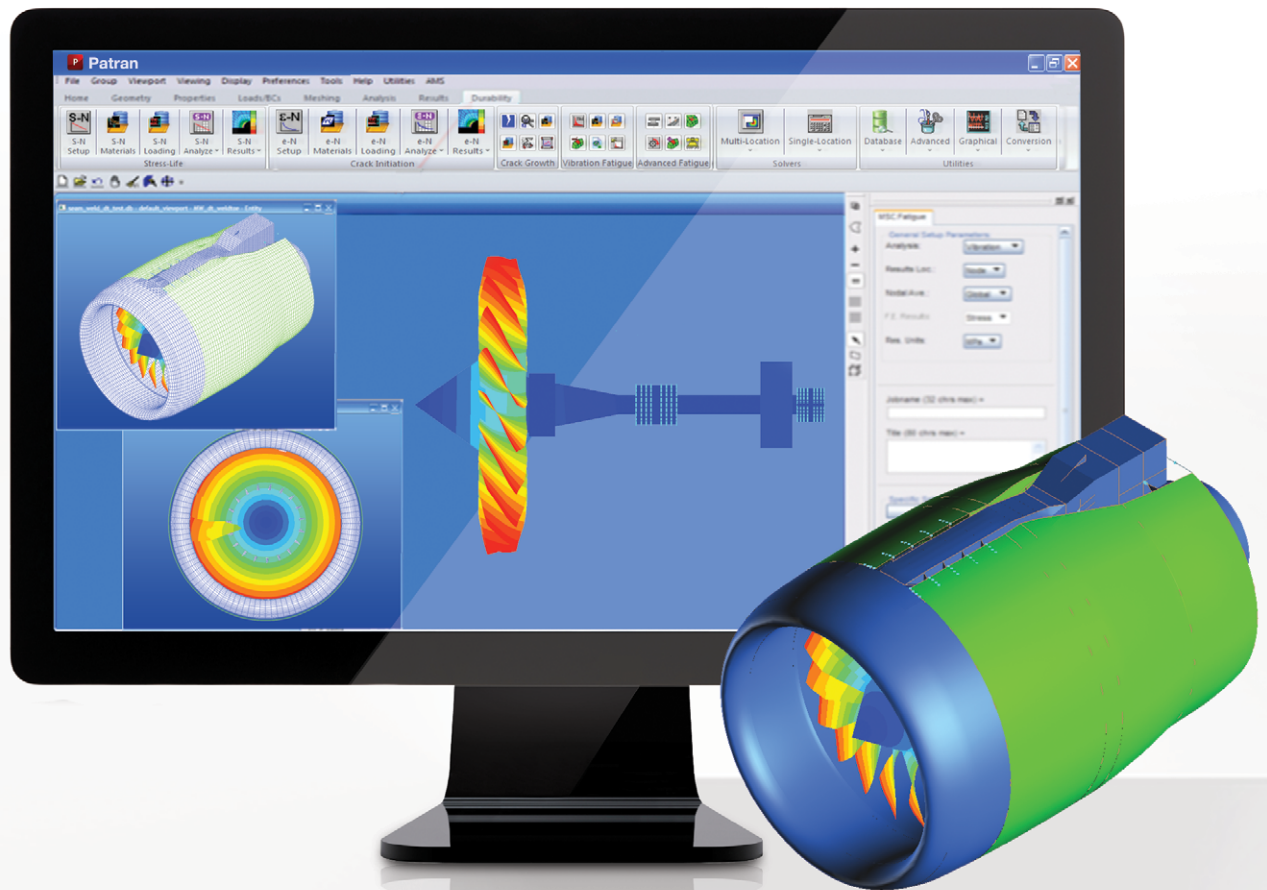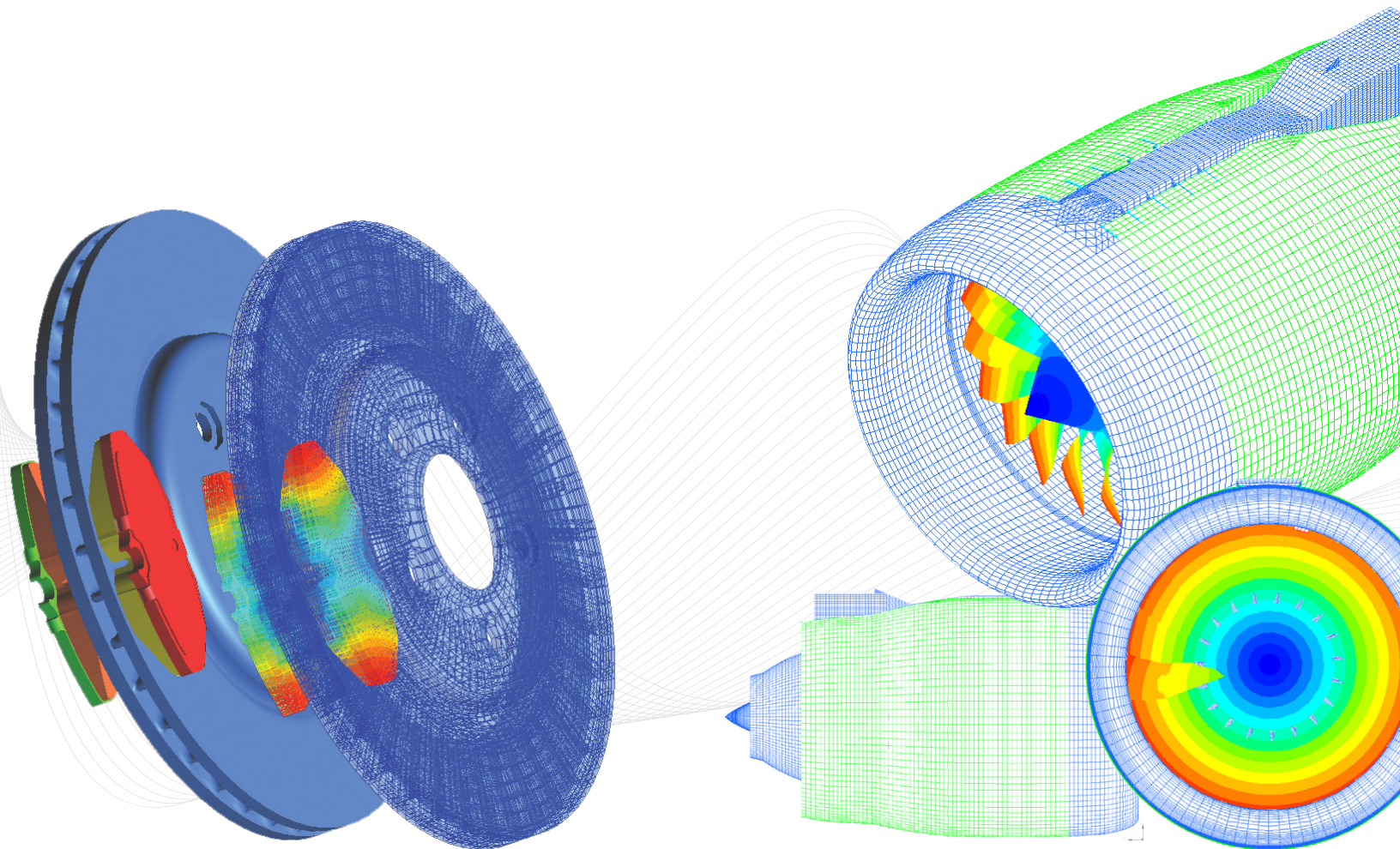# MSC Nastran™

Structural & Multidiscipline Simulation

MSC Nastran is Engineered for You

MSC Nastran is the premiere finite element analysis solver from MSC Software that continues to be the selected choice by engineers for over 40 years.

From the high performance computing capability to the high degree of certainty it delivers, MSC Nastran is engineered to give you a heightened awareness of how your products will behave.

Why Many Choose MSC Nastran for FEA

High Performance

Known across the world for generating fast and accurate simulation results, this advanced solver efficiently takes advantage of your computing resources, thanks to continuously improved parallel processing capabilities, smart algorithms, and convenience tools. Simulate with speed and increase your productivity knowing MSC Nastran finishes large complex simulations faster than leading competitors.

Accuracy

MSC Nastran is built on work contracted by NASA and is the trusted FEA solution for industries worldwide. Nearly every spacecraft, aircraft, and vehicle designed in the last 40 years has been analyzed using MSC Nastran because it delivers unparalleled accuracy. Today, MSC Software is constantly improving MSC Nastran to produce results that continue preserving its reputation as an accurate solver.

Outstanding Support Network

MSC Software provides you a convenient network of support that enables you to increase the depth of your simulations. You may speak to one of our engineers for assistance or access Simcompanion, the MSC Knowledge base for technical articles, documentation, webinars, technical support and more. You can interact with other knowledgeable MSC Nastran users on our online forums. You can attend user conferences hosted by MSC or training courses also hosted by MSC. Work with MSC Nastran knowing we strive to provide information and support your needs.

MSC Nastran Development

In 2011, Maximum PC listed MSC Software as one of "The 10 Original Software Companies." The list is shared with Apple, Computer Sciences Corporation, IBM, Microsoft, and others. This recognition is credited to the rich talent MSC Software has employed to develop MSC Nastran, and today, great minds are actively developing new capabilities that continue to bring efficient solutions to you.

Uninterrupted Action

Other FEA solvers require separate models for separate analyses, but MSC Nastran provides options to combine analyses together. Make one model with numerous analyses and have a single run for uninterrupted action with MSC Nastran's Analysis Chaining and Multidiscipline analysis capabilities.
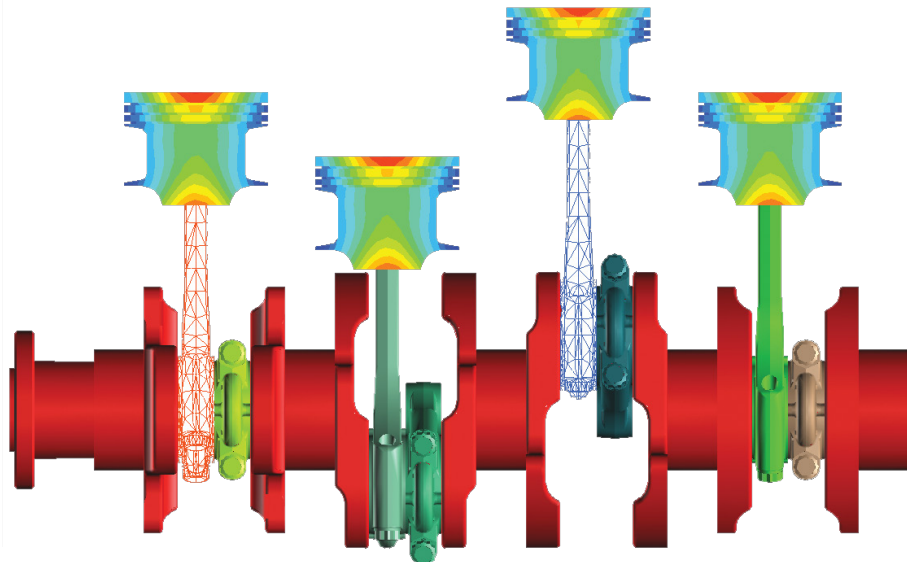
Nonlinear and Linear Structural Analysis

Use MSC Nastran to efficiently and accurately capture the nonlinear and linear behavior of your designs.
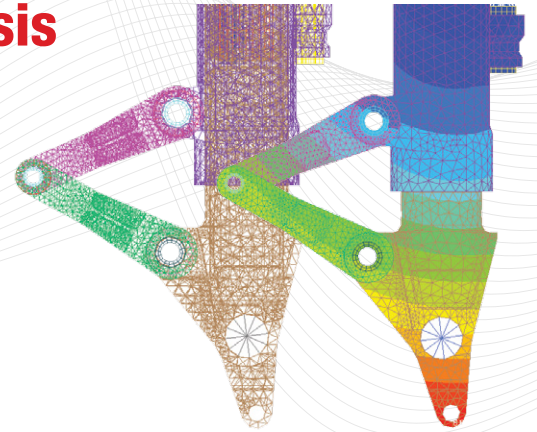
> "MSC's integrated solution for linear and nonlinear calculations facilitates reuse of models which saves a lot of time in pre-processing and enables us to standardize the data exchange formats for body models when collaborating with other departments or external suppliers"
>
> Sylvain Calmels,
> PSA Peugeot Citroën

Implicit Nonlinear

- Perform nonlinear static or nonlinear transient studies

- Represent scenarios that include nonlinear materials, geometric nonlinearities, contact and constraint changes

- Utilize materials and finite elements capable of large strains, large displacements and rotations

- Select from a list of nonlinear materials: Elastic-Plastic, Nonlinear Elastic, Advanced Hyperelastic, Advanced Composites, Gasket, Crack, Creep, Shape Memory Alloy, and more

- Find critical stability loads by performing nonlinear buckling analyses

Analysis Chaining and Multidiscipline Analysis

- Perform nonlinear analysis chaining where multiple analyses, based on the nonlinear equilibrium state of a structure, are chained and solved

- Combine MSC Nastran's extensive number of linear solution types into single FE models and single analysis runs

- Execute coupled thermo-mechanical analysis, where an analysis can be static or dynamic and coupled to steady state or transient heat thermal analysis

- Perform coupled thermo-mechanical analyses
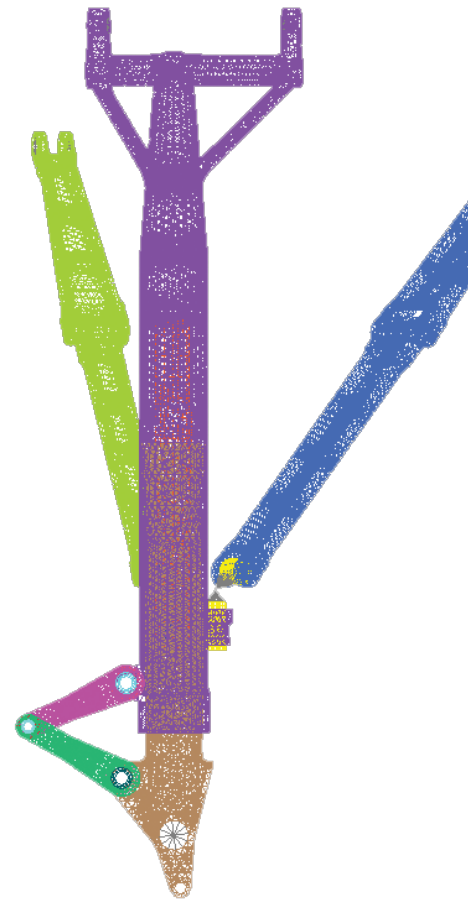
Composites Modeling & Analysis
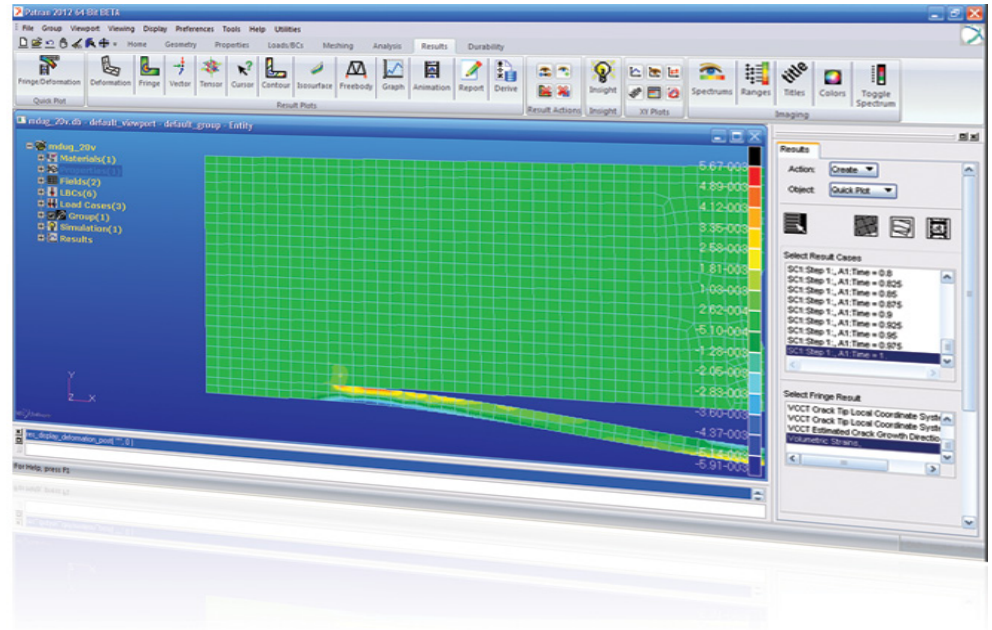
Nonlinear Contact

- Study multi-body contact for 2D or 3D scenarios

- Model contact between pure deformable bodies or a combination of deformable and rigid bodies

- Use sophisticated built in contact detection and separation controls

- Include friction in your analysis

- Review vital contact results: contact status, contact forces and stresses

- For assembly modeling, define numerous contact interactions with ease through the use of contact pairs

Nonlinear Explicit

- Analyze dynamics of short duration with severe geometric and material nonlinearities including, but not limited to, crash, drop test, and impact

- Simulate complex fluid structure interaction problems

- Use the smooth-particle hydrodynamics (SPH) method to model fluid flow problems for crashworthiness on water or soft soil, high velocity impact, and penetration and perforation problems

- Simulate crash, impact and similar scenarios

Rotordynamics

- Simulate rotordynamic related situations such as imbalance response and general excitation, maneuver loads, blade-out-response, and others

- Calculate critical speeds and whirl frequencies

- Model multi rotor systems

- Predict rotor rubbing

- Represent rotordynamic models with line or axisymmetric elements

- Employ external superelements on rotor models

- Accurately model squeeze film dampers
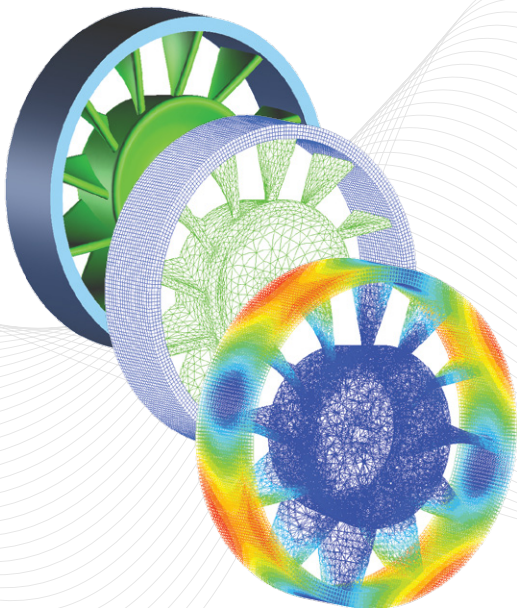
Structural Linear

- Analyze models subjected to static loads within the linear domain

- Find the normal modes and natural frequency of your components

- Perform linear buckling analyses

- Take advantage of local adaptive mesh refinement for automated alteration and controlling of meshes in areas of interest

Dynamics

- Perform by direct or modal means: Frequency response analysis, Transient Response Analysis, and Complex Eigenvalue analysis

- Carry out linear or nonlinear transient response analysis

- Execute random analysis with coupled excitations

- Perform static Aeroelastic, dynamic Aeroelastic, and flutter analysis of structures

- Perform supersonic Aeroelastic analysis of structures that experience unsteady supersonic lifting surface aerodynamics such as high-speed transports, launch and re-entry vehicles, air-combat vehicles, and missiles

- Use Flightloads to predict external loads on aerospace vehicles as well as predict structural dynamic response

- Simulate Rotor Dynamic Related Situations such as Imbalance Response and General Excitation, Maneuver Loads, Blade-Out-Response, and others

More Solutions in One Solver

Expand the depth of your simulations with MSC Nastran's wide spectrum of multidiscipline solutions, and anticipate complex structural behaviors before creating expensive physical prototypes.

"MSC Nastran reduced the weight by a factor of two, while maintaining the required optical and structural performance"

Dr. Victor Genberg, Sigmadyne
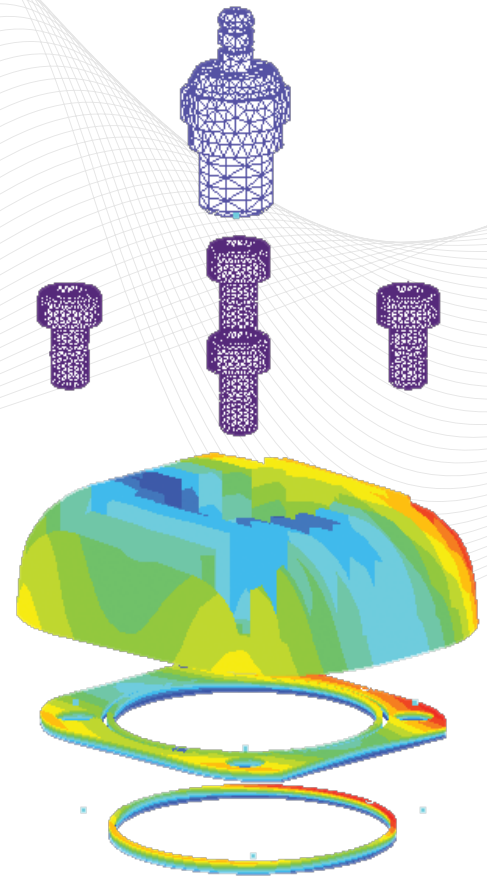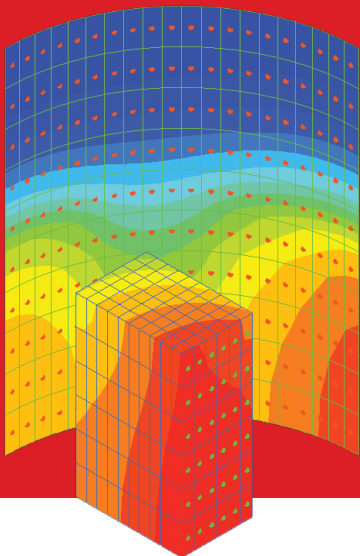
Thermal

- Perform linear or nonlinear steady-state or transient heat transfer analysis
- Simulate conduction, free or forced convection, radiation to space, radiation enclosures, and coupled advection
- Analyze thermal contact scenarios
- Create coupled thermal-mechanical simulations

Composites

- Analyze structures composed of composite laminates
- Study the behavior of composite honeycomb sections
- Investigate the delamination and failure of plies, matrix, fiber and interlaminate plies of composite structures at micro-mechanic levels
- Predict failure with a selection of 24 failure theories
- Use the Virtual Crack Closure Technique to model fracture mechanics
- Model with certainty the progressive failure of your advanced composite structures
- Promote advanced composite modeling through the use of User Defined Subroutine and integrate with material modeling solutions such as Digimat

Assembly

- Model linear or nonlinear contact phenomena with accuracy thanks to sophisticated contact algorithms
- Utilize connector elements to efficiently model spot welds, seam welds, bolts, screws, and other similar structural connections and fasteners
- Utilize the built in gasket material model to design gaskets with desired behavior

Fatigue Analysis

- Perform fatigue life and damage analysis within concurrent analysis
- Use stress-life or strain-life methods for life calculations
- Perform design optimization in conjunction with fatigue analysis

Advanced Multiphysics Simulation
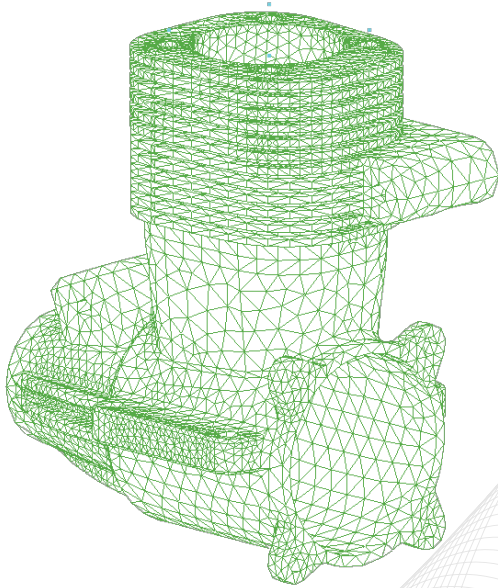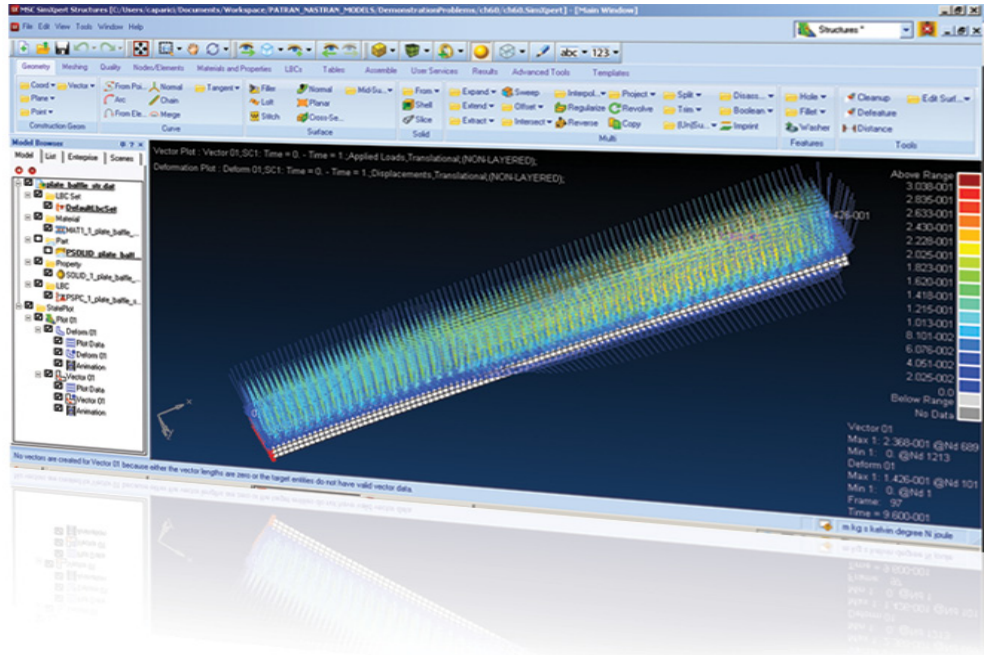
Advanced Structures

- Simulate interior and exterior acoustic analysis

- Solve fluid structure interaction problems with OpenFSI. Some sample applications include: door seal, aspiration, shock absorbers, hydraulic engine mounts, convertible top, flexible wings, time domain flutter, latch loads, wind turbines, and flows in blood vessels.

- Use the Multi-Physics Code Coupling Interface to couple different analysis codes in an analysis

- Utilize the Dynamic Design Analysis Method (DDAM) to determine the dynamic response of a component subjected to shock loading.

- Perform large-scale dynamic analysis in a fraction of the time to solve dynamic and acoustic problems with Automated Component Modal Synthesis (ACMS)

- Analyze large problems, that would otherwise be impossible on limited hardware resources, by partitioning large models into smaller, workable superelements

- Work with sophisticated adaptive meshing and rezoning capabilities in order to maintain the quality of elements during an analysis

- Study the creep and relaxation behavior of structural materials

- Perform multi-flexible-body dynamic analysis with Adams from an MSC Nastran generated Adams/flex input file

- Efficiently perform analysis of complex, symmetric geometries subjected to unsymmetric loadings

- Utilize plain strain and plane stress elements

- Analyze effects of poroelastic trim components on acoustic performance of cabins

- Reuse impedance matrices of trim components in different configurations for faster design studies

- Quickly acquire load summations or free-body interface loads for large numbers of load cases by using Monitor Points

- Add customized element formulations, materials, contact definition, and more with User Defined Services (UDS)

MSC Focuses On Solver Performance
So You Can Focus On Engineering

Perform system simulations with sophisticated parallel processing capabilities and smart, efficient solvers. Also, optimize your structural systems with built in optimization tools in MSC Nastran.

> "MSC Nastran and SimXpert have helped us reduce the time to market on a typical project by 50% while achieving a huge reduction in prototyping expenses"
>
> Srinivas Gade, American BOA

High Performance Computing

- Run analysis jobs in parallel on multi-core processors for faster simulations

- Utilize current computer multiprocessor technologies in parallel for reduced solution times in both networked cluster and SMP environments

- Take advantage of the latest unsymmetric matrix solutions for applications such as rotordynamics, break squeal, and exterior acoustic analysis

- Work with continuously improved parallel scalability for Automated Component Modal Synthesis in Noise, Vibrations, and Harshness analysis

- Extend your computing resources with support for GPGPU hardware

Optimization

- Utilize Size Optimization to improve structural properties including thickness, ply angle, area, Young's Modulus, and others

- Improve the boundary profile of a structural component with Shape Optimization

- Use Topology Optimization early in your design to find optimal design shapes for your parts

- Perform an advanced element-by-element sizing optimization with Topometry Optimization

- Enhance sheet metal parts or similar components with Topography (Bead or Stamp) Optimization

- Design sophisticated experiments for measuring the performance of your mechanical system with Adams/Insight

- Optimize your designs for maximum fatigue life (or minimal damage), or minimize weight for desired fatigue life
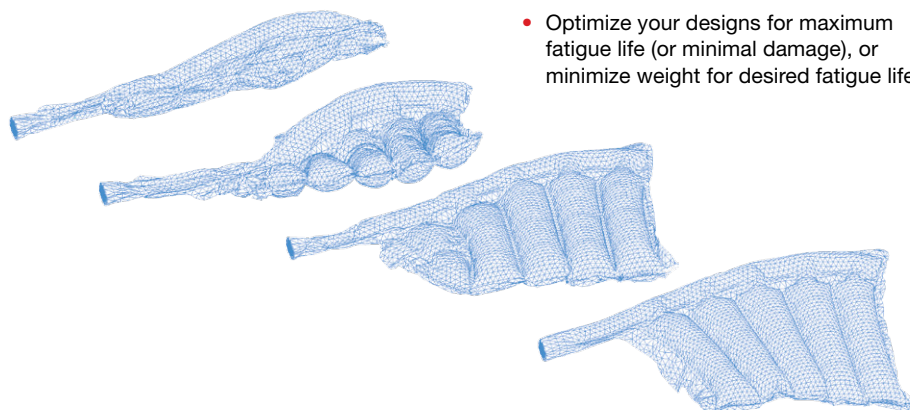
Other MSC Software Products

Patran®

Complete FEA Modeling Solution

Patran provides a user environment for modeling the most complex FEA problems.

SimXpert®

Fully Integrated Multidiscipline Simulation Solution

SimXpert integrates CAE Disciplines into a single environment so engineers can simulate reality.

MSC Nastran Desktop™

Multidiscipline Simulation for your Desktop

Packaged to suit your needs, MSC Nastran Desktop offers bundled CAE solutions for mid-sized manufacturing businesses.

Actran™

Powerful Acoustic Simulation Software

The Actran product suite is the the most powerful engineering solution for acoustic, vibro-acoustic, and aero-acoustic modeling and simulation.

Adams™

The Multibody Dynamics Simulation Solution

Adams helps engineers understand real dynamics of mechanical systems.

SimManager™

Simulation Data and Process Management

SimManager helps companies establish repeatable processes for simulation.

SimDesigner™

CAD-embedded Multidiscipline Simulation

SimDesigner helps design engineers bring analysis early in the design process to accelerate time to market.

Digimat

The Nonlinear Multi-scale Material and Structure Modeling Platform

Digimat lets engineers do both micro- and macro-scale analyses of composites, predicting how they will perform and calculating their mechanical, thermal and electrical properties for use in all sorts of downstream FEA analyses.

Our products, services & people are used by 900 of the top 1000 manufacturers in the world, including:

- Aerospace & Defense
- Automotive & Transportation
- Agricultural Equipment
- Heavy Machinery
- Medical Devices
- Oil and Gas
- Nuclear
- Renewable Energy
- Consumer Products
- Packaging
- Electronics

About MSC Software
Simulating Reality, Delivering Certainty

MSC Software is one of the ten original software companies and the worldwide leader in multidiscipline simulation. As a trusted partner, MSC Software helps companies improve quality, save time and reduce costs associated with design and test of manufactured products. Academic institutions, researchers, and students employ MSC technology to expand individual knowledge as well as expand the horizon of simulation.

MSC Software's engineering simulation technology is used by leading manufacturers for linear and nonlinear finite element analysis (FEA), acoustics, CFD, multi-physics, optimization, fatigue and durability, multi-body dynamics, and control systems simulation. The company's products accurately and reliably predict how products will behave in the real world to help engineers design more innovative products - quickly and cost effectively.

Company Profile

MSC Software Corporation was formed 48 years ago and was awarded the original contract from NASA to commercialize the finite element analysis (FEA) software known as Nastran (NASA Structural Analysis). MSC pioneered many of the technologies that are now relied upon by industry to analyze and predict stress and strain, vibration & dynamics, acoustics, and thermal analysis in our flagship product, MSC Nastran.

Over our rich history, MSC has developed or acquired many other well known CAE applications including Patran, Adams, Marc, Dytran, Fatigue, SimXpert, SimDesigner, SimManager, Easy5, Sinda, and Actran. We are committed to the continued development of new CAE technology that integrates disciplines and technologies from standalone CAE tools into unified multi-discipline solvers and user environments. These "next generation" products enable engineers to improve the reliability and accuracy of their virtual prototypes by including multi-physics and multi-discipline interactions.

MSC is also the CAE industry's leader in extending simulation to the engineering enterprise. Our customers recognize the need to scale the benefits of virtual prototyping and testing from pockets of experts to mainstream engineering and product development, and MSC offers the only Simulation Data and Process Management platform in the world that has been successfully deployed in industries including automotive, aerospace, shipbuilding, electronics, and more MSC Software employs 1,000 professionals in 20 countries.

MSC Software Products

MSC Software makes products that enable engineers to validate and optimize their designs using virtual prototypes. Customers in almost every part of manufacturing use our software to complement, and in some cases even replace the physical prototype "build and test" process that has traditionally been used in product design.
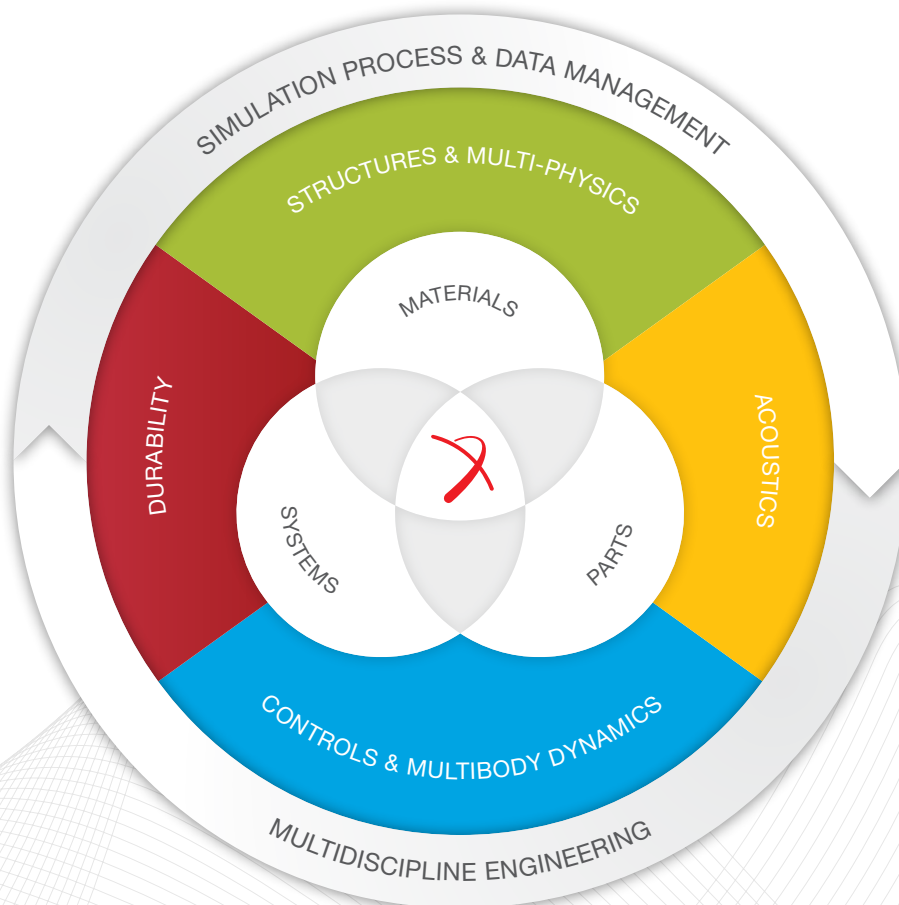
MSC Nastran™
Structural & Multidiscipline Simulation

MSC Software is one of the ten original software companies and the worldwide leader in multidiscipline simulation. As a trusted partner, MSC Software helps companies improve quality, save time and reduce costs associated with design and test of manufactured products. Academic institutions, researchers, and students employ MSC technology to expand individual knowledge as well as expand the horizon of simulation. MSC Software employs professionals in 20 countries.

For additional information about MSC Software's products and services, please visit: **www.mscsoftware.com.**