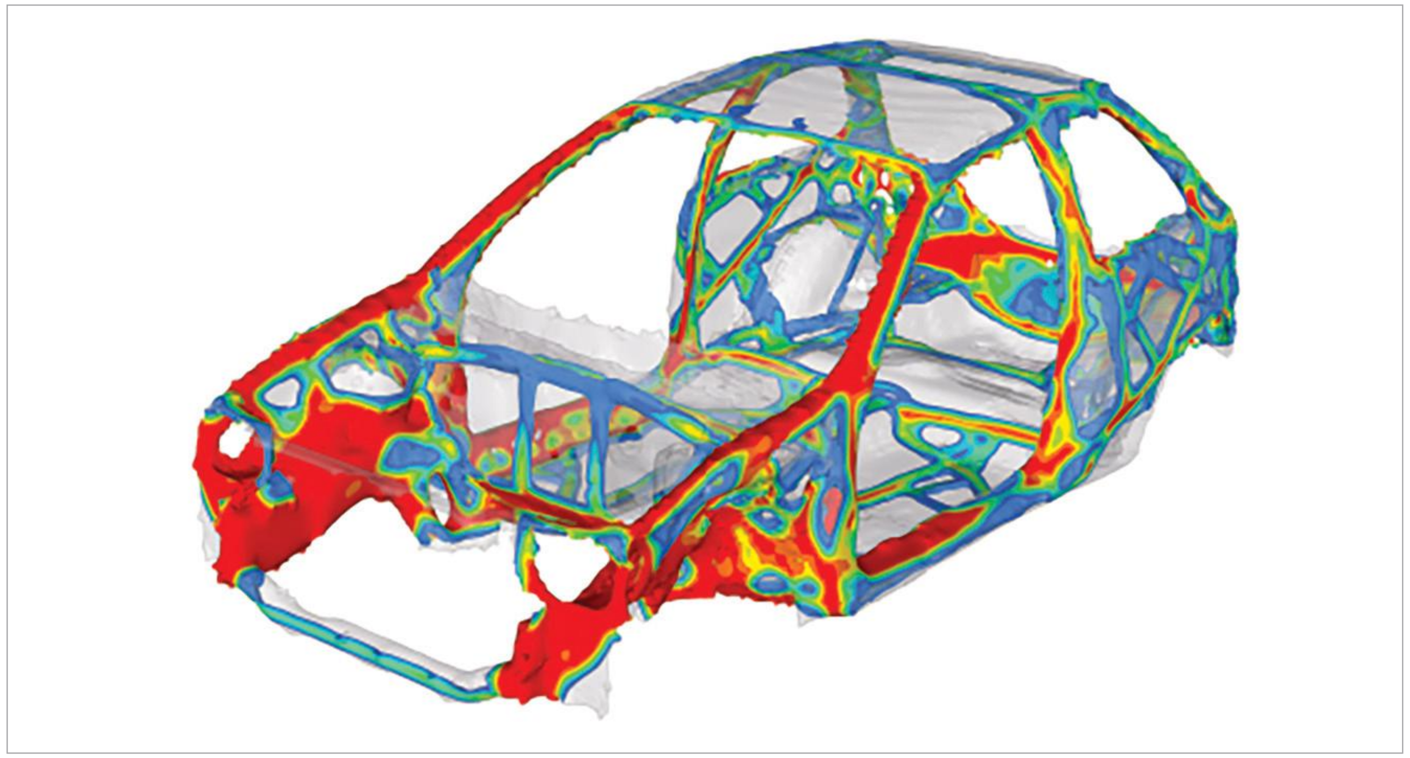
Altair® OptiStruct™

Structural Analysis and Optimization



Altair® OptiStruct is an industry proven, modern structural analysis solver for linear and nonlinear simulation under static and dynamic loadings. It is the most widely used solution for structural design and optimization in all industries. Altair® OptiStruct helps designers and engineers analyze and optimize structures for performance characteristics such as strength, durability, and NVH, to rapidly develop innovative, lightweight, and structurally efficient designs.

Product Highlights:

- The most advanced solver for NVH analysis
- Full featured solver for nonlinear analysis
- Highly parallelized solver
- 20-year legacy of award-winning structural optimization technology
- Advanced Laminated Composite Optimization Capability

Learn more:
Altair.com/optistruct

Benefits

Fast and Accurate Solver Technology

- **Most advanced solver for NVH analysis:** Altair® OptiStruct supports the most advanced features and results output necessary for efficient and insightful noise, vibration and harshness (NVH) analyses and diagnostics.
- **Robust solver for nonlinear analysis and powertrain durability:** Altair® OptiStruct has grown to support a comprehensive range of physics for powertrain analysis. This includes solutions for heat transfer, bolt and gasket modeling, hyperelastic materials, and efficient contact algorithms.
- **Highly parallelized solver:** Through methods such as domain decomposition, Altair® OptiStruct can be executed on hundreds of cores providing a high degree of scalability.
- **Seamless integration into existing processes:** Integrated in Altair® HyperWorks, Altair® OptiStruct can help significantly reduce corporate spending on competitive solver technology, while providing superior analysis workflows.

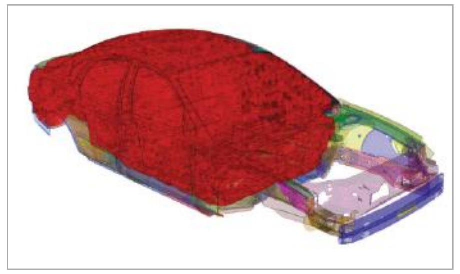
Award-Winning Optimization

- **Innovative optimization technology:** For over 20 years, Altair® OptiStruct has lead the development of innovative optimization technology with many first-to-market technologies such as stress and fatigue based topology optimization, topology-driven design for 3D printed lattice structures, and technologies to design and optimize advanced materials such as composites.
- **Optimization-enabled solutions:** Altair® OptiStruct provides the most comprehensive library of performance criteria and manufacturing constraints allowing the needed flexibility to formulate the widest range of optimization problems.

Capabilities

Integrated Fast and Large Scale Eigenvalue Solver: A built-in, standard feature of Altair® OptiStruct in an Automated Multi-level Sub-structuring Eigen Solver (AMSES) that can rapidly calculate thousands of modes with millions of degrees of freedom.

Complete solution for powertrain durability



Full-vehicle noise and vibration analysis

Topology optimization for lattice structures

Advanced NVH Analysis: Altair® OptiStruct provides unique and advanced functionality for NVH analysis including one-step TPA (Transfer Path Analysis), Powerflow analysis, model reduction techniques (CMS and CDS super elements), design sensitivities, and an ERP (Equivalent Radiated Power) design criterion to optimize structures for NVH.

Creating Design Concepts

- **Topology optimization:** Altair® OptiStruct uses topology optimization to generate innovative concept design proposals. Altair® OptiStruct generates an optimal design proposal based on a user-defined design space, performance targets, and manufacturing constraints. Topology optimization can be applied to 1D, 2D and 3D design spaces.
- **Topography optimization:** For thin-walled structures, beads or swages are often used as reinforcement features. For a given set of bead dimensions, Altair® OptiStruct's topography optimization technology will generate innovative design proposals with the optimal bead pattern and location for reinforcement to meet certain performance requirements. Typical applications include panel stiffening and managing frequencies.
- **Free-size optimization:** Free-size optimization is widely applied in finding the optimal thickness distribution in machined metallic structures and identifying the optimal ply shapes in laminate composites. Element thickness per material layer is a design variable in free-size optimization.

Optimization for Design Fine-Tuning

- **Size optimization:** Optimal model parameters such as material properties, cross-sectional dimensions, and gauges can be determined through size optimization.
- **Shape optimization:** Shape optimization is performed to refine an existing design through user-defined shape variables. The shape variables are generated using the morphing technology – Altair® HyperMorph™ – available in Altair® HyperMesh™.
- **Free-shape optimization:** Altair® OptiStruct's proprietary technique for non-parametric shape optimization automatically generates shape variables and determines optimal shape contours based on design requirements. This relieves users from the task of defining shape variables and allows for greater flexibility for design improvements. Free-shape optimization is very effective in reducing high-stress concentrations.

Design and Optimization of Laminate Composites: A unique 3-phase process has been implemented in Altair® OptiStruct to aid in the design and optimization of laminate composites. The process is based on a natural and easy-to-use ply based modeling approach. This also facilitates incorporating various manufacturing constraints, such as ply drop-off, specific to laminate composite design. Application of this process yields optimal ply shapes (phase 1), optimal number of plies (phase 2) and the optimal ply stacking sequence (phase 3).

Design and Optimization of Additivel Manufactured Lattice Structures: Lattice structures offer many desirable characteristics such as lightweight and good thermal properties. They are also highly desirable in biomedical implants due to their porous nature and the ability to facilitate the integration of tissue with the trabecular structure. Altair® OptiStruct has a unique solution to design such lattice structures based on topology optimization. Subsequently, large scale sizing optimization studies can be run on the lattice beams while incorporating detailed performance targets such as stress, buckling, displacement and frequency.

Analysis Feature Highlights

Stiffness, Strength and Stability

- Linear and nonlinear static and dynamic analysis with contact and plasticity
- Large displacement analysis with continuous sliding and hyperelastic materials
- Fast contact analysis
- Buckling analysis

Noise and Vibrations

- Normal modes analysis for real and complex eigenvalue analysis
- Direct and modal frequency response analysis
- Random response analysis
- Response spectrum analysis
- Direct and modal transient response analysis
- Preloading using nonlinear results for buckling, frequency response, and transient analysis
- Rotor dynamics
- Coupled fluid-structure (NVH) analysis
- AMSES large scale eigenvalue solver
- Fast large scale modal solver (FASTFR)
- Result output at peak response frequencies (PEAKOUT)
- One-step transfer path analysis (PFPATH)
- Radiated sound analysis
- Frequency-dependent and poro-elastic material properties

Powertrain Durability

- 1D and 3D bolt pretension
- Gasket modeling
- Contact modeling and contact-friendly elements
- Plasticity with hardening
- Temperature dependent material properties
- Domain decomposition

Heat Transfer Analysis

- Linear and nonlinear steady-state analysis
- Linear transient analysis
- Coupled thermo-mechanical analysis
- One-step transient thermal stress analysis
- Contact-based thermal analysis

Kinematics and Dynamics

- Static, quasi-static, and dynamic analysis
- Loads extraction and effort estimation
- Optimization of system and flexible-bodies

Structural Optimization

- Topology, topography, and free-size optimization
- Size, shape, and free-shape optimization
- Design and optimization of laminate composites
- Design and optimization of additively manufactured lattice structures
- Equivalent static load method
- Multi-model optimization