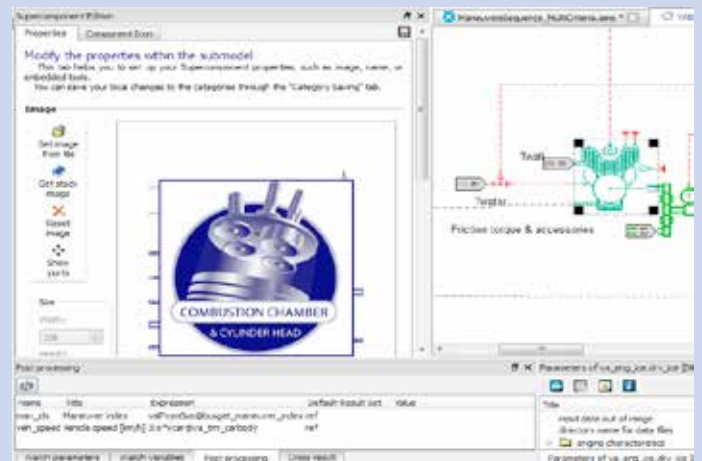
Advanced controls validation platform

Besides supporting more real-time hardware platforms with more real-time capable libraries, LMS Imagine.Lab AMESim Rev 12 integrates an improved Simulink interface. The Simulink controller model can be imported within LMS Imagine.Lab AMESim to be solved with the embedded Simulink fixed-step solver. This permits Stateflow model importation and intellectual property protection.

LMS Imagine.Lab AMESim Rev 12 also comes with a new National Instrument VeriStand interface. This direct connection lets users export LMS Imagine.Lab AMESim models to VeriStand to couple with other VeriStand compliant models for controls validation. This way, LMS Imagine.Lab AMESim plant models can be used for hardware-In-the-loop with a VeriStand connection to the controller unit.
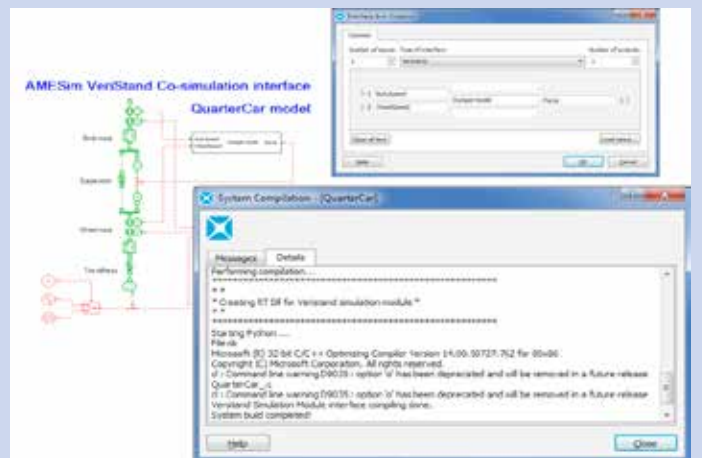
More features:

- Plots: Multiple-axes, Interactive X/Y zoom, Pan, Layout management
- Parallel processing for DOE
- Dashboard: Flight Instruments Toolbox, Animated Interactive Controls, AVI Export, Batch Support, Custom Dual State Buttons
- DOE: Save and Post-Process All Run Results
- LMS Imagine.Lab AMESim API and Scripting Extensions
- Improved Parallel Processing for Design Exploration
- CPU Performance Improvement of the CFD-1D Solver
- A&D Technology Procyon Real-time Platform Support
- Editing Diagrams in Modelica Editor
- FMI for Co-simulation Slave 1.0

LMS Imagine.Lab SysDM & System Synthesis
The model and architecture management tools

Integrated LMS Imagine.Lab SysDM Client for LMS Imagine.Lab AMESim

The new integrated LMS Imagine.Lab SysDM client for LMS Imagine. Lab AMESim extends the platform's model-based systems engineering capabilities. With this new feature, users can benefit directly from LMS Imagine.Lab SysDM's model and data management features with an efficient and transparent integration into day-to-day working environments.
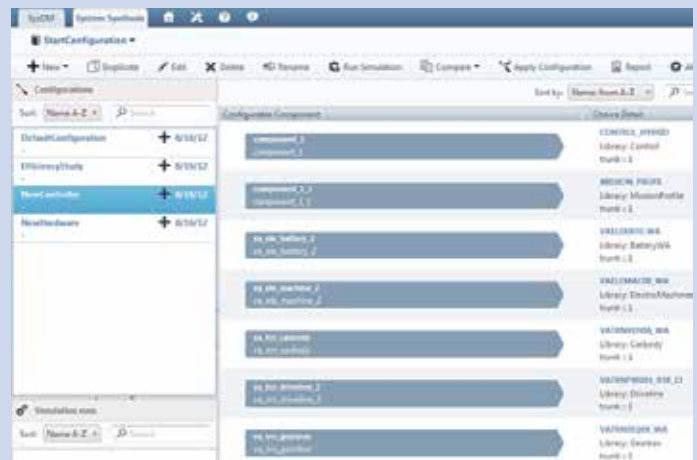
For example, engineering departments can easily publish newly developed models or modified and updated models in a central LMS Imagine.Lab SysDM repository without leaving LMS Imagine. Lab AMESim. Likewise, users will also have direct access to other published models for localized re-use in new modeling projects.

Tool-neutral configurations builder

LMS Imagine.Lab System Synthesis Rev 12 offers more capabilities to build system configurations based on tool-neutral system architecture. Thanks to this, creating and validating multiple configurations for product design can be completely independent of the simulation tool. To achieve this, LMS Imagine.Lab System Synthesis supports SysML system architecture importation.

SysML system architecture describes the different system omponents and how they interact. Multiple configurations can be created by choosing models for the system components from the user libraries. At the end of the configuration process, executable models are generated by LMS Imagine.Lab System Synthesis. During this process, LMS Imagine.Lab System Synthesis Rev 12 interacts with LMS Imagine.Lab SysDM to retrieve the models from the user libraries, and store and manage multiple system configurations in the LMS Imagine. Lab SysDM repository.


More features:

- Enhanced LMS Imagine.Lab AMESim User Library Management
- Simulink User Library Management
- Enhanced Flexibility in Classification
- Collection Related Features
- Architecture Driven Simulation: LMS Imagine.Lab AMESim
- Architecture Driven Simulation: Simulink
- Architecture Driven Simulation: SysML
- Configuration Management Features

Applications for automotive and ground vehicles

Vehicle and powertrain innovation

For automotive manufacturers and suppliers, business success depends on bringing to market affordable vehicles with a new generation of fuel-efficient powertrains – with excellent fuel economy and reduced CO_2 emissions in mind – without compromising brand values, such as performance, drivability and safety. Desired product innovation is increasingly dependent on controls or mechatronic systems. This requires Electronic Control Units (ECU) innovation that flawlessly integrates within underlying mechanical subsystems.

This requires an evolution from rapid prototyping, using physical hardware, to a model-based systems engineering approach, using simulation models to represent the controlled systems. LMS Imagine. Lab proposes innovative, comprehensive solutions to support this development approach. A wide range of validated, automotive-specific libraries allows multi-disciplinary design optimization. The capability to select the appropriate accuracy as well as the ease-of-use support the design process from subsystems design and sizing to full vehicle integration. These multi-physics subsystem and system models can be made available as real-time-enabled plant models to frontload controls engineering.

Vehicle Dynamics
Vehicle System Dynamics
Vehicle Dynamics Control
Braking Systems
Steering Systems
Suspension / Anti-roll

Internal Combustion Engine
Engine Controls
Air Path Management
Combustion
Fuel Injection & Valvetrain

Vehicle Energy Management
Engine Integration
Drivability
Thermal Management

Electric Systems
Energy Storage Systems
Automotive Electrics

Transmission
Manual, Automatic
Continuously Variable
Dual Clutch
Hybrid Architectures

Thermal Management Systems
Heat, Ventilation and Air-Conditioning
Lubrication
Engine Cooling

Integrated customization tools

With the new Apps Designer, interactive, customized graphical user interface elements can be integrated into LMS Imagine.Lab AMESim. This includes text, buttons or slide bars as well as plots and graphical animation. Apps are smart interfaces that include simple or complex data processing capabilities, such as numerical computation, signal analysis, optimization and identification.

This new feature has been extensively used to create new dedicated, application-oriented tools and interfaces in LMS Imagine.Lab Rev12, including a new heat exchanger regression tool, a new battery parameter identification tool, a trajectory generation tool, a combustion analysis tool and an engine block parameterization tool.
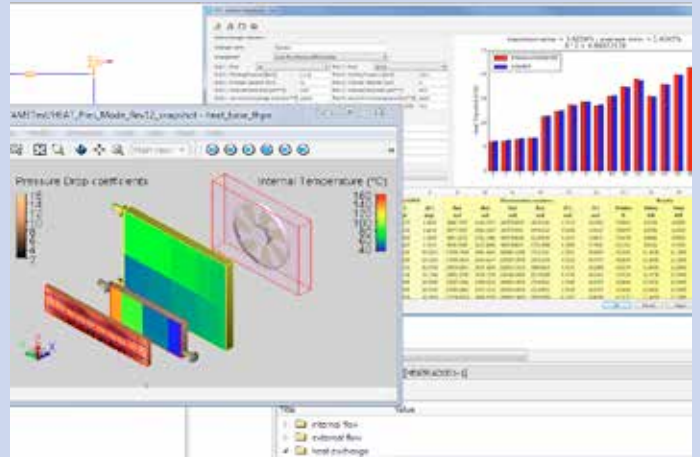
Drivability assessment methodology

LMS Imagine.Lab Rev12 now offers a comprehensive drivability assessment methodology. Starting from a large set of pre-defined scenarios, such as standard or realistic cycles and maneuvers (tip-in and tip-out, gear shift, and full or partial throttle acceleration) as well as full vehicle models, the new versatile drivability assessment tool analyzes driver perception during each manoeuver and feedbacks customizable, objective drivability ratings.

Rating represented in a radar or spider graph can be used to rapidly compare several criteria for different design options. Trade-off balancing between fuel economy, performance and drivability becomes possible during the early stages of the design cycle.
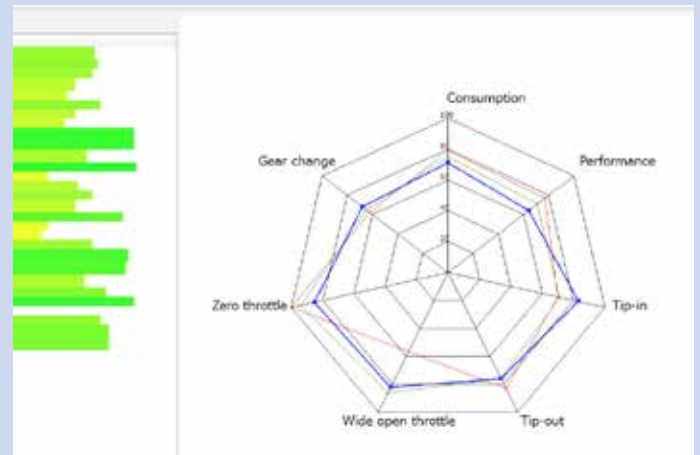
More features:

- New Torsional Vibration Analysis of (L4) Engine Crankshaft Demos
- New App for Dual Mass Flywheel Pre-processing
- New Advanced Driver Models
- New Mean Value Engine Model & Demonstrators
- New Hybrid Mesh Features in IFP-C3D
- New Calibration Tool for Two Phase Flow / Air Conditioning Heat Exchanger
- Component Design in Two Phase Flow Applications
- Chassis Modularity for Multi-Axle Modeling
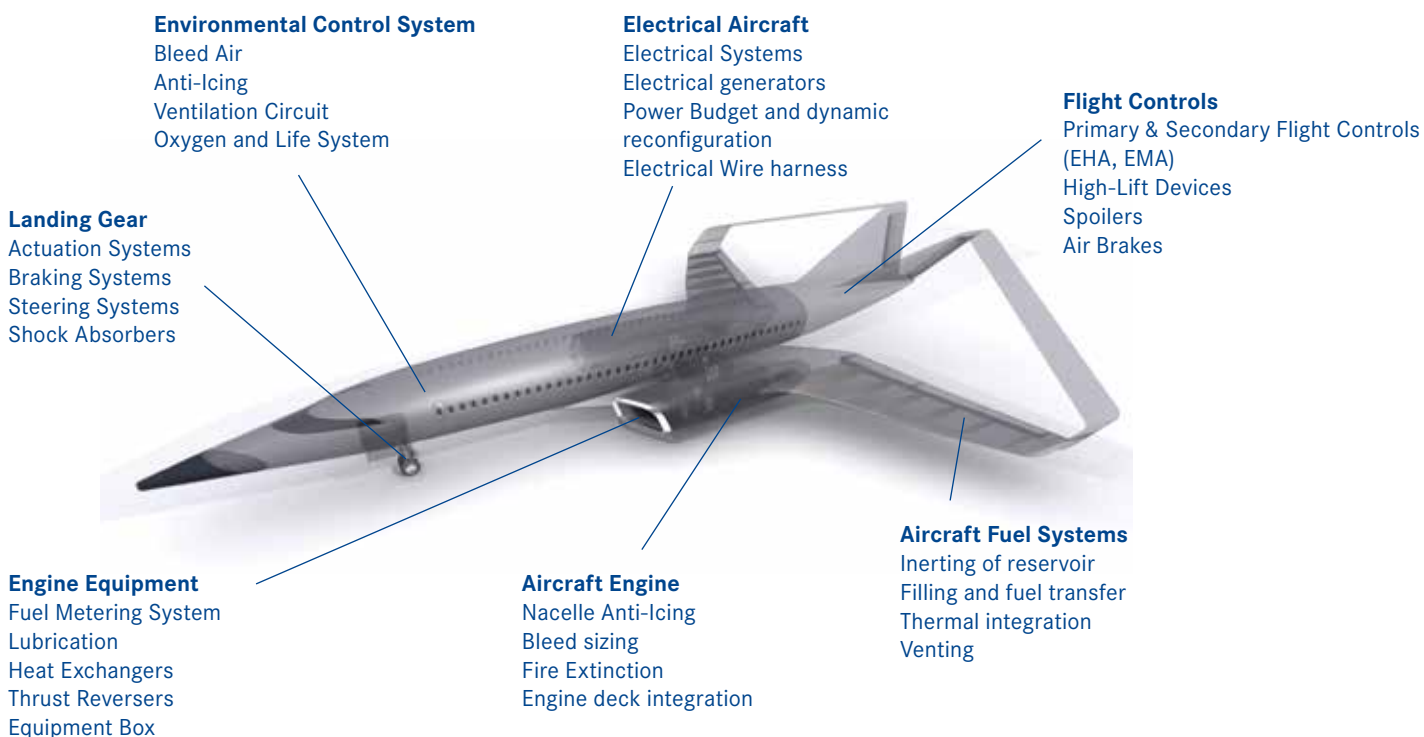- Automatic Launcher For Chassis Multi-Criteria Analysis & Demonstrator

Applications for aeronautics and space

Supporting aeronautics and aviation engineering challenges

The aviation industry has an extensive innovation agenda. Market demands, such as increased safety and comfort, better fuel economy, reduced emissions and noise levels, and overall lower operating costs, are forcing the aircraft industry to rethink traditional engineering methods. Today, the industry as a whole is undergoing a transformation towards new design processes and better use of technology. Managing a growing complexity in systems and solving integration issues have become two critical challenges that push manufacturers and suppliers to make a decisive move towards model-based systems engineering.

In this context, LMS Imagine.Lab provides engineers with a fully scalable solution for aircraft systems design from component design to system integration. Multi-domain and multi-user environments support the complete aircraft development process from the early design stage up to final integration. More than a simple simulation tool, LMS Imagine.Lab gives engineers the capability to create a more secure modeling process for aircraft integration, known as Virtual Integrated Aircraft, and to work in real-time for controls validation with deeper physical insight, known as Virtual Iron Bird. With historical expertise in hydraulic and air systems, LMS Imagine.Lab has extended its domains of expertise to cover thermal integration for new challenges, like electrical aircraft, engine and fuel systems design.

Environmental Control System
Bleed Air
Anti-Icing
Ventilation Circuit
Oxygen and Life System

Electrical Aircraft
Electrical Systems
Electrical generators
Power Budget and dynamic reconfiguration
Electrical Wire harness

Flight Controls
Primary & Secondary Flight Controls (EHA, EMA)
High-Lift Devices
Spoilers
Air Brakes

Landing Gear
Actuation Systems
Braking Systems
Steering Systems
Shock Absorbers

Engine Equipment
Fuel Metering System
Lubrication
Heat Exchangers
Thrust Reversers
Equipment Box

Aircraft Engine
Nacelle Anti-Icing
Bleed sizing
Fire Extinction
Engine deck integration

Aircraft Fuel Systems
Inerting of reservoir
Filling and fuel transfer
Thermal integration
Venting

Fuel Systems library

The new Fuel Systems library supports fuel thermal analyses for complete thermal integration of the aircraft. It takes into account the hydraulic networks as well as electrical systems and in-tank variable wetted surfaces.

The library accounts for gravity to determine the exact pressure at every point in every tank for earlier and safer tank design validation during fuelling, de-fuelling and transfers. This new library offers an unrivalled solution to assess not only the fuel system as a piping network, but also it can be used to analyze the entire thermal integration, inerting system and pressurization network.
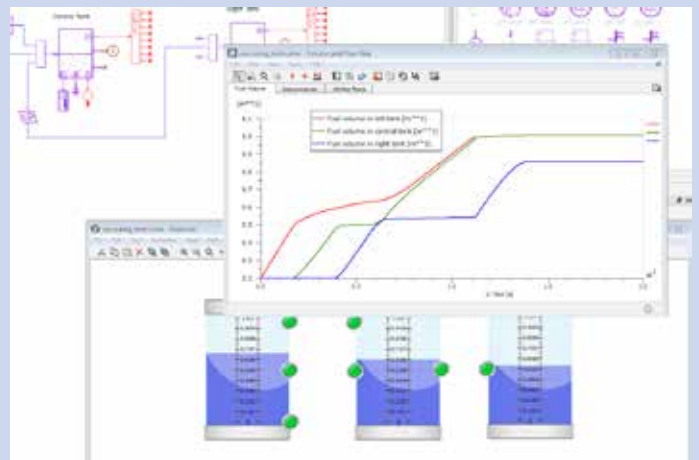
Aircraft Electrics library

The new Aircraft Electrics library helps designing reliable electrical networks. With this library, LMS Imagine.Lab Rev 12 provides a complete solution covering areas, such as power budget and slow transient and high transient analysis capabilities.

Dedicated components easily and smoothly integrate elements of more electrical aircraft within the well-known framework of more traditional aircraft design steps. Users of LMS Imagine.Lab Rev 12 and the new library can combine fuel, thermal exchanges, air systems and flight controls or even landing gear actuation devices to fairly assess the energy requirement. Engineers can reconfigure the entire aircraft network and assess possible emergency situations.

More features:

- New Aeronautics & Space library
- Coupling NPSS® to LMS Imagine.Lab AMESim
- New Adaptive Thermal-Hydraulics solution
- New Regression Tools for Heat Exchanger Submodels
- New Finite Element Import Library
- Consistent and Generic Way to Model Convective Heat Exchanges
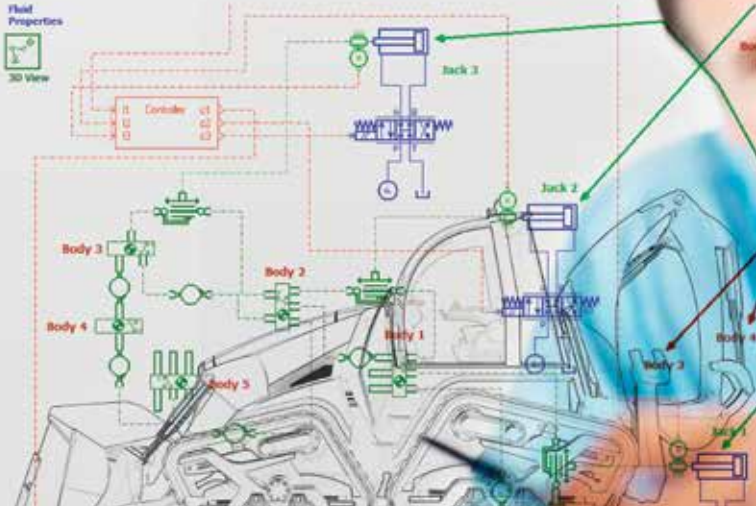
Applications for mechanical industries

Innovation for mechanical industries

Like many other sectors where product complexity has grown exponentially, the mechanical industries sector has to deal with various critical engineering challenges – regulations, market expectations, and economic environments. Just like other industries, they design and manufacture high-performance products, which are continuously improved to reach higher energy efficiency and overall sustainability levels. A large majority of systems developed in the mechanical industry field are complex, controlled systems. To pro-actively engineer the functional performance of these intelligent systems, manufacturers have to optimize the complex interaction between mechanical, hydraulic, pneumatic, thermal and electric/electronic components and subsystems.

For performance and energy-saving purposes, transient behavior has to be assessed in a scalable fashion to validate each stage of the mechatronic systems design cycle. In addition, this field tends to work with huge data sets that have to be managed in a dedicated environment. This is why LMS Imagine.Lab is an ideal solution for model-based systems engineering. Geared towards mechatronic system simulation, the LMS Imagine.Lab platform offers engineers an open development approach starting from functional requirements until physical modeling and simulation.

Gas-Mixture Systems
Pipes /pipe fitting
Valve
Heat exchanger

Pneumatic Systems
Compressor
Valve
Actuator

Hydraulic Systems
Pump / Valve
Actuator
Pipes/pipe fitting

Gas-Mixture Systems
Pipes /pipe fitting
Valve
Heat exchanger

Two-Phase Flow Systems
Air conditioning system
Heat pump
Rankine cycle system

Electrical Systems
Circuit Breaker
Switches/Relay
Electric storage

Electromechanical
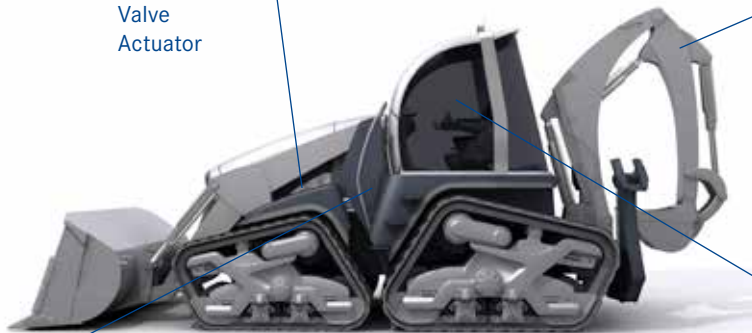Components
Solenoid valve
Electrical motor
Piezoelectric actuator

Mobile Hydraulics Actuation Systems
Fluid power actuation

An unrivalled thermofluids solution

LMS Imagine.Lab Rev 12 comes with a new Adaptive Thermal-Hydraulic solution to select a sufficient "assumed" level for fluid systems analysis. It is adaptable to isothermal, isentropic or full energy balance analysis within a unique model. Depending on the selected assumption, equations, parameters and variables numbers are adapted to improve user-friendliness, add scalability to analysis and adapt the CPU times accordingly.

LMS Imagine.Lab Rev 12 improves the way to use, parameterize and characterize heat exchanger components. It now integrates an automatic calibration tool to easily correlate heat exchanger performance to measurement data from condensers or evaporators.

Heat exchanger regression tools have also been improved. It is now possible to use NTU methods for highly accurate correlation whatever the flow regime (laminar, turbulent) or the amount of experimental data.
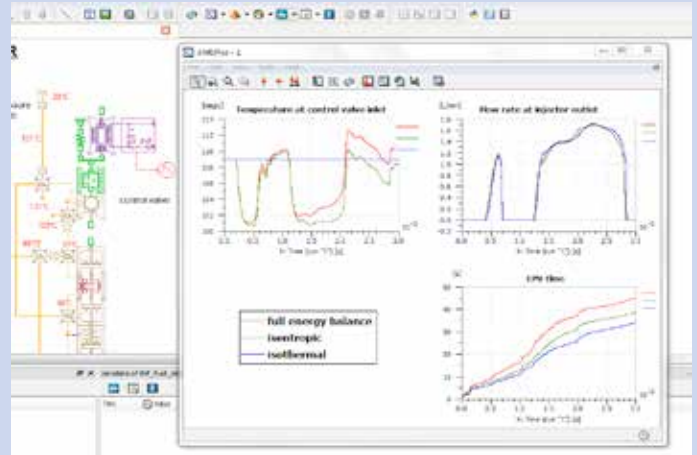
Energy Storage Systems solution

The new Energy Storage System solution and the associated Battery Identification Tool perfectly complements the existing, extended electrical solution for electrical networks sizing, electric machines and associated control, electric basics and switches.

Included in the package, the new Electric Storage library lets users study the thermal-electric behavior of ultra-capacitors and battery components, including a scalable approach to analyze the battery performance on the cell level. This solution accurately represents the transient and steady-state response of classical battery technologies and shows how they affect the electric system performance.
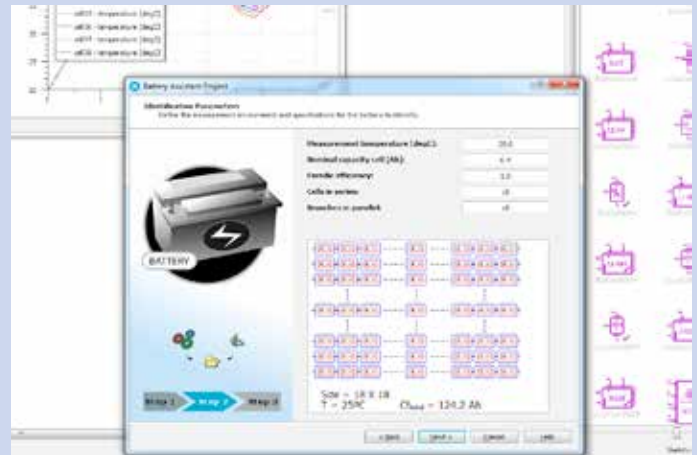
More features:

- New Planar Mechanical Ropes and Sheaves
- New Finite Element Import Library
- Planar Mechanical Body with Variable Inertia and Position of Center of Gravity
- Mechanical Signed Sensors
- New Adaptive Thermal-Hydraulics solution
- Media Properties Assistant
- New Regression Tools for Heat Exchangers Submodels
- New Thermal Library Components & Submodels
- New Calibration Tool for Two-Phase Flow/Air Conditioning
- Heat Exchangers

LMS is a leading provider of test and mechatronic simulation software and engineering services in the automotive, aerospace and other advanced manufacturing industries. As a business segment within Siemens PLM Software, LMS provides a unique portfolio of products and services for manufacturing companies to manage the complexities of tomorrow's product development by incorporating model-based mechatronic simulation and advanced testing in the product development process. LMS tunes into mission-critical engineering attributes, ranging from system dynamics, structural integrity and sound quality to durability, safety and power consumption. With multi-domain and mechatronic simulation solutions, LMS addresses the complex engineering challenges associated with intelligent system design and model-based systems engineering. Thanks to its technology and more than 1250 dedicated people, LMS has become the partner of choice of more than 5000 manufacturing companies worldwide. LMS operates in more than 30 key locations around the world.

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