# MSC Software Suite

MSC Apex: Integrated Modelling & Simulation

MSC Apex Modeler is a CAE specific direct modelling and meshing solution that streamlines CAD clean-up, simplification and meshing workflow. The solution features sophisticated and interactive tools that are easy to use and easy to learn. MSC Apex Structures is an add-on product which expands MSC Apex Modeler functionality with capabilities for linear static and dynamic structural analysis.

MSC Apex structures packages a user interface for scenario definition and results post-processing, as well as integrated solver methods. This solution is unique in that it combines computational parts and assemblies technology with a generative framework, which enables interactive and incremental analysis. The integration of the user interface with solver methods gives the user a unique ability to interactively and incrementally validate that FEM models are solver ready. At the user's demand, a series of solver checks can be run against individual parts and assemblies and the model diagnostics are reported in the Analysis Readiness panel. This Incremental Validation is a radical departure from the very time consuming traditional approach where pre/post processor and solver are separate.
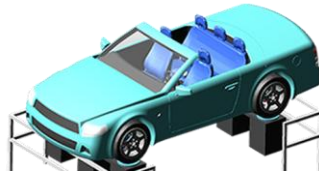
Adams: Multi-Body Dynamics

As the world's most famous and widely used Multibody Dynamics (MBD) software, Adams improves engineering efficiency and reduces product development costs by enabling early system-level design validation. Engineers can evaluate and manage the complex interactions between disciplines including motion, structures, actuation, and controls to better optimize product designs for performance, safety, and comfort. Along with extensive analysis capabilities, Adams is optimized for large-scale problems, taking advantage of high performance computing environments.

Utilizing multibody dynamics solution technology, Adams runs nonlinear dynamics in a fraction of the time required by FEA solutions. Loads and forces computed by Adams simulations improve the accuracy of FEA by providing better assessment of how they vary throughout a full range of motion and operating environments.
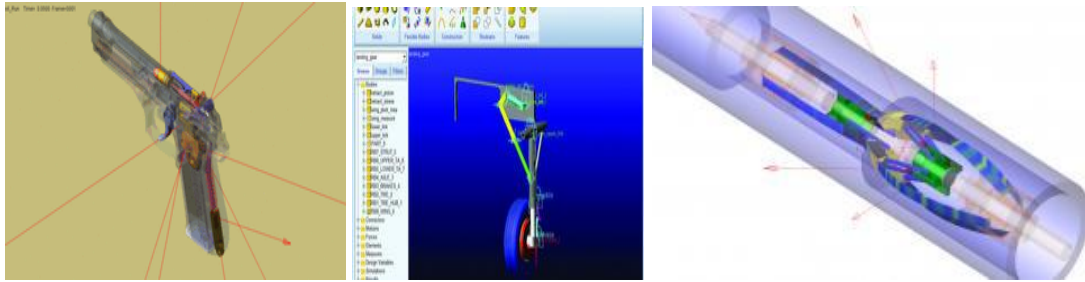
Additional modules available with Adams allow users to integrate mechanical components, pneumatics, hydraulics, electronics, and control systems technologies to build and test virtual prototypes that accurately account for the interactions between these subsystems.

Adams Control integration – Adams Control and Adams Mechatronics

Adams Mechatronics is a plug-in to Adams which can be used to easily incorporate control systems into mechanical models. Adams Mechatronics has been developed based on the Adams Control functionality and contains modeling elements which transfer information to/from the control system. For example, using Adams Mechatronics in Adams Car, you can quickly create assemblies of vehicle systems including control systems, and then analyze them to understand their performance and behavior.

Adams Flexible Body Integration – Adams Flex and Adams Viewflex
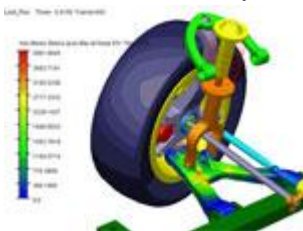
Adams Flex provides the technology to correctly include a component's flexibility even in presence of large overall motion and complex interaction with other modeling elements. Greater emphasis has been placed these days on high-speed, lightweight, precise mechanical systems. Often these systems will contain one or more structural components where deformation effects are paramount for design analyses and the rigid body assumption is no longer valid. Adams Flex allows importing finite element models from most major FEA software packages and is fully integrated with Adams package providing access to convenient modeling and powerful post-processing capabilities.

Adams Durability - Integrate with MSC Fatigue to do component life prediction


Durability testing is a critical aspect of product development and issues discovered late in the development cycle lead to project delays and budget overruns. Worse yet, "in service" failures lead to dissatisfied customers, safety issues, and warranty costs. Adams Durability allows engineers to assess stress, strain or life of components within mechanical systems to design products to last. Direct access to physical test data in industry-standard file formats enables engineers to use loads data captured during tests, and to easily correlate simulation and testing results.

Adams Vibration - Create input and output channels for vibration analyses


With Adams Vibration, engineers replace physical tests on shaker devices with virtual prototypes. Noise, vibration, and harshness (NVH) are critical factors in the performance of many mechanical designs but designing for optimum NVH can be difficult. Adams Vibration allows engineers to easily study forced vibration of mechanical systems using frequency domain analysis.
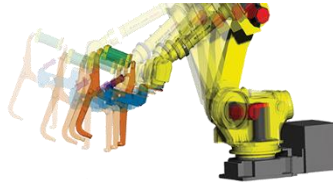
Easy5: Advanced Controls & Systems Simulation

Accurately simulate control systems, hydraulics (including thermal effects), pneumatics, gaseous flow, thermal, electrical, mechanical, refrigeration, environment control, lubrication or fuel systems, and sampled-data/discrete-time behaviour.

Engineering aircraft, vehicles, agricultural equipment, and other complex systems requires a systems-engineering approach in which not only the components and subsystems but the entire system as a whole is tested. Traditional build and test methodologies are time-consuming and expensive; and now more than ever, every industry is challenged to meet the conflicting requirements of increasing innovation while reducing cost and time to market.
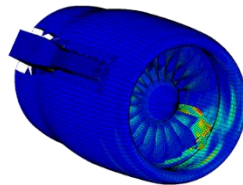
MSC Nastran: Structural, Thermal & Dynamic Analysis

MSC Nastran is a multidisciplinary structural analysis application used by engineers to perform static, dynamic, and thermal analysis across the linear and nonlinear domains, complemented with automated structural optimization and award winning embedded fatigue analysis technologies, all enabled by high performance computing. The most common uses of MSC Nastran are:

- Multidisciplinary Structural Analysis
- Structural Assembly Modeling
- MSC Nastran Advanced Nonlinear Analysis
- MSC Nastran Embedded Fatigue
- Perform Fatigue Analysis Faster
- Optimize Product Life, Reduce Product Weight

Engineers use MSC Nastran to ensure structural systems have the necessary strength, stiffness, and life to preclude failure (excess stresses, resonance, buckling, or detrimental deformations) that may compromise structural function and safety. MSC Nastran is also used to improve the economy and passenger comfort of structural designs.

Marc: Advanced Nonlinear Simulation Solution

Marc is a powerful, general-purpose, nonlinear finite element analysis solution to accurately simulate the product behavior under static, dynamic and multi-physics loading scenarios. Marc's versatility in modeling nonlinear material behaviors and transient environmental conditions makes it ideal to solve your complex design problems.

Marc is ideal for product manufacturers looking for a robust nonlinear solution. It has capabilities to elegantly simulate all kinds of nonlinearities, namely geometric, material and boundary condition nonlinearity, including contact. It is also the only commercial solution that has robust manufacturing simulation and product testing simulation capabilities, with the ability to predict damage, failure and crack propagation. Combined with its multi-physics capabilities that help you couple thermal, electrical, magnetic and structural analyses, Marc is the complete solution that can address all your nonlinear simulation requirements.
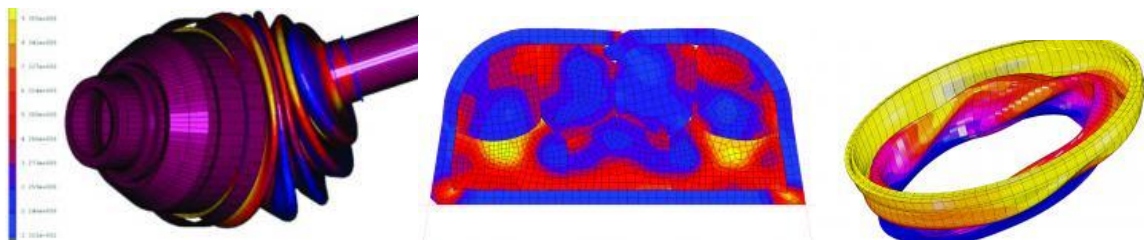

Marc's Nonlinear and Multiphysics Solution is commonly used for:
- Nonlinear analysis that incorporates all forms of nonlinearities (Material, geometric, boundary condition including contact)
- Coupled thermomechanical analysis
- Electromagnetics
- Piezoelectric analysis
- Electrical-Thermal-Mechanical
- Ductile damage
- Damage accumulation in elastomers
- Composite failure analysis
- Laminate bond failure
- Low tension cracking and crushing
- Fracture mechanics
- Crack propagation under monotonous, low cycle and high cycle loads
- User defined failure models
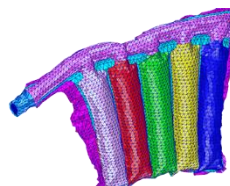
Dytran: Explicit Dynamics and Fluid Structure Interaction

Dytran is an explicit finite element analysis (FEA) solution for simulating short-duration events like impact and crash, and to analyze the complex nonlinear behavior that structures undergo during these events. Dytran enables you to study the structural integrity of designs to ensure that final products stand a better chance of meeting customer safety, reliability, and regulatory requirements. Dytran delivers a structural, material flow and coupled FSI analysis capabilities in a single package. Dytran uses a unique coupling feature that enables integrated analysis of structural components with fluids and highly deformed materials in one continuous simulation.
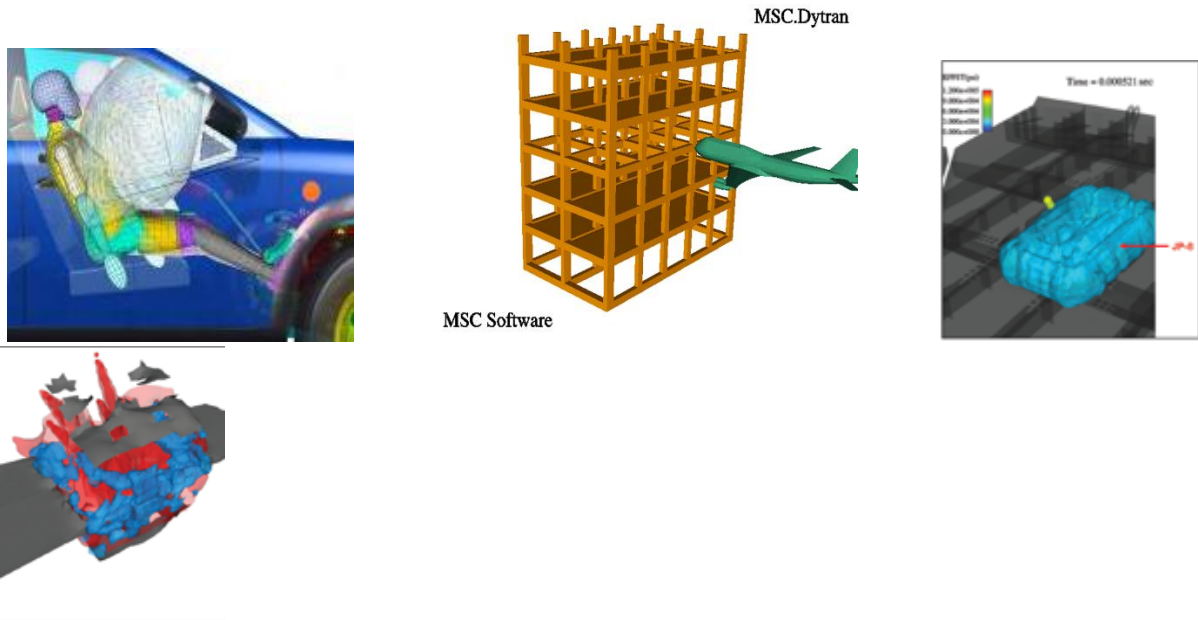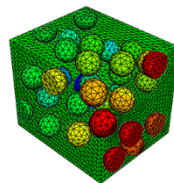

## Digimat: The Nonlinear Multi-scale Material and Composite Structure Modelling Platform

Digimat technology provides design tools that give the user 100% confidence in their composites products thanks to an accurate description of the local composite behaviour. Accurate material modelling allows one to reduce the "factor of safety" - allowing composite materials to be used to 100% of their potential, maximizing their competitiveness against metal and leading to substantial weight reduction. Digimat tools integrate smoothly within the current FEA process, bridging the gap between manufacturing process and structural analysis.
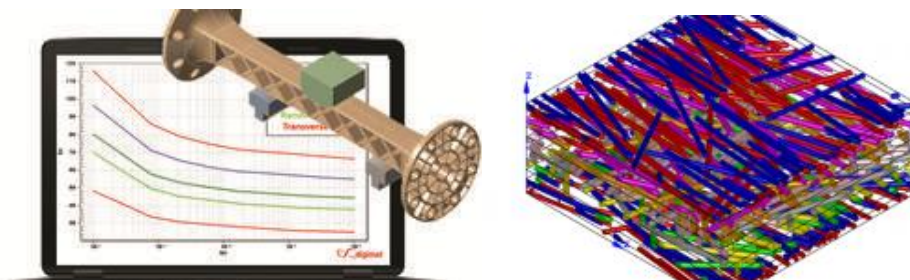
Digimat technology connects the whole value chain together (Material Suppliers, Tier1s and OEMs) and helps to:
- Investigate and predict the behavior of a large mix of composite materials
- Design & Manufacture Innovative High-Performance Composite Parts

- Minimize weight, cost and time-to-market optimal composite industrial parts
- Improve prediction of structural FEA by accounting for manufacturing process
- Reduce material testing and prototyping
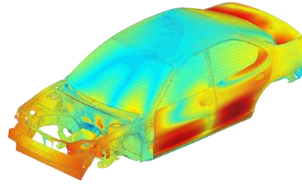
Actran Acoustics: Powerful Acoustic Simulation Software

Actran is the premier acoustics software to solve acoustics, vibro-acoustics, and aero-acoustics problems. Used by automotive manufacturers and suppliers, aerospace and Defence companies, and consumer product manufacturers, Actran helps engineers better understand and improve the acoustics performance of their designs. Actran provides a rich library of material models, a complete element library that includes infinite elements, high performance solvers to solve large size problems and a user-friendly GUI that is highly customizable to your needs. Actran, with its modular nature, can be deployed based on your applications and requirements.
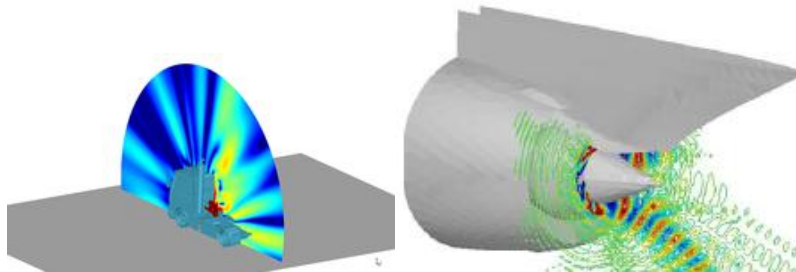

Actran DGM: Jet engine exhaust noise modelling

Actran DGM solves the linearized Euler equations using discontinuous finite elements and is used for predicting the noise propagation in complex physical conditions. It is particularly well suited to solving aero-acoustic problems at the exhaust of a double flux aero-engine, including effects such as propagation through strong shear layers, high temperature gradients and non-homentropic mean flows.

Examples of usage of Actran:
- Sound radiation by vibrating structures: powertrain, engine components, compressors, electrical motors, loudspeakers and more
- Air conditioning units and distribution systems
- Sound absorption inside passenger compartment of cars, trains and aircrafts
- Aircraft engine noise, including nacelle design
- Ducted cooling systems
- Helicopter turbine noise
- Exhaust and Inlet of turbomachines
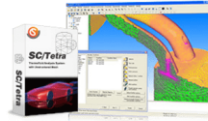
SC/Tetra: General purpose thermo-fluid analysis system with unstructured mesh

SC/Tetra is a general purpose thermo-fluid simulation software that uses a hybrid mesh to accurately represent complex shapes and model geometry. Features such as a sophisticated mesh generation system, high speed computing, low memory consumption, and a user-friendly interface throughout to increase user efficiency.
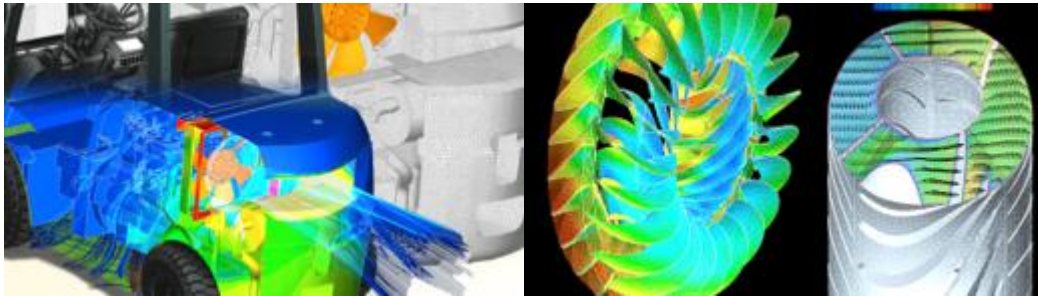
Heat Designer: Thermal Design Tool for Electronics

HeatDesigner performs thermal fluid analysis specifically designed for electronic cooling. HeatDesigner's performance is optimized for applications that do not require precise reproduction of fine geometrical curvature to predict an accurate flow field. However, HeatDesigner is capable of accommodating meshes with over one hundred million elements, enabling it to capture fine geometrical details. The major advantages of HeatDesigner are fast calculation times and low memory consumption.
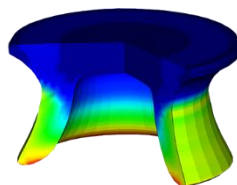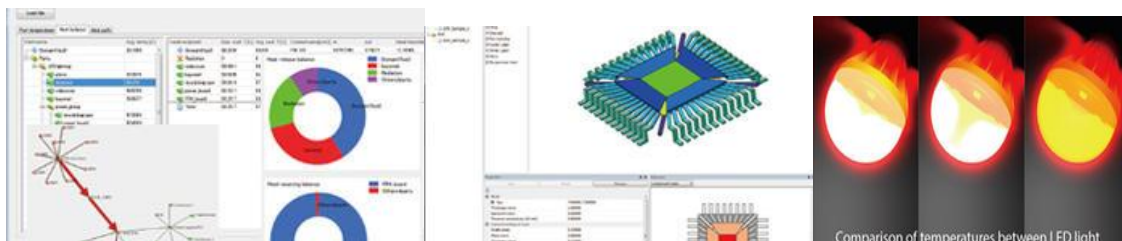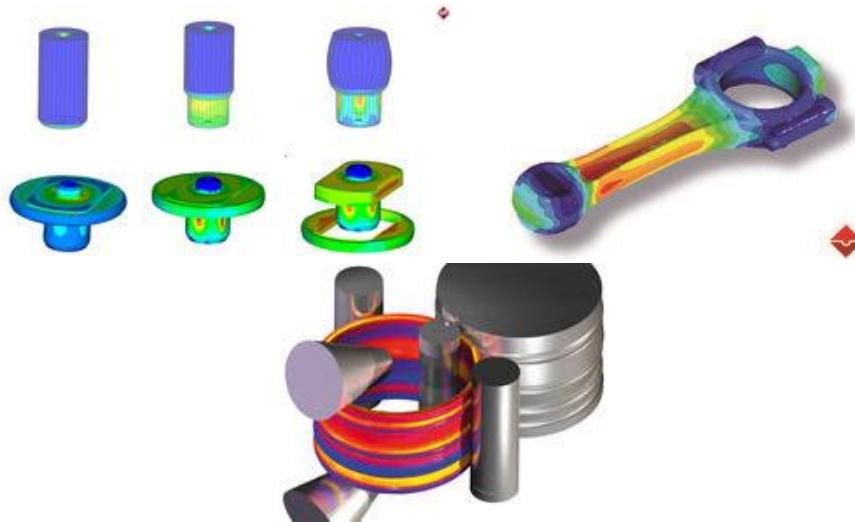

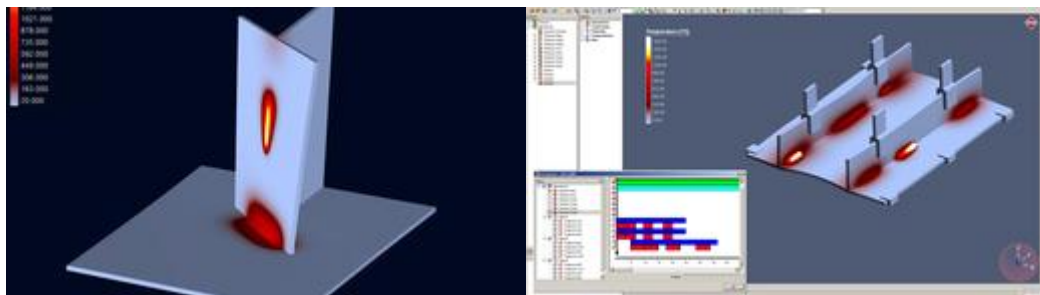## Simufact: Manufacturing Process Simulation for Metalworking Industry

Simufact is an industry leader in providing simulation solutions for all of the metal manufacturing process chains. These include metal forming, mechanical and thermal joining operations, and additive manufacturing processes. Simufact's product solutions can optimize these manufacturing processes by reducing costs and time to market, while consistently providing accurate results.

Simufact Forming covers the complete spectrum of forming technologies and guarantees a realistic portrayal of the processes with full 3D functionality and 3D representation of all the tools and parts. Accurate simulations are possible by capturing the key aspects that affect the processes. Some of the manufacturing operations performed using Simufact are:

- Sheet metal forming
- Rolling
- Ring rolling
- Open die forging
- Heat treatment

Simufact Welding helps simulate complex welding processes that may involve multiple welding sequences and predicts distortions of the components, while considering phase transformations occurring during the process. With Simufact Welding, users gain insight into the properties of the weld seam, and welding defects such as hot cracks, helping them to address problems prior to putting the process into use.

Simufact Additive is a powerful simulation environment for "right the first time" optimization of powder bed additive manufacturing processes (SLS, SLM,LBM, DMLS , EBM) Simufact Additive predicts the distortion and residual stresses in the part and guides the production engineer in how to compensate to ensure a quality part the first time. Process control variables may be selected to optimize the 3-D printing process to reduce time and waste.
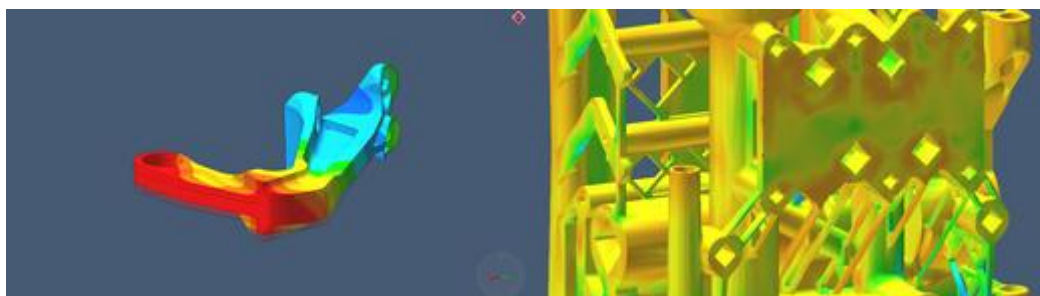
Virtual Test Drive

VIRES: Complete tool-chain for driving simulation applications

VTD is used for the creation, configuration, presentation and evaluation of virtual environments in the scope of road and rail based simulations. It is used for the development of ADAS and automated driving systems as well as the core for training simulators. It covers the full range from the generation of 3D content to the simulation of complex traffic scenarios and, finally, to the simulation of either simplified or physically driven sensors. It is used in SiL, DiL, ViL and HiL applications and may also be operated as co-simulations including 3rd party or custom packages.