

## Analysis Types

### General, Linear, and Nonlinear Analyses

- Static stress/displacement
- Direct cyclic
- Low-cycle fatigue
- Viscoelastic/viscoplastic response
- Dynamic stress/displacement
- Steady-state transport
- Heat transfer (transient and steady-state)
- Mass diffusion (transient and steady-state)
- Acoustics
- Multiphysics
  - Thermo-mechanical
  - Thermo-electrical
  - Piezoelectric
  - Pore fluid flow-mechanical
  - Shock and structural-acoustic

### Linear Perturbation Analyses

- Static stress/displacement
  - Linear static
  - Eigenvalue buckling
- Dynamic stress/displacement
  - Natural frequency extraction
  - Complex eigenvalue extraction
  - Steady-state dynamics (direct and mode-based)
  - Transient modal dynamics
  - Response spectrum
  - Random response

## Analysis and Modeling Techniques

- Import
- Restart
- Substructuring
- Submodeling
- Material removal and addition
- Mesh-to-mesh solution mapping
- Adaptive remeshing
- Fracture mechanics (including VCCT)
- Symmetric model generation and results transfer
- Cyclic symmetry
- Inertia relief
- Nonstructural mass
- Direct matrix input
- Cosimulation
- Automatic resolution of overconstraints
- Data parameterization and parametric studies
- Automatic perturbation of geometry
- Local degrees of freedom
- Hydrostatic fluid cavities
- Annealing
- Reinforcements
- Embedded elements
- Elastic formulation
- Meshed beam cross-sections
- Rigid, display, and isothermal bodies

## Solution Techniques

- Parallel execution on both shared memory and distributed memory parallel (cluster) systems
- Parallel direct sparse solver with dynamic load balancing
- Parallel iterative solver
- Parallel Lanczos eigenvalue solution
- Parallel AMS eigenvalue solution
- Parallel element operations
- Multiple load cases
- Full Newton and quasi-Newton methods

## Material Definitions

### Elastic Mechanical Properties

- Linear elasticity
- Orthotropic and anisotropic linear elasticity
- Porous elasticity
- Hypoelasticity
- Hyperelasticity (including permanent set)
- Anisotropic hyperelasticity
- Elastomeric foam
- Mullins effect
- Viscoelasticity
- Hysteresis

### Inelastic Mechanical Properties

- Metal plasticity
  - Isotropic and anisotropic yield criteria
  - Isotropic, kinematic, and ORNL hardening
  - Porous metal plasticity
  - Cast iron
  - Two-layer viscoplasticity
  - Creep
  - Volumetric swelling
  - Deformation plasticity
  - Johnson-Cook plasticity
- Extended Drucker-Prager plasticity
- Capped Drucker-Prager plasticity
- Cam-Clay plasticity
- Mohr-Coulomb plasticity
- Crushable foam plasticity
- Jointed materials
- Concrete
- Progressive damage and failure
  - Ductile
  - Shear
  - Forming limit diagram (FLD)
  - Forming limit stress diagram (FLSD)
  - Műschenborn-Sonne forming limit diagram (MSFLD)
  - Hashin unidirectional composite

### Additional Material Properties

- Density
- Material damping
- Thermal expansion
- Thermal and electrical conductivity
- Specific heat

- Latent heat
- Damage and failure for fiber-reinforced composites
- Piezoelectric properties
- Acoustic medium properties
  - Bulk modulus
  - Volumetric drag
- Porous acoustic medium
  - Delany-Bazley
  - Miki
- Hydrostatic fluid properties
  - Hydraulic fluids
  - Pneumatic fluids
- Mass diffusion properties
  - Diffusivity
  - Solubility
- Pore fluid flow properties
  - Permeability
  - Porous bulk moduli
  - Absorption/exsorption
  - Swelling gel
  - Moisture swelling
- User materials

## Element Library

### Continuum

- Stress analysis
  - 2-D (plane stress, plane strain, and generalized plane strain)
  - 3-D (regular and variable node)
  - Cylindrical
  - Axisymmetric (with and without twist)
  - Axisymmetric with nonlinear, asymmetric deformation
  - Infinite
  - Warping
- Heat transfer
  - 1-D
  - 2-D
  - 3-D
  - Axisymmetric
- Mass diffusion
  - 2-D
  - 3-D
  - Axisymmetric
- Temperature-displacement
  - 2-D (plane stress, plane strain, and generalized plane strain)
  - 3-D
  - Axisymmetric (with and without twist)
- Pore pressure
  - 2-D (plane strain)
  - 3-D
  - Axisymmetric
  - Axisymmetric with nonlinear, asymmetric deformation
- Piezoelectric
  - 2-D (plane stress and plane strain)
  - 3-D
  - Axisymmetric
  - Axisymmetric with nonlinear, asymmetric deformation

- Thermal-electrical
  - 1-D
  - 2-D
  - 3-D
  - Axisymmetric

- Acoustic
  - 1-D
  - 2-D
  - 3-D
  - Axisymmetric
  - Infinite

## Shells

- Stress analysis
  - 3-D
  - Continuum shell
  - Axisymmetric
  - Axisymmetric with nonlinear, asymmetric deformation
- Heat transfer
  - 3-D
  - Axisymmetric
- Temperature-displacement
  - 3-D
  - Axisymmetric

## Membranes

- Stress analysis
  - 3-D
  - Cylindrical
  - Axisymmetric (with and without twist)

## Beams

- Stress analysis
  - 2-D
  - 3-D (regular, open section, and tapered)

## Pipes

- Stress analysis
  - 2-D
  - 3-D

## Elbows

- Stress analysis
  - 3-D

## Frame Elements

- Stress analysis
  - 2-D
  - 3-D

## Trusses

- Stress analysis
  - 2-D
  - 3-D
- Temperature-displacement
  - 2-D
  - 3-D
- Piezoelectric
  - 2-D
  - 3-D

## Gasket Elements

- Stress analysis
  - 2-D (plane stress and plane strain)
  - 3-D
  - Axisymmetric

## Inertial Elements

- Stress analysis
  - Point mass
  - Rotary inertia

## Rigid Elements

- Stress analysis
  - 2-D
  - 3-D

## Capacitance Elements

- Heat transfer point heat capacitance

## Connector Elements

- Stress analysis
  - 2-D
  - 3-D

## Cohesive Elements

- Stress analysis
  - 2-D
  - 3-D

## Springs, Dashpots, and Flexible Joints

- Stress analysis
  - 2-D
  - 3-D
- Pore pressure
  - 2-D
  - 3-D

## Distributing Coupling

- Stress analysis
  - 2-D
  - 3-D

## Special-Purpose Elements

- Surface elements
- Hydrostatic fluid elements
- Tube support elements
- Line spring elements
- Pipe-soil interaction elements
- Acoustic interface elements

## User-Defined Elements

- Provides the ability to define custom elements

## Prescribed Conditions

- Amplitude curves
- Initial conditions
- Boundary conditions
- Loads
  - Distributed
  - Surface tractions
  - Concentrated forces and moments

- Follower forces
- Thermal
- Electrical
- Acoustic
- Pore fluid flow
- Prescribed assembly loads
- Predefined fields
- User-defined
- Sensors and actuators

## Constraints and Interactions

### Kinematic Constraints

- Linear constraint equations
- General multi-point constraints
- Kinematic coupling
- Surface-based constraints
  - Mesh ties
  - Kinematic and distributing couplings
  - Shell-to-solid couplings
  - Mesh-independent fasteners
- Embedded elements
- Element end release

### Surface-Based Contact Modeling

- General ("automatic") contact
- Contact interactions
  - 2-D, 3-D
  - Deformable-deformable contact
  - Rigid-rigid contact
  - Self-contact
- Contact formulations
  - Balanced or pure master-slave contact
  - Finite, small, and infinitesimal sliding
- Mechanical contact properties
  - Penalty contact
  - Hard contact with classical Lagrange multiplier method
  - Hard contact with augmented Lagrangian method
  - Contact damping
  - Static and kinetic Coulomb friction
  - Anisotropic friction
  - User-defined friction models
  - Pressure penetration (2-D & 3-D)
  - Debonding
  - Cohesive behavior
  - Thermal conductance and radiation contact properties
- Electrical contact properties
- Pore fluid contact properties
- User-defined interfacial constitutive behavior

### Element-Based Contact Modeling

- Gap contact elements
  - Mechanical and thermal

### Cavity Radiation

- 2-D, 3-D, axisymmetric
- Closed and open cavities
- Symmetry and surface blocking
- Surface motion with automatic viewfactor computations
- Surface radiation properties

## User Subroutines

- Over 40 user-defined subroutines

## Additional Features

- Drag chains
- “Spud can” joint elements
- Tube-in-tube slide lines

## Input

- Keywords
- Set concept
- Multiple coordinate systems
- Parts and assemblies
- Nastran bulk data

## Output

- Interactive graphical postprocessing
- Platform-neutral output database
- Printed output
- External file output
- Restart output
- Diagnostic messages
- Nastran Output2
- Scripting interface

## Supported Platforms

- Windows/x86-32
- Windows/x86-64
- Linux/x86-64
- Linux/Itanium
- HP-UX/Itanium
- AIX/Power

## Documentation

- Analysis User’s Manual
- Keywords Manual
- Getting Started Manual
- Example Problems Manual
- Benchmarks Manual
- Verification Manual
- Theory Manual
- Interfaces User’s Manuals
- Release Notes

## Product Support

- Maintenance and support
- Quality Monitoring Service
- Installation
- Training and users’ meetings

## Related Products

### Abaqus/AMS

- High-performance automatic multi-level substructuring eigensolver

### Abaqus/Design

- Design sensitivity analysis
- Sensitivities with respect to shape and material parameters
- Nonlinear geometric effects

### Abaqus/Aqua

- Surrounding medium
  - Fluid profile
  - Wave profile
  - Wind profile
- Loading
  - Drag
  - Buoyancy
  - Inertia

## Interface Products

- Enable the use of Abaqus/Standard with complementary software from third-party suppliers in areas such as plastics injection molding and multibody dynamics