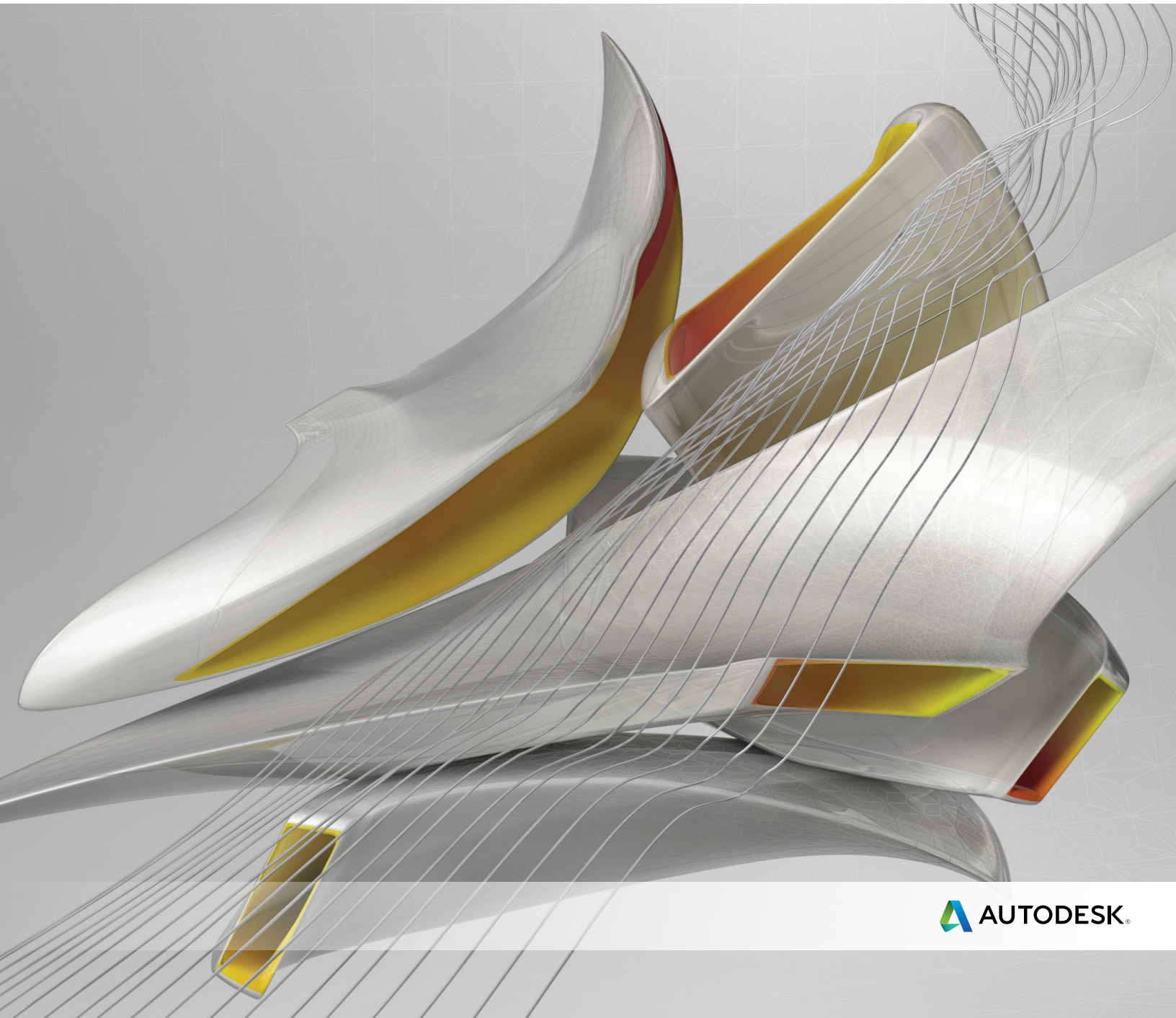
AUTODESK®
SIMULATION MECHANICAL

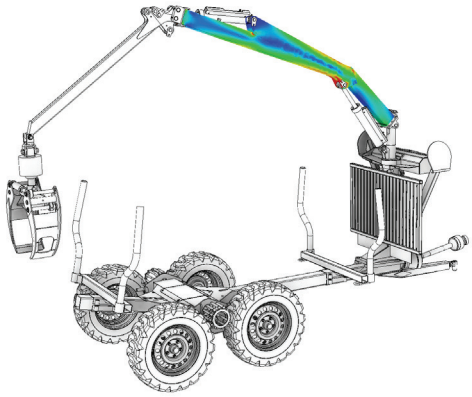
Complete and robust mechanical simulation solution

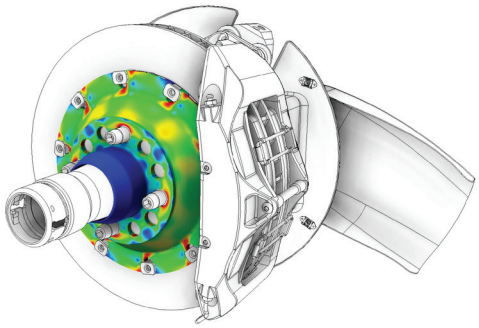


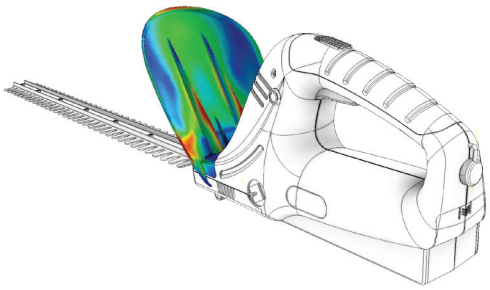
AUTODESK.

A mechanical simulation solution for finite element analysis powered by the Autodesk Nastran solver

Accurately predict product behavior, optimize and validate designs with a wide range of mechanical simulation capabilities before manufacturing







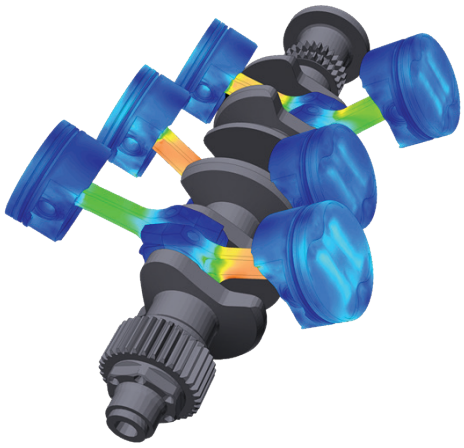
Autodesk® Simulation Mechanical software, powered by Autodesk® Nastran®, provides a wide range of accurate mechanical simulation capabilities to help you predict product performance, optimize designs, and validate product behavior before manufacturing.

Autodesk Simulation Mechanical enables users to utilize a highly accurate, industry-tested, general-purpose finite element solver to run comprehensive multiphysics simulations with other Autodesk products. Supporting multi-CAD environments, Simulation Mechanical provides flexibility in simulating CAD models in various formats. Simulation Mechanical brings finite element analysis (FEA) to all designers, engineers, and analysts to help them make great products.

A complete mechanical simulation solution

Autodesk Simulation Mechanical is a stand-alone FEA mechanical simulation solution that provides a complete offering of capabilities, such as:

- **A wide range of analysis capabilities:** Delivers a broad range of analysis capabilities that enable designers, engineers, and analysts to bring product performance knowledge into the design cycle, helping them to improve collaboration, design better and safer products, save time, and reduce costs.
- **Easy-to-use interface:** Connects with many CAD solutions, making it easy to set up simulations and produce desired results and generate reports.
- **Robust solver technology:** Provides more accurate results through advanced analysis using the industry-trusted Autodesk Nastran solver.
- **Extensive material model library:** Utilizes a wide range of element and material model options and a customizable database of more than 8,000 available materials.
- **Multi-CAD modeling:** Imports and evaluates a range of potential designs from Autodesk® AutoCAD®, and Autodesk® Inventor® software, SolidWorks®, PTC® Creo® and Pro/ENGINEER®, Rhinoceros®, CATIA®, SpaceClaim®, Siemens® NX, Parasolid®, and JT files, ACIS, IGES, and STEP.
- **Autodesk SimStudio Tools:** SimStudio Tools allow you to quickly edit your geometry for simluation. It reads in multiple CAD file formats and enables you to quickly simplify models, eliminate unnecessary detail, perform basic repair, or easily make design changes so you can explore various design ideas faster.
- **Multiphysics simulations:** Provides multiphysics simulation, such as thermal-electric and fluid-structural, and the ability to simulate as-manufactured material properties for injection-molded parts.
- **Stress linearization:** For linear static stress analyses, define a customizable Stress Classification Line (SCL) and perform stress linearization based on ASME Boiler and Pressure Vessel Code.
- **Autodesk product integrations:** Integrates with Autodesk's portfolio of products, such as design, simulation, visualization, and data management solutions.



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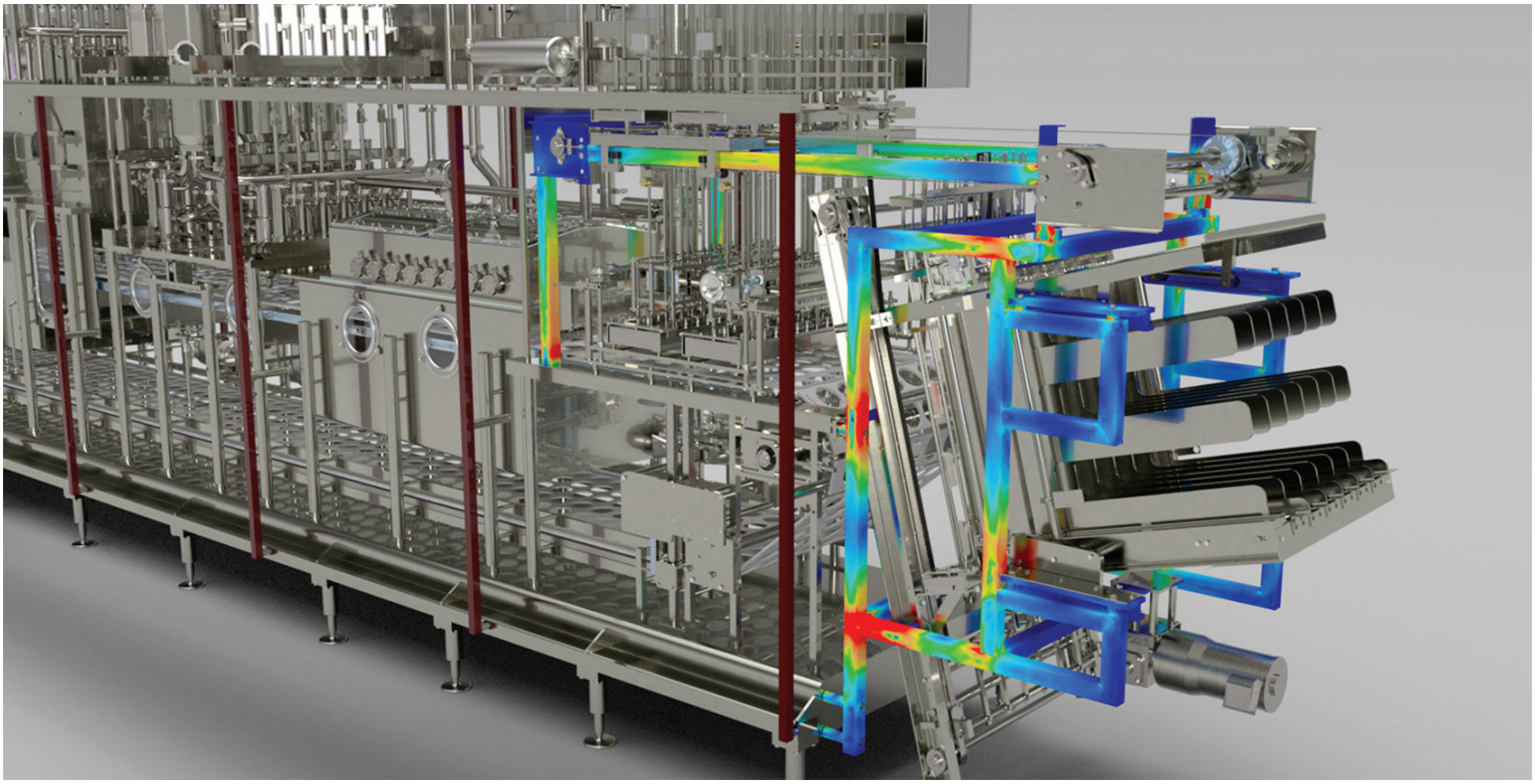

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Facing these challenges?

- Engineers and analysts need to make accurate design decisions without building multiple physical prototypes.
- Confidence in simulation results is required before investing resources in design changes or new products.
- Product designs include a wide range of materials—not just common metals.
- Motion and the combination of multiple physical effects are critical design considerations.
- Product design teams need to perform simulation on geometry from multiple CAD software tools.
- Field failures need to be avoided; must determine durability of structures under repeated loading.
- Design and manufacture of models need to be optimized.

Benefits of Autodesk Simulation Mechanical

Perform accurate simulations efficiently

Simulation enables critical engineering decisions to be made earlier in the design process. With Autodesk Simulation Mechanical engineers and analysts can have a simulation solution that allows them to study initial design intent more easily, and more accurately predict the performance of a simulated product.

When working with CAD geometry, automatic meshing tools produce high-quality elements on the first pass—ensuring simulation accuracy within the areas of greatest engineering concern, and helping to predict product performance in less time. Built-in modeling capabilities enable designers, engineers, and analysts to edit the mesh directly to help with the accurate placement of loads and constraints or to create simplified geometry for proof-of-concept studies. In addition to increasing productivity through modeling flexibility, designers, engineers, and analysts can quickly validate concepts before resources are invested in significant design changes or new products.

Learn more about your product's performance

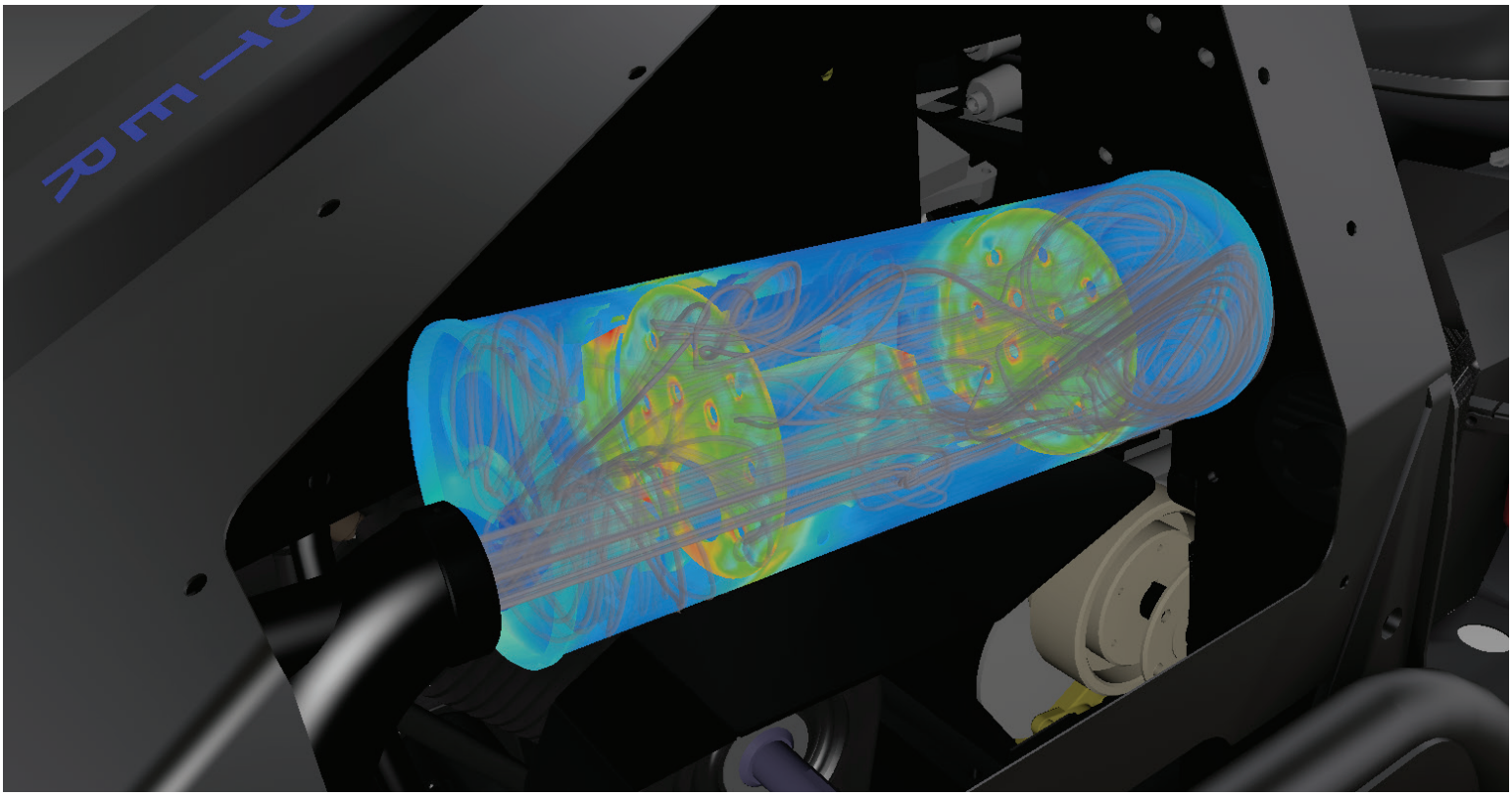
Through easy-to-use tools, extensive CAD support, and proven technology, Autodesk Simulation Mechanical software helps you predict the real-world performance of products. Design validation and optimization through extensive engineering simulation helps you bring better products to market faster—and at less cost.

Simulate more, reduce errors, and optimize designs

Necessary design changes become more apparent when a product's real-world environment is fully simulated, but computationally intensive analyses can be both time- and resource-intensive. Robust solvers in Autodesk Simulation Mechanical software utilize the power of all available computing resources for local or remote solves, enabling designers, engineers, and analysts to study more realistic product designs in a practical amount of time.

Easily expand engineering simulation capabilities

Decisions to integrate engineering simulation further into the design process often leads to unexpected costs and delays to retrain the product design team. By providing an entire range of validation and optimization tools within the same easy-to-use interface, Autodesk Simulation Mechanical software enables designers, engineers, and analysts to start with mainstream tools and then expand their toolkit to include more advanced analysis, such as mechanical event simulation (MES), without the need to learn new workflows.



Powered by Autodesk Nastran

Autodesk Nastran is an industry-recognized, general purpose FEA solver known for its accuracy in analyzing linear and nonlinear stress, dynamics, and heat transfer characteristics of structures and mechanical components. Autodesk Nastran also offers an editor for real-time results and changes in solution parameters while solving—enabling users to identify and fix issues earlier in simulations. This high-end simulation technology is included with Simulation Mechanical so you can obtain more accurate results for complex simulations.

A wide range of material models

Support for a wide range of linear and nonlinear materials allows for better understanding of the real-world behavior of products. Whatever materials are included in a design, from metal to rubber, material data is vital to the accuracy of an engineering simulation—allowing designers and engineers to learn more about how a product will perform or even how it might fail.

Combine multiple physical effects in advanced simulations

Real-world product behavior is often the result of multiple physical effects interacting simultaneously. Advanced simulation setup is made easier through the use of standard engineering terminology, visual process guidance, and user-friendly tools and wizards that automate the transfer of simulation results between multiple analyses—focusing designers, engineers, and analysts on product performance, rather than advanced numerical or simulation methods.

Collaborate in a multi-CAD environment

Manufacturers often create and share designs in multiple CAD softxware tools, making it difficult to integrate engineering simulation tools into an existing design process without requiring significant and costly changes. Autodesk Simulation Mechanical software supports efficient workflows in today's multi-CAD environment by providing direct geometry exchange and full associativity with Autodesk Inventor, SolidWorks, Pro/ENGINEER, PTC Creo, and other software.

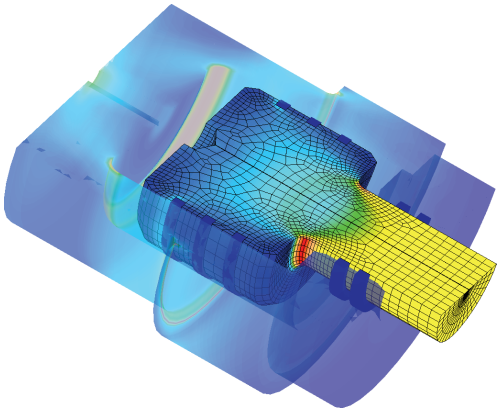
Autodesk's complete portfolio of simulation products

Autodesk Simulation Mechanical is part of the mechanical simulation offerings from Autodesk, which are all powered by the Autodesk Nastran solver. Autodesk Nastran is an industry-recognized FEA solver that delivers accurate results to complex simulations.

Autodesk also offers additional simulation products to help you predict product performance further by optimizing and validating your designs. The Autodesk® Simulation family of products enables you to integrate mechanical, structural, fluid flow, thermal, composite, and plastic injection molding simulation tools into your product development process to help reduce costs and speed time to market. Autodesk provides a range of flexible solutions that enable you to solve locally or remotely, to help you increase your productivity.

A wide range of analysis capabilities

Linear



Linear analyses follow these basic assumptions:

- Loading causes only small deflections or rotations
- Change in direction of loading due to deformation is small and can be neglected
- Materials are linear within elastic region on stress-strain curve
- Boundary conditions do not change

Static Stress with Linear Material Models

- Calculate displacements and stresses due to static loads
- Although contact is a nonlinear effect, it can be included in a static stress analysis (solution becomes iterative)

Natural Frequency (Modal)

- Calculate natural frequencies and mode shapes of model due to purely geometric and material properties

Natural Frequency with Load Stiffening

- Axial, compressive or tensile loads affect the frequency of system

Response Spectrum

- Calculate maximum displacements and stresses due to spectrum-type load

Random Vibration

- Calculate statistical response of a system due to random vibration, white noise, or power spectrum density

Frequency Response

- Calculate steady-state response due to harmonic or sinusoidal load or acceleration

Transient Stress (Direct Integration or Modal Superposition)

- Calculate displacements and stresses over time due to loads that vary in a known fashion
- Inertial effects are included

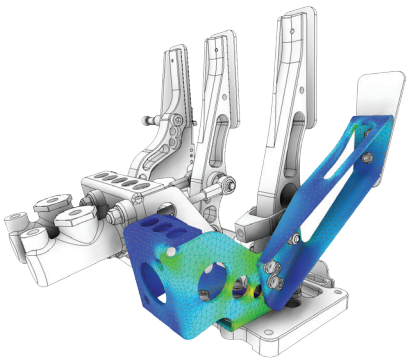
Critical Buckling Load

- Calculate loads that cause a model to buckle due to geometric instability
- No inertial effects

Dynamic Design Analysis Method (DDAM)

- Calculate maximum displacements and stresses due to spectrum-type load
- Used when designing naval equipment or vessels

Nonlinear



Nonlinear analyses permit the following:

- Loading can cause large deflections and/or rotations
- Rigid body motion and/or rotations are accounted for
- Loading can change in direction due to deformation
- Materials can be nonlinear (either elastic or plastic)
- Boundary conditions can change over time in a known fashion

MES (Mechanical Event Simulation) with Nonlinear Material Models

- Calculate displacements, velocities, accelerations, and stresses over time due to dynamic loads
- Loads can be constant, vary over time, or vary based on calculated results
- Inertial effects are included

Static Stress with Nonlinear Material Models

- Calculate displacements and stresses due to static loads
- Loads can be constant, vary between time steps or load cases, or vary based on calculated results
- Inertial effects are ignored

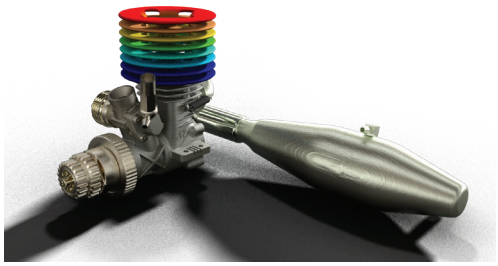
Natural Frequency (Modal) with Nonlinear Material Models

- Calculate natural frequencies and mode shapes of model
- Change in frequency due to displacements or changing material properties is not included
- Loads do not affect frequencies
- Boundary conditions are fixed

MES Riks Analysis

- Calculate displacements and stresses before and after model has buckled or collapsed
- Inertial effects are ignored

Thermal



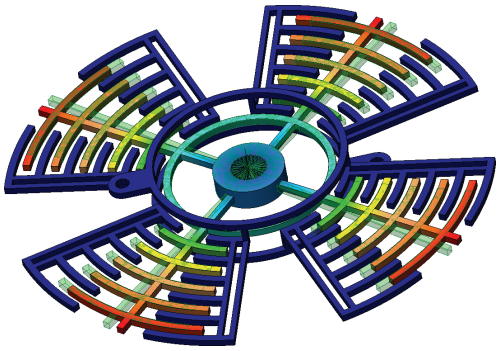
Steady-State Heat Transfer

- Calculate temperature and heat fluxes after an infinite time period
- Thermal loads are constant over time

Transient Heat Transfer

- Calculate temperature and heat fluxes over time due to thermal loads
- Thermal loads can be constant or change over time
- Material can change states between solid and liquid

Electrostatic



Electrostatic Current and Voltage

- Calculate current and voltage distribution after an infinite time period due to induced voltages and current sources

Electrostatic Field Strength and Voltage

- Calculate electric field and voltage distribution after an infinite time period in an insulator due to induced voltages and charges

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