Abaqus 6.11 Demo & Update

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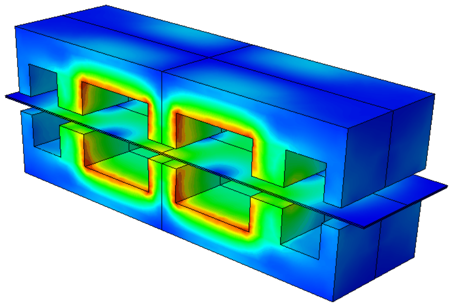
Demo

- Interactive Mapping
- Fasteners
- Free Body Display

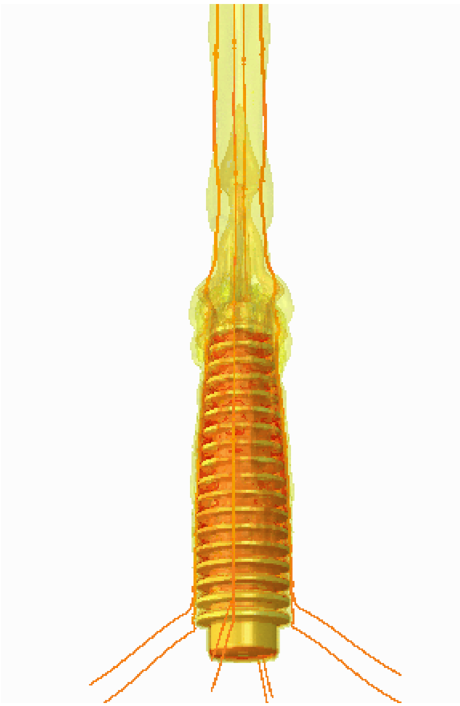
Presentation

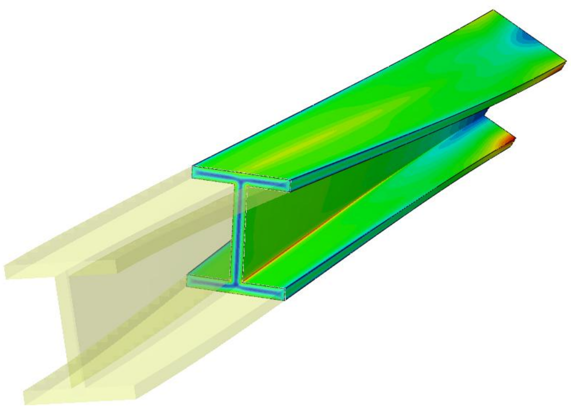
- Multiphysics
- Performance
- Modelling & Visualisation

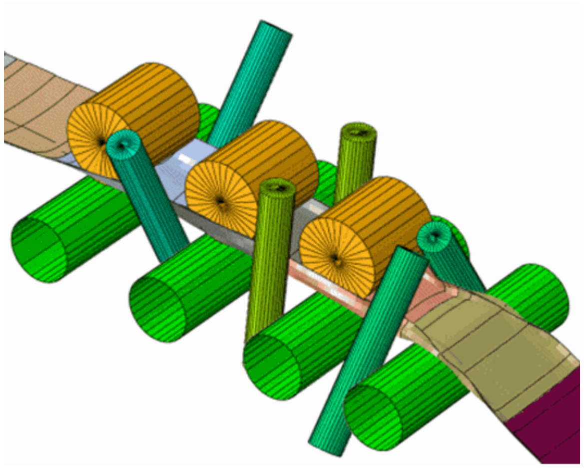
Abaqus 6.11



- Contains over 110 new features
- Significantly expanded *multiphysics*
- See *Release Notes* for comprehensive listing of everything that is new



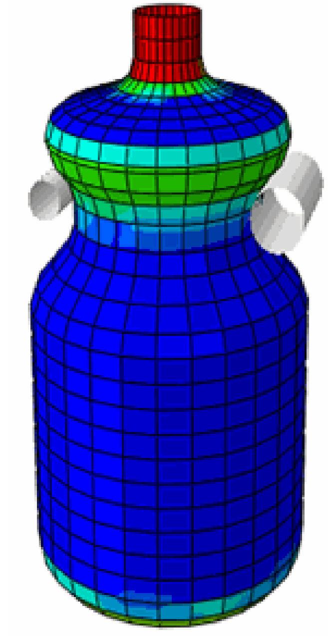




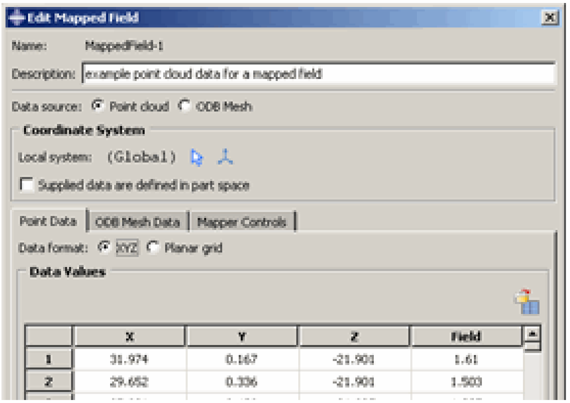
Interactive Mapping

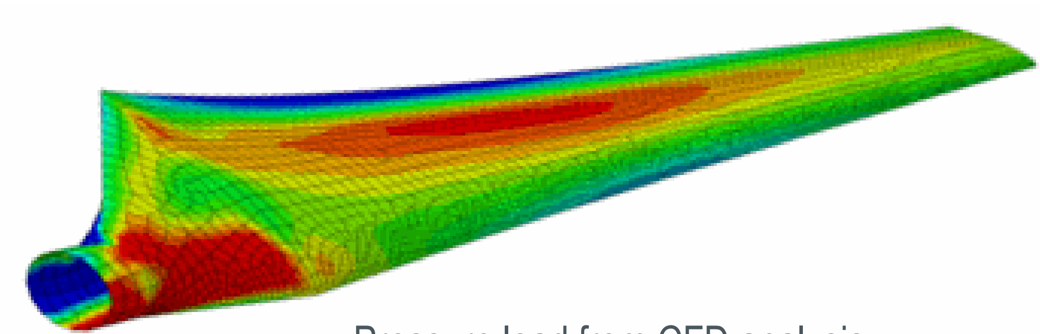
Key Features

- Extension of batch mapping capability that already exists
- Supports scalar fields such as pressure, temperature, density, shell thickness, film coefficients, etc.
- Data sources include text files, spreadsheets, and odb's
- Robust default tolerances



Shell thickness from manufacturing simulation



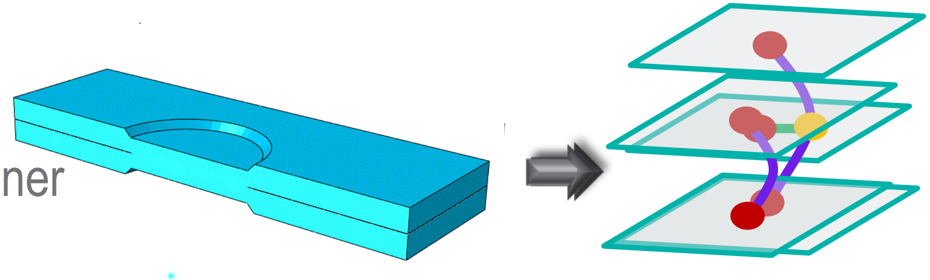


Pressure load from CFD analysis

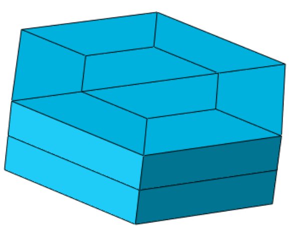
Assembled Fasteners

Key Features

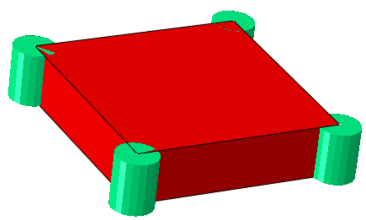
- Generalization of existing fastener modelling capability
- Instance user-defined fastener templates into an assembly



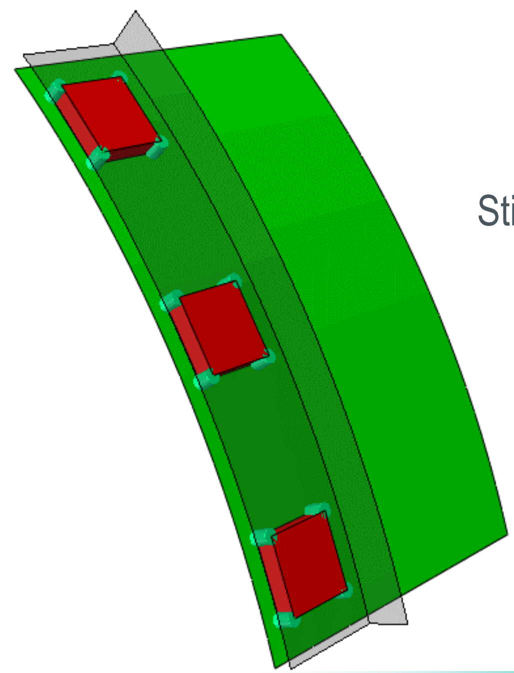
Spotweld idealization



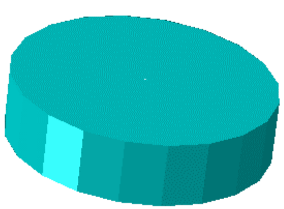
Solids



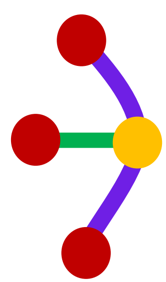
Solids and beams



Stiffened panel



Beams

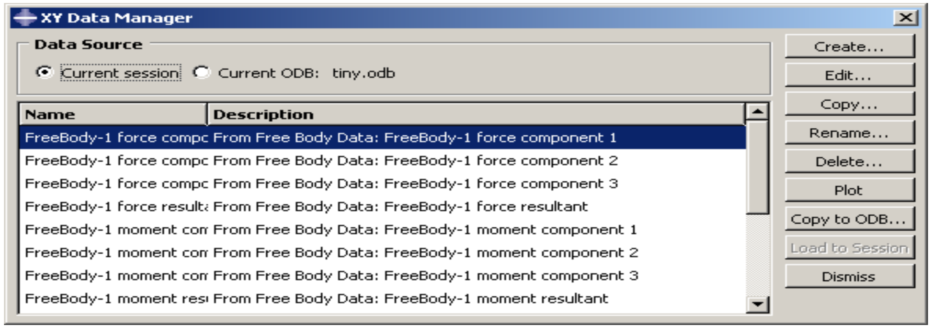


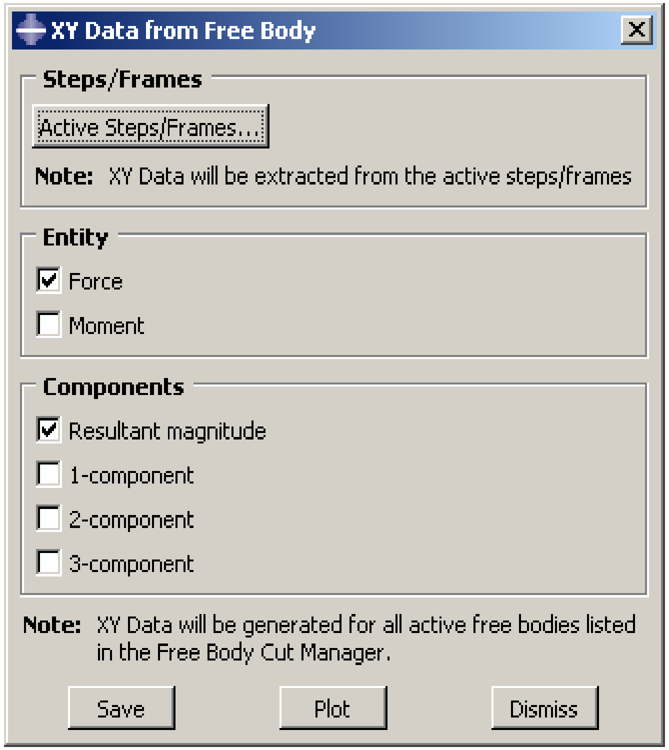
Connector construct

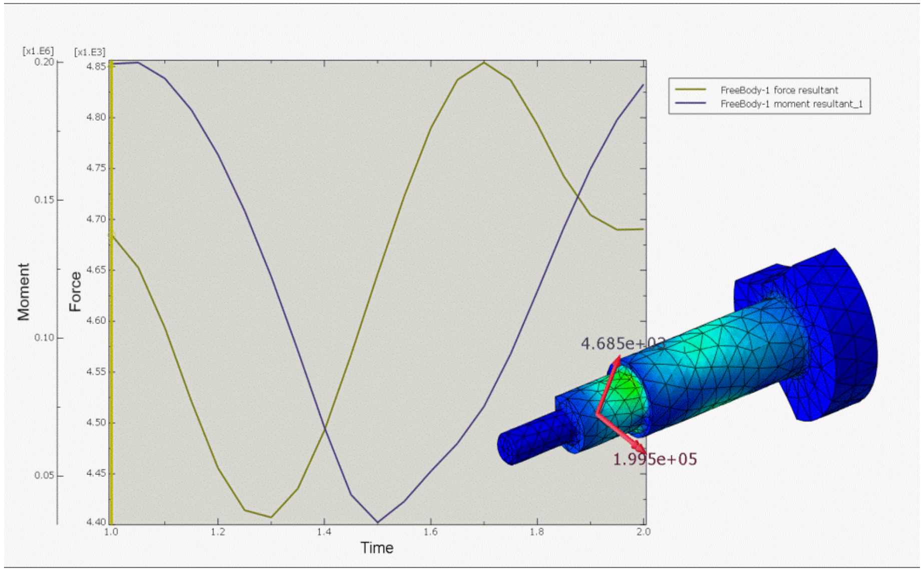
Freebody display

XY time history plot

- Available for free body definitions based nodes & elements (NFORC)
- XY data from Free Body option



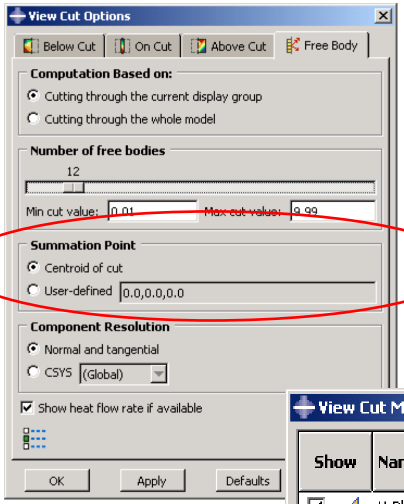


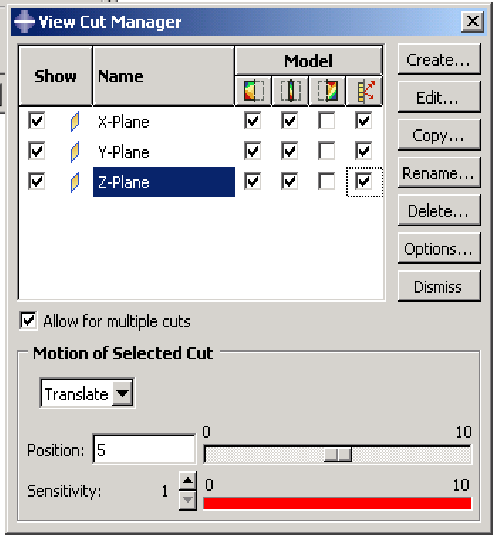


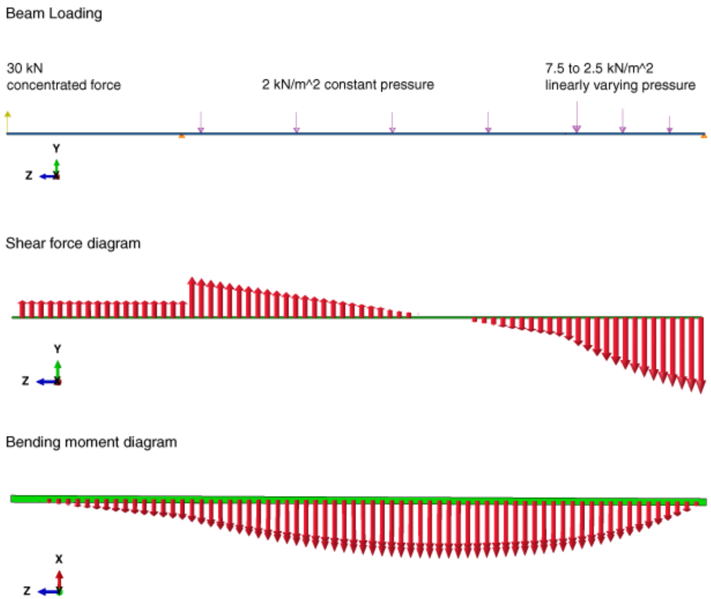
Freebody display

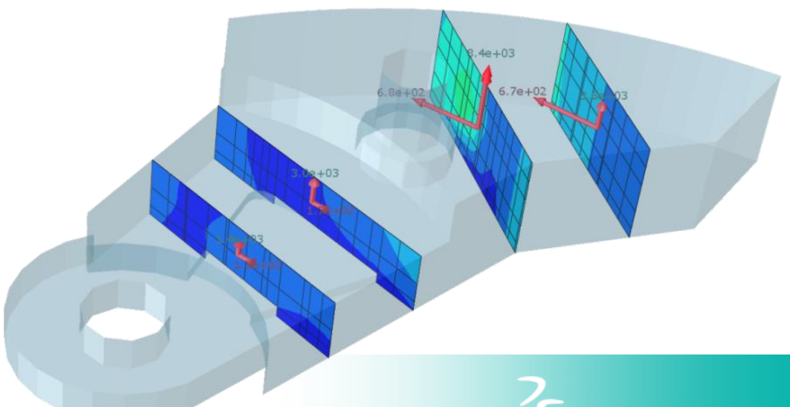
Free body on multiple view cuts and multiple display

- Free body force and moment displayed with multiple view cuts
- Multiple free bodies on a single view cut





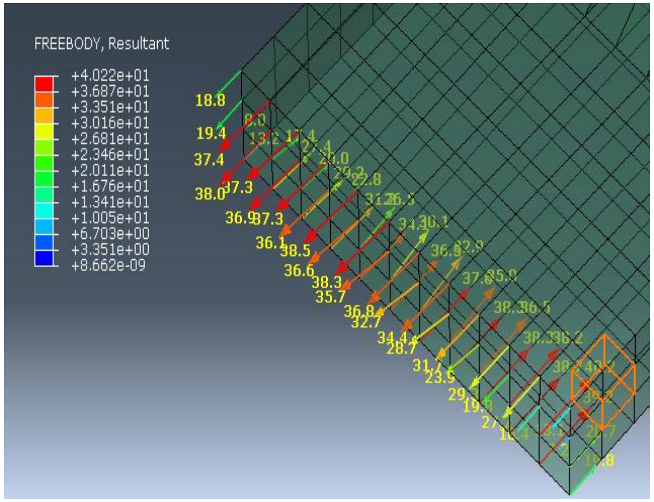


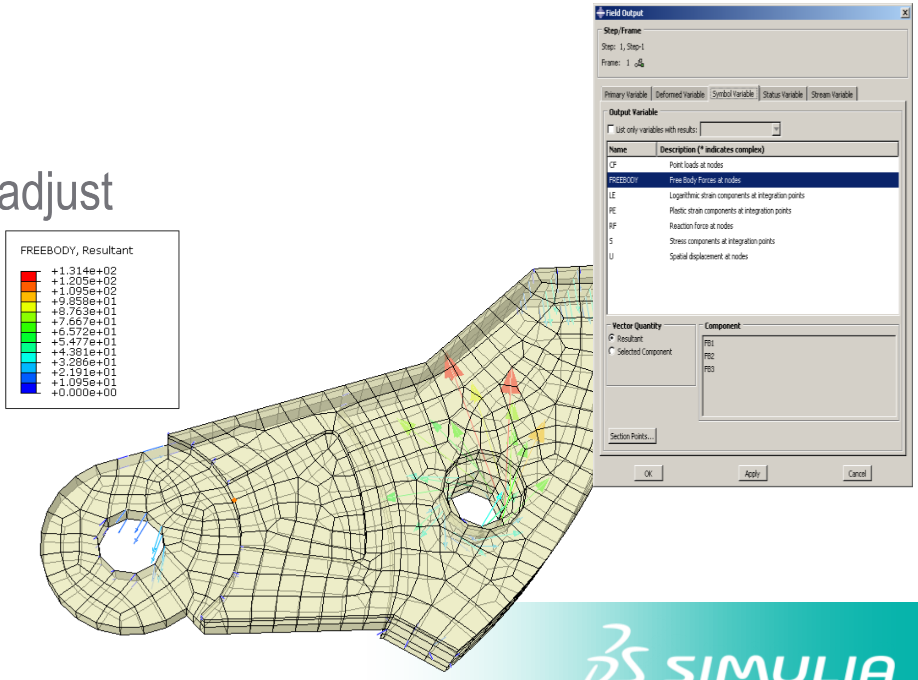


Freebody display

Free body nodal forces symbol plots

- Display resultant nodal forces due to applied loads as free body vectors
- New “FREEBODY” variable based on NFORC output
- Choose resultant or selected components.
- Use with display groups
- Vector Symbol Options applicable
  - Uniform color and spectrum color, adjust symbol size, symbol thickness and arrowhead style, etc
- Display values





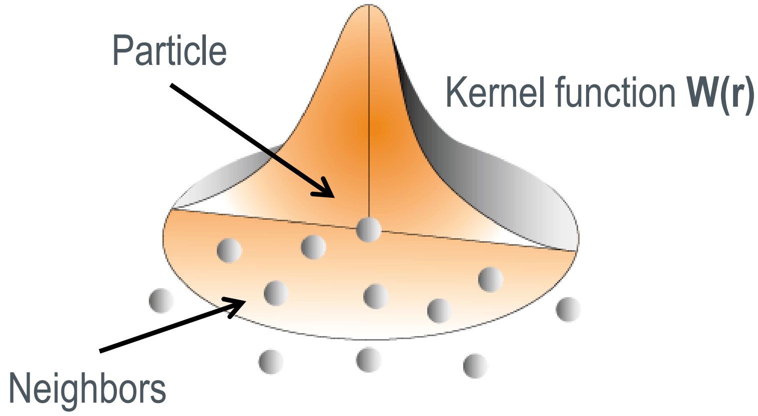
Multiphysics

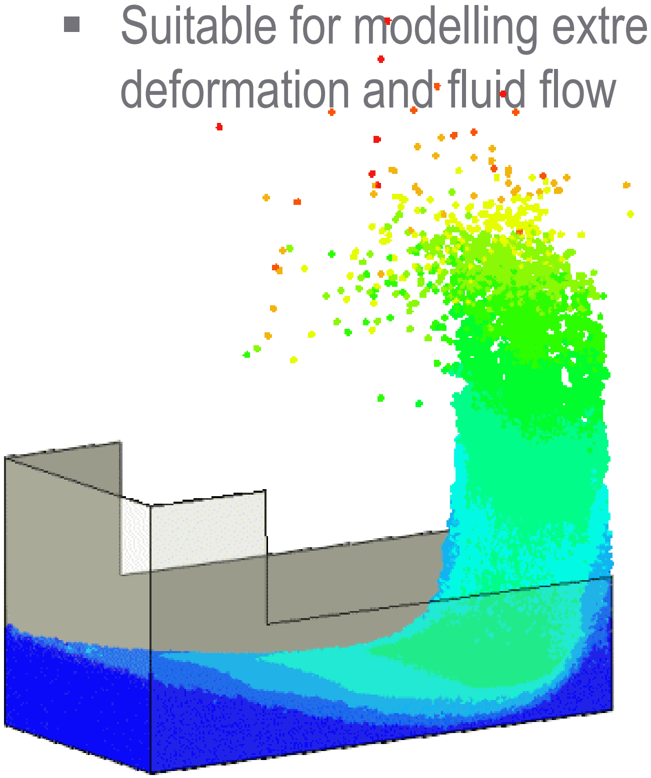
SIMULIA

Smoothed Particle Hydrodynamics

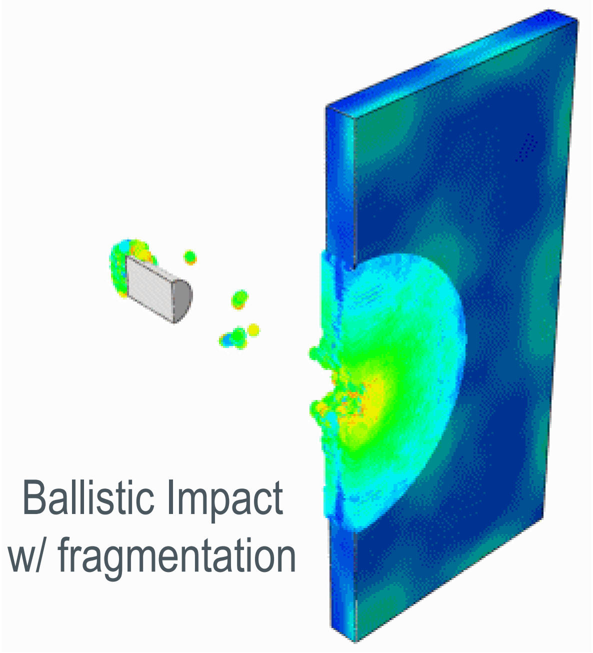
What is it?

- Mesh-free Lagrangian method based on continuum theory
- Particle connectivity is *dynamic*
- Suitable for modelling extreme deformation and fluid flow





Fluid sloshing

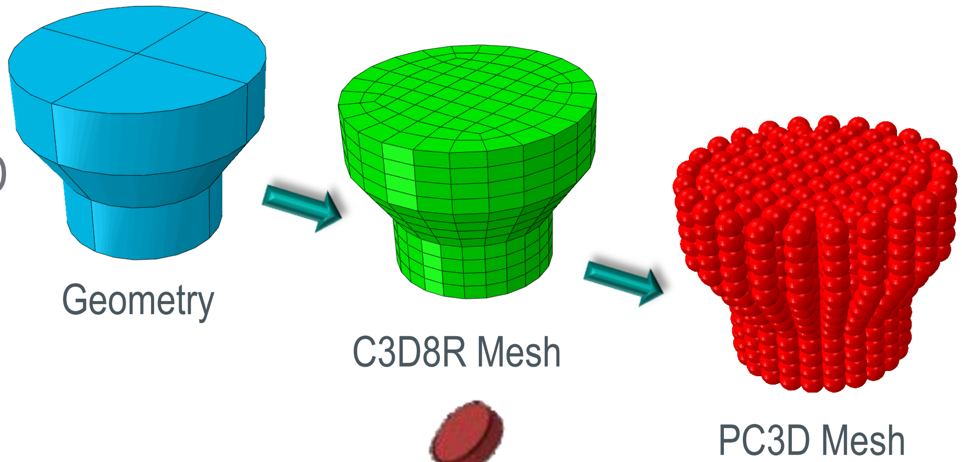


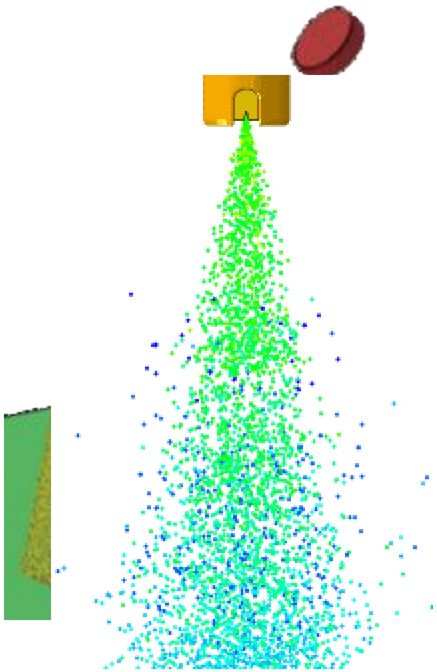
Ballistic Impact w/ fragmentation

Smoothed Particle Hydrodynamics

Key Features

- New 3D point element PC3D
- Explicit dynamic procedure
- All materials can be used
- Node-based loads, BC’s, IC’s, & constraints
- Gravity is the only body load
- Contact using node-based surfaces
- Output same as C3D8R
- Particles are limited to one parallel domain

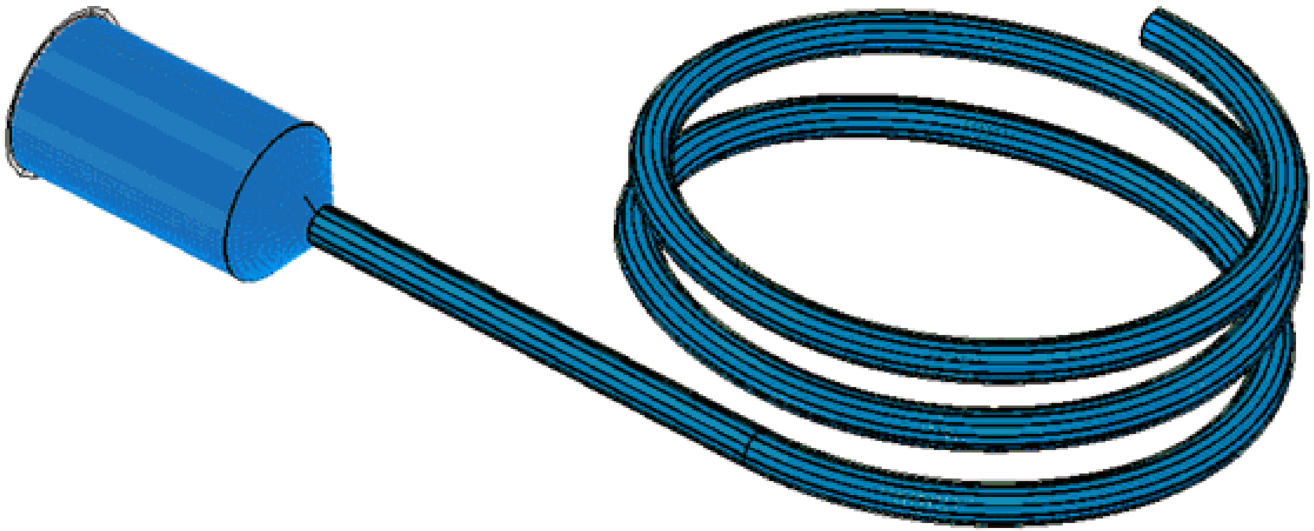


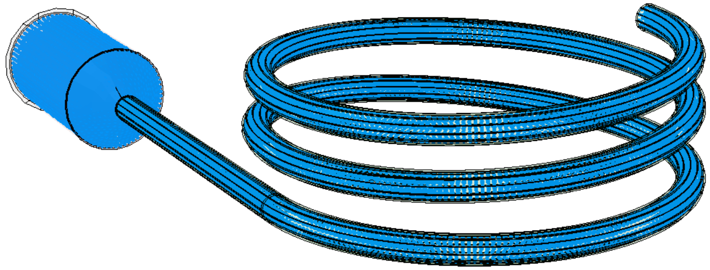


Liquid spraying through a nozzle

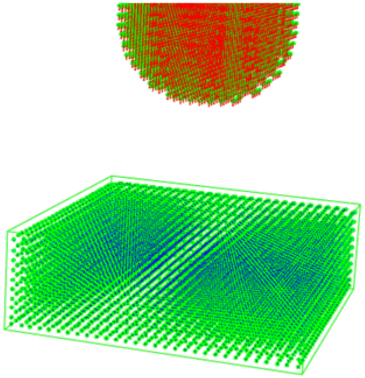
Fluid-filled bottle drop

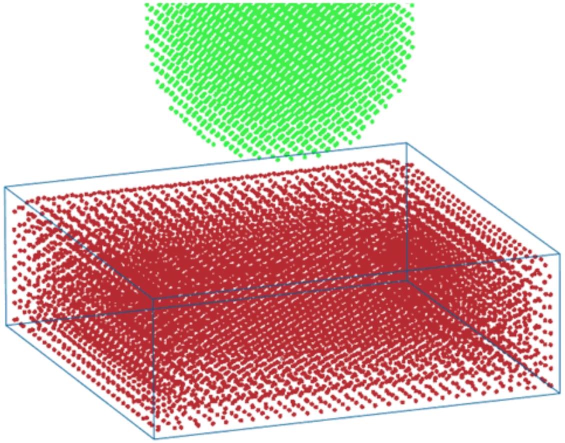
Garden hose: pressurization + spraying

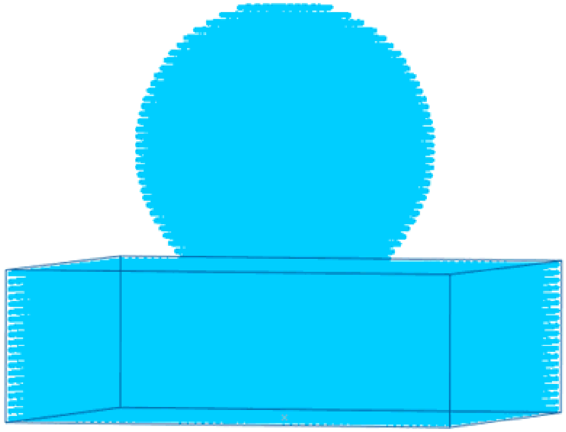




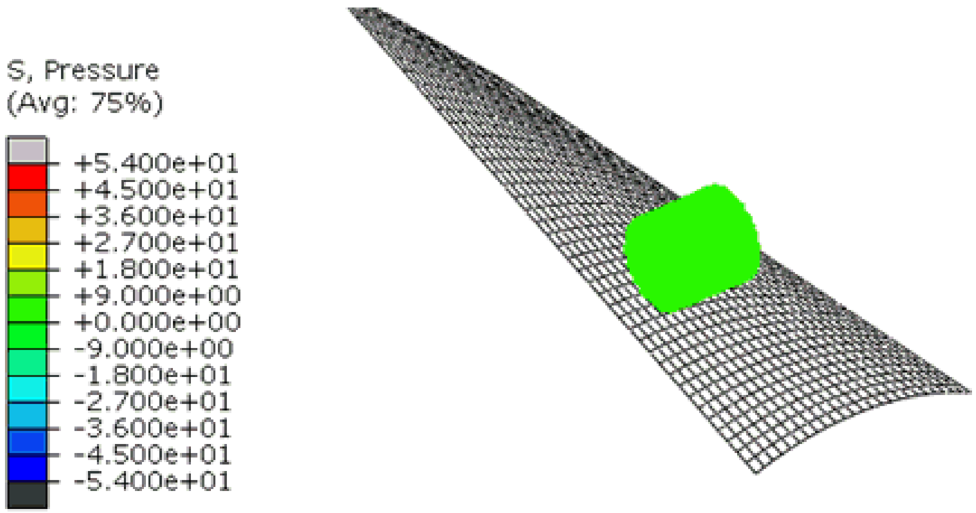
Water Splash In a Square Pan

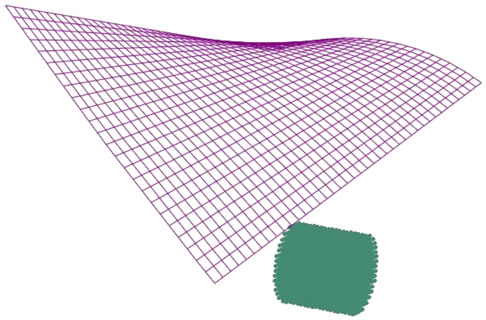




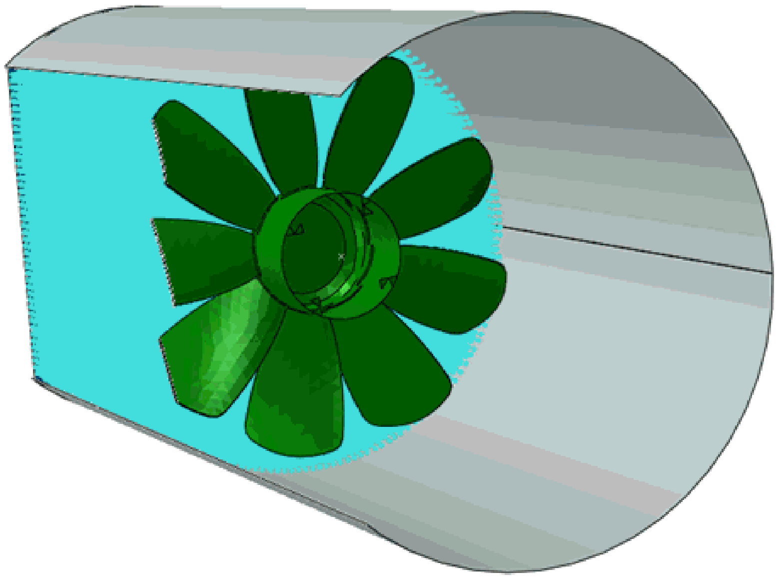


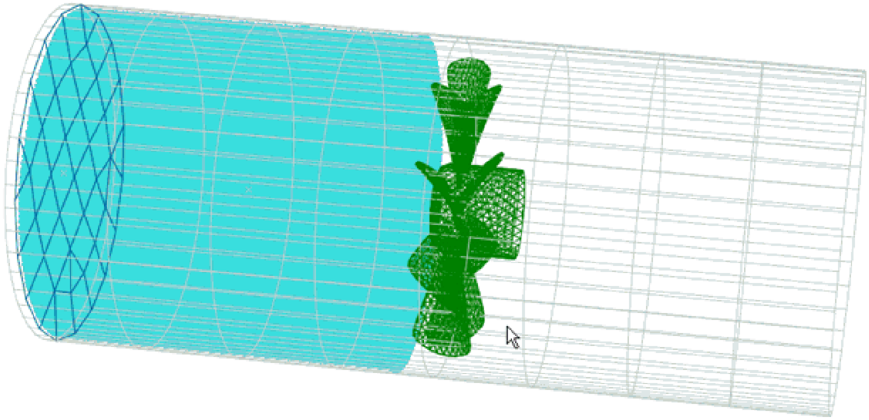
Bird Fan Blade Slashing



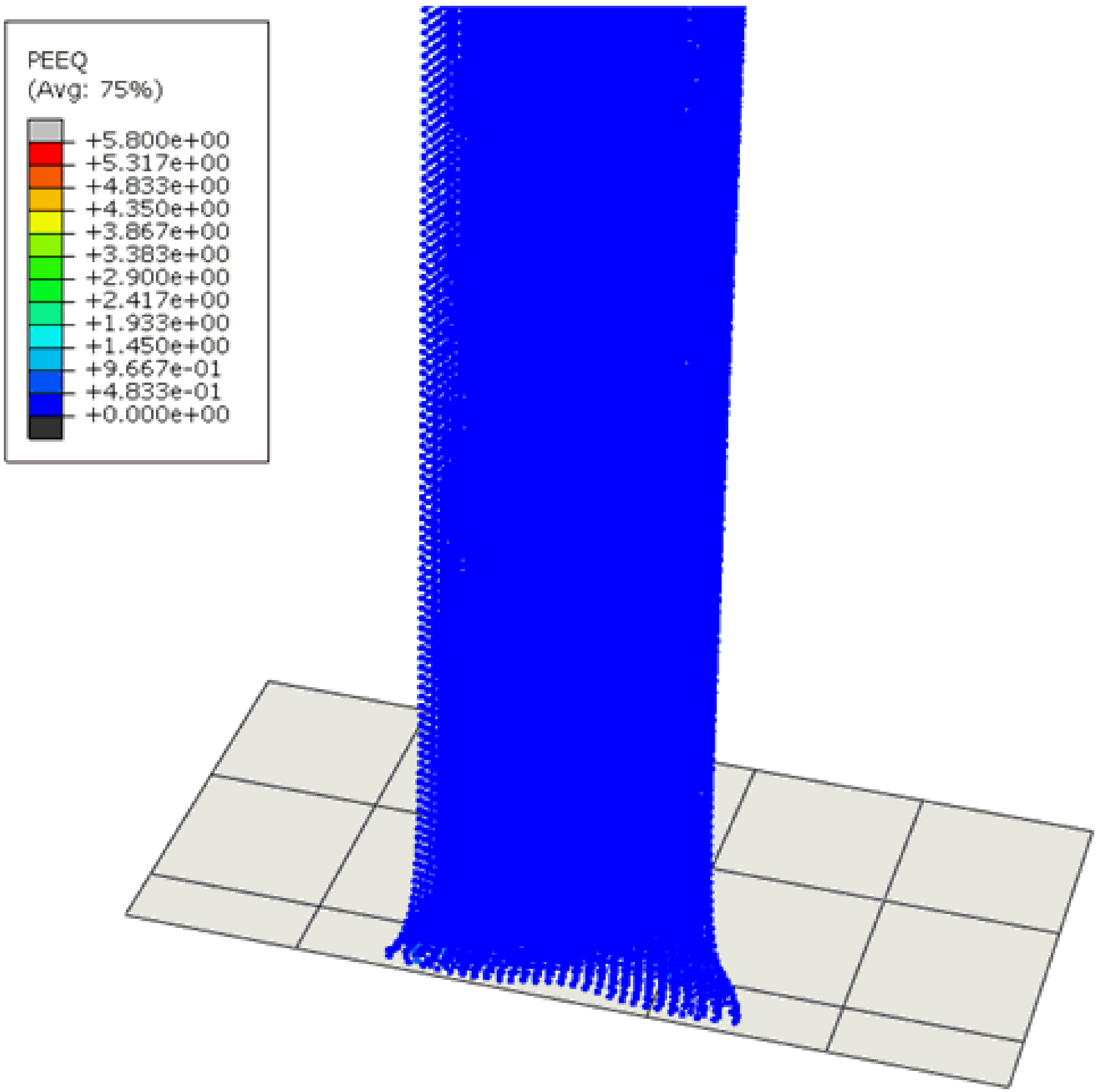


Priming a Pump



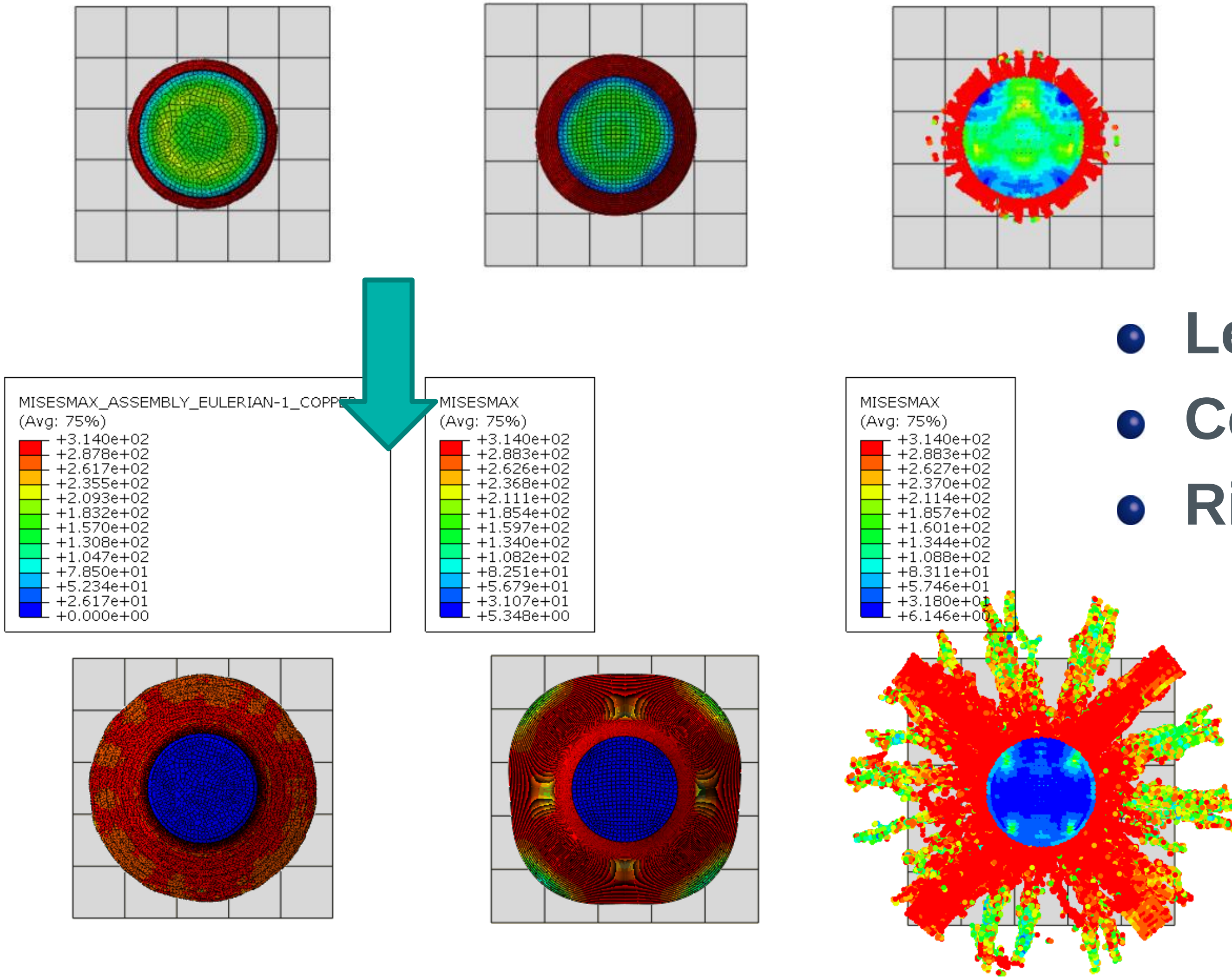


Taylor Test



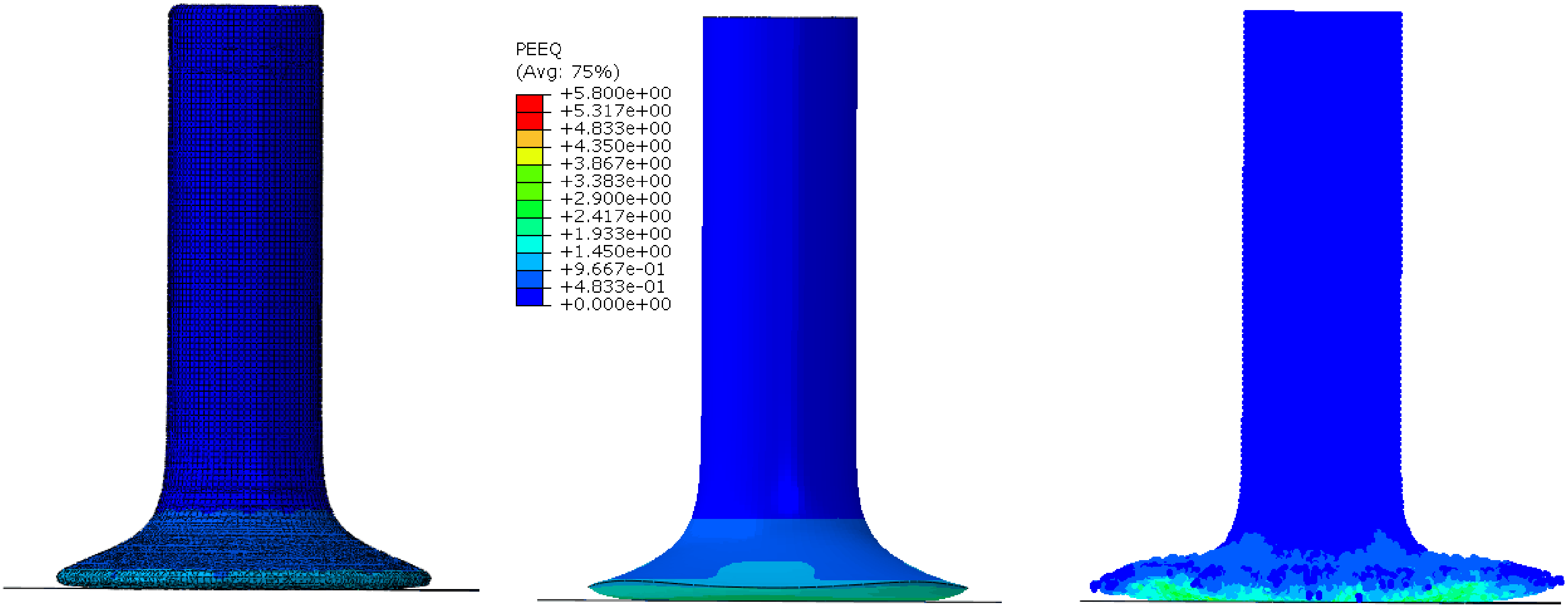
PEEQ
(Avg: 75%)
+5.800e+00
+5.317e+00
+4.833e+00
+4.350e+00
+3.867e+00
+3.383e+00
+2.900e+00
+2.417e+00
+1.933e+00
+1.450e+00
+9.667e-01
+4.833e-01
+0.000e+00

Taylor Test – comparison w CEL & C3D8R



- **Left: CEL**
- **Center: C3D8R**
- **Right: SPH**

Taylor Test – comparison w CEL & C3D8R

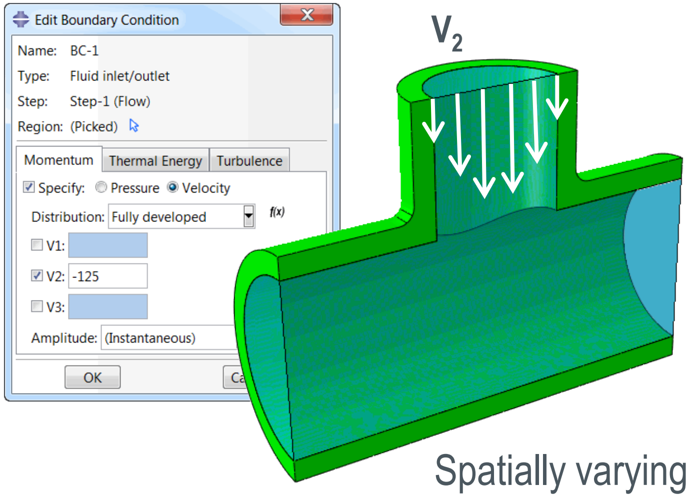


- **Left: CEL**
- **Center: C3D8R**
- **Right: SPH**

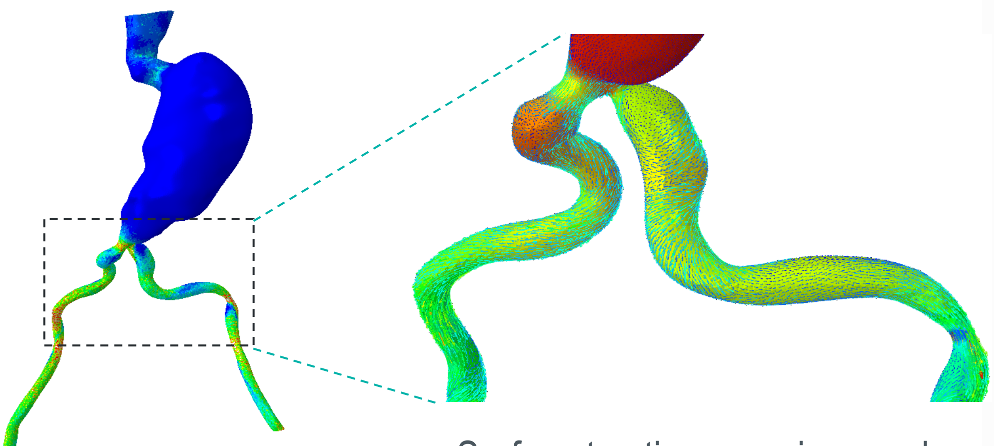
CFD Enhancements

Key Features

- Improved RNG k-ε model
- Temperature-dependent viscosity
- Surface output variables
- Spatially varying velocity BC's
- Simplified co-simulation submission
- Keyword documentation

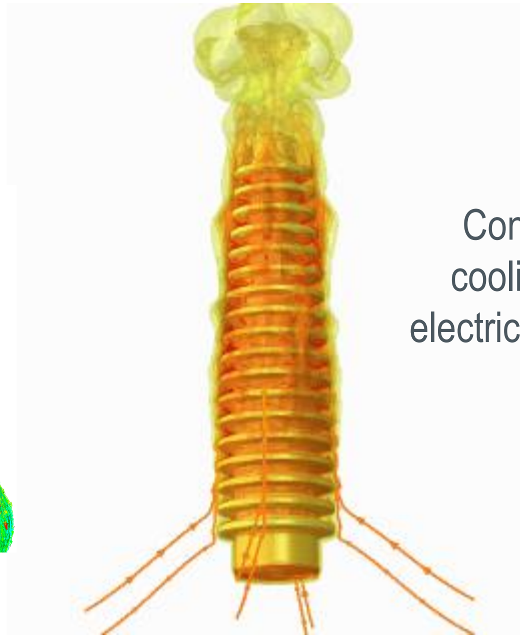


Spatially varying inlet boundary condition



Wall shear stress

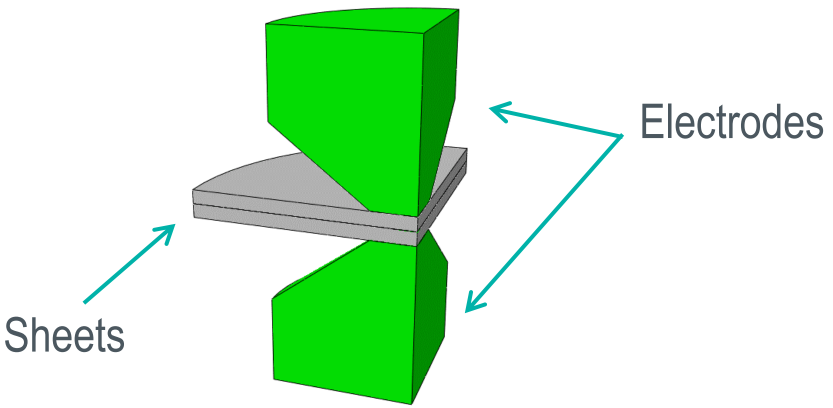
Surface traction superimposed on pressure contours



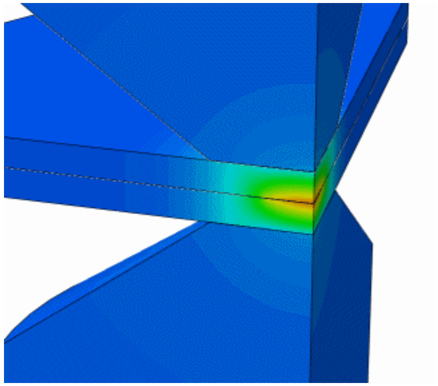
Convective cooling of an electrical insulator

Coupled Thermal-Electrical-Structural

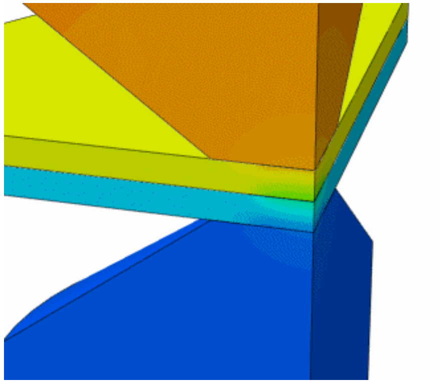
- Key Features
  - Extension of existing thermal-electrical procedure to include structural response
  - Gap electrical conductivity can depend on separation and contact pressure



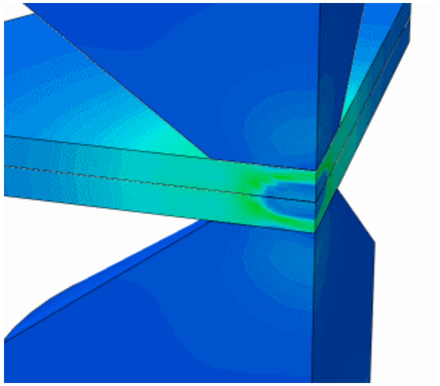
Spot welding



Temperature



Electrical potential



Stress

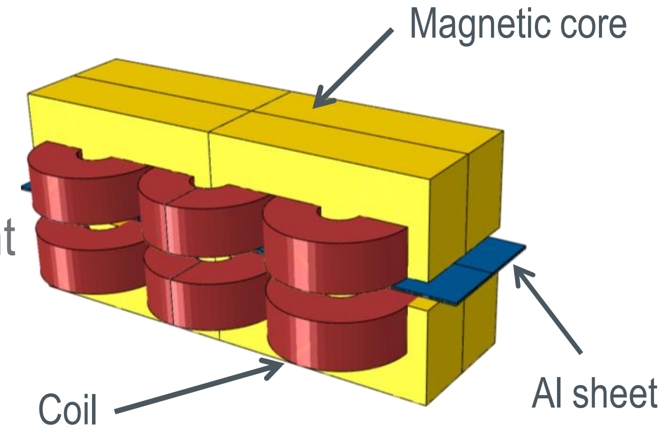
Electromagnetics

Key Features

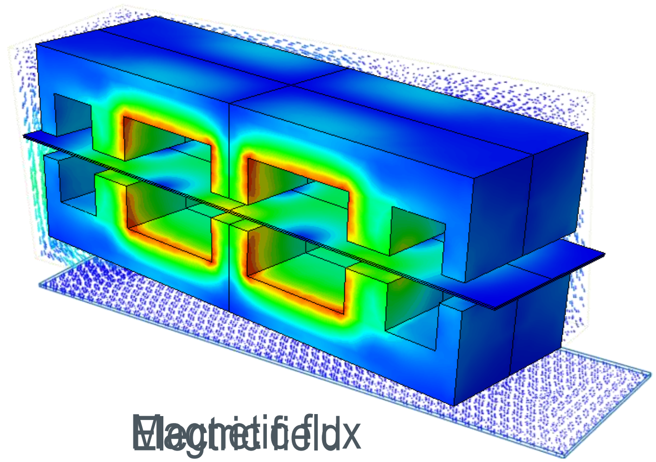
- Low Frequency time harmonic eddy current analysis
- Body and surface current excitation
- Sequentially coupled Thermo-Mechanical analysis

Limitations

- Linear B-H material behavior
- Mesh ties are not supported
- Cannot specify voltage or total current

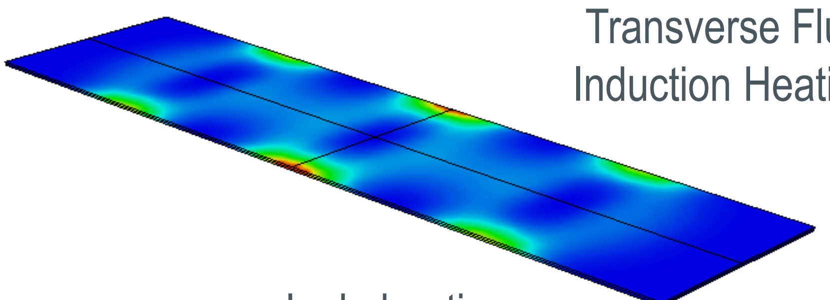


Model (without air)



Magnetic flux / Electric field

Transverse Flux Induction Heating



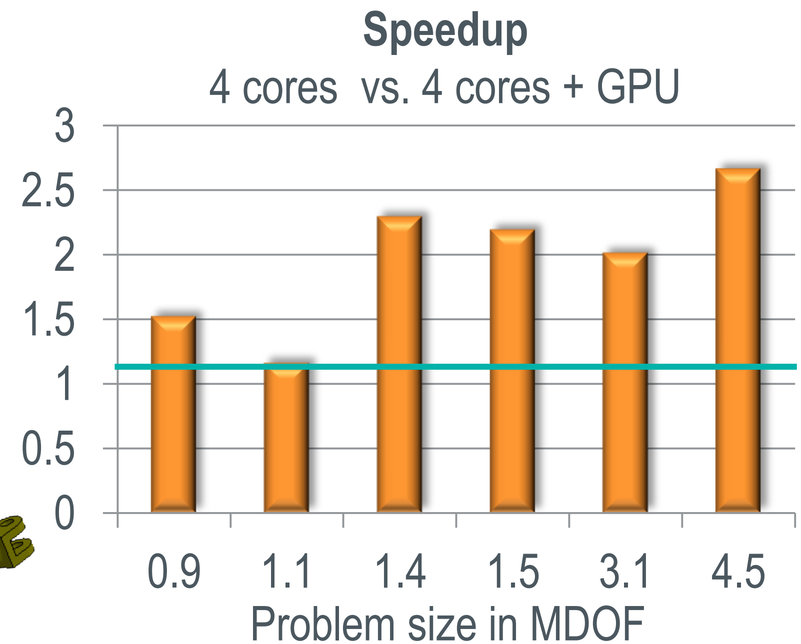
Joule heating

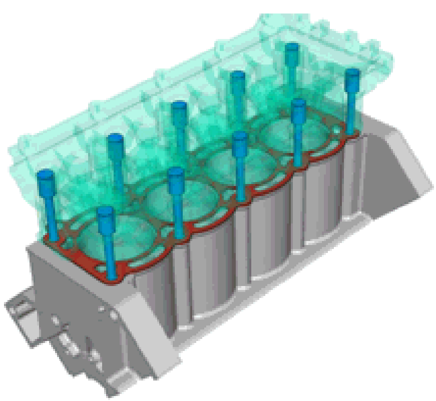
Performance

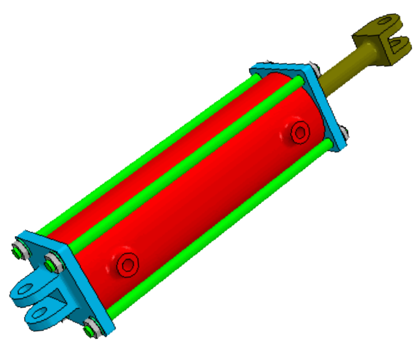
GPU Acceleration

Key Features

- Works with direct sparse solver
- Benefits solver dominated problems (> 1 MDOF)
- Limited to symmetric storage
- Limited to SMP & 1 GPU
- GPU is treated as 1 additional core for licensing
- Supports NVIDIA Tesla 20-Series and Quadro 6000 GPU's



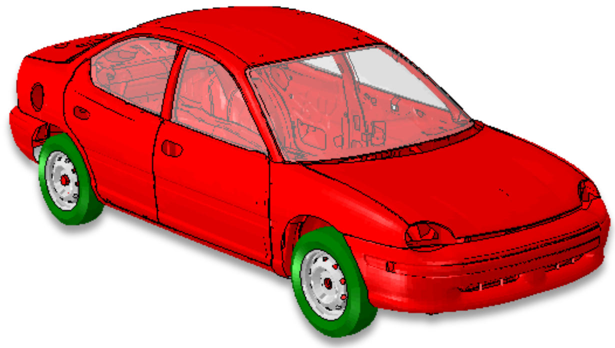


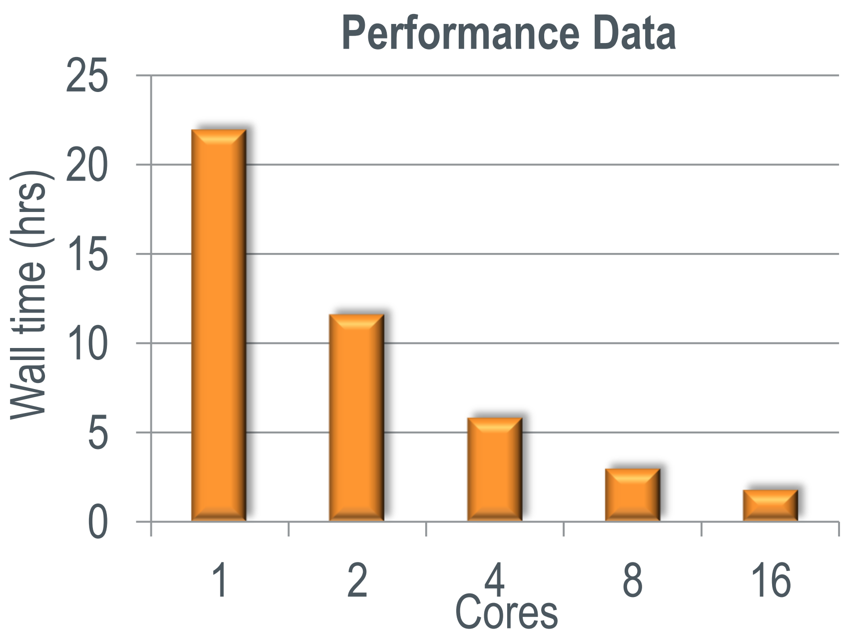


Mode-based Steady State Dynamics

Key Features

- Shared-memory parallel processing provides impressive scaling on 16+ cores
- Works with structural and coupled structural-acoustic analysis

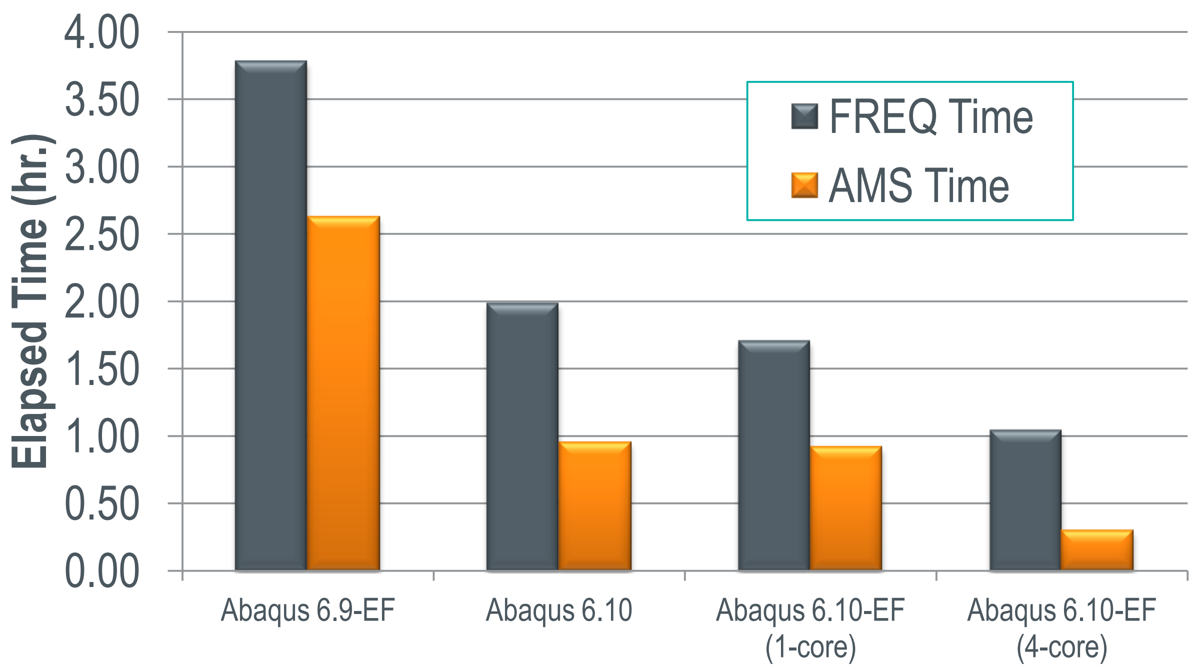




Analysis based on 10,000 eigenmodes with response computed at 500 frequency points

Parallel AMS eigensolver

- AMS is an approximate technique for large models with large number of modes (>1000)
  - Runs in parallel on a single compute node (no DMP)



9.3M DOF model

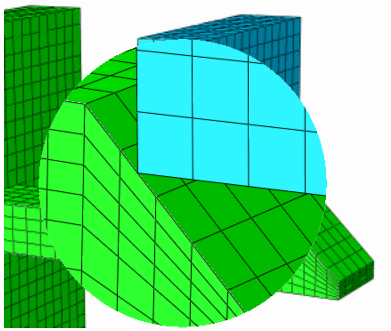
4208 modes

Modelling & Visualisation

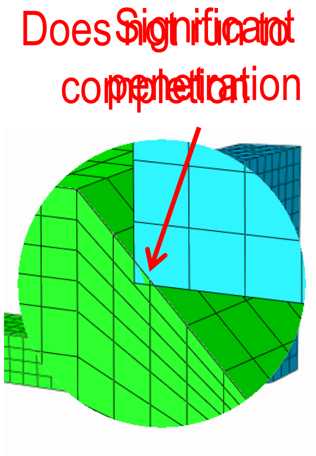
General Contact Enhancements in Standard

Key Features

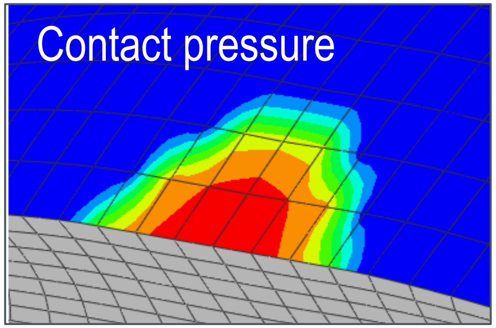
- Edge-to-surface formulation improves resolution of contact involving feature edges
- Contact stress error indicator output provides insight into results accuracy

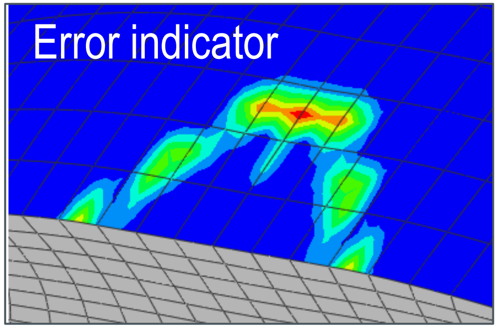


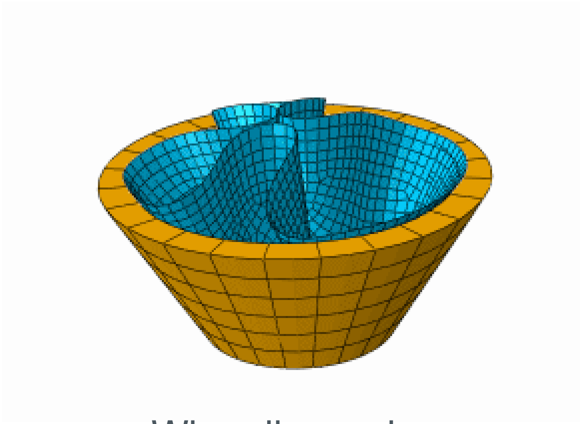
w/ edges



w/o edges







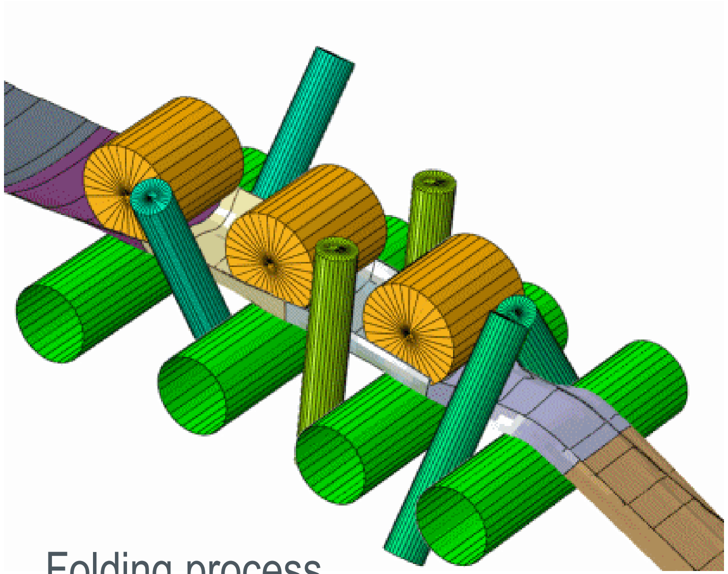
Wipe dispensing

- ✓ Accurate prediction of peak contact pressure
- ✓ Some uncertainty where gradient is large but pressure is low

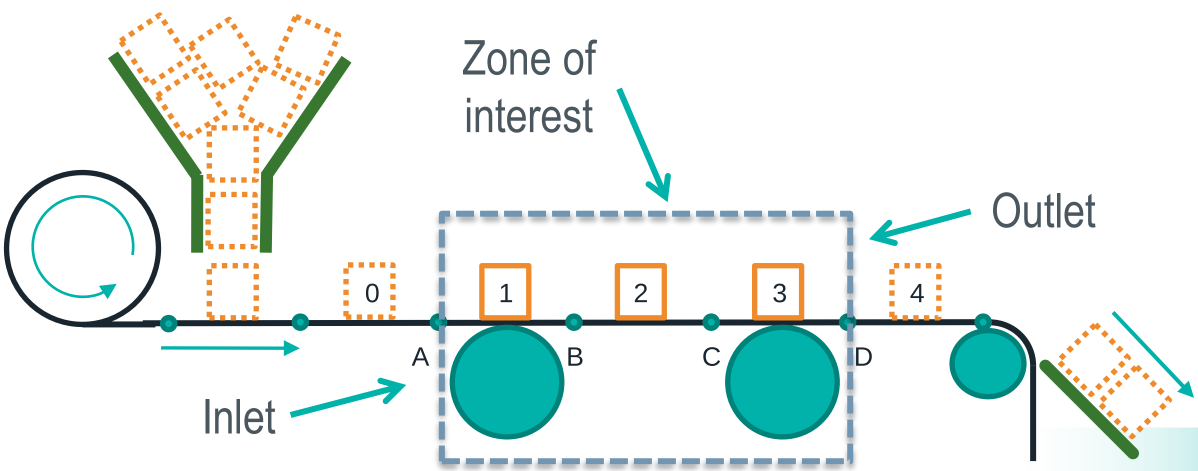
Periodic Media Transport

Key Features

- Efficient technique for modelling continuous processes
- Links topologically identical meshed structures together forming a chain
- These structures need only span the zone of interest
- Structures are automatically moved from the outlet to the inlet



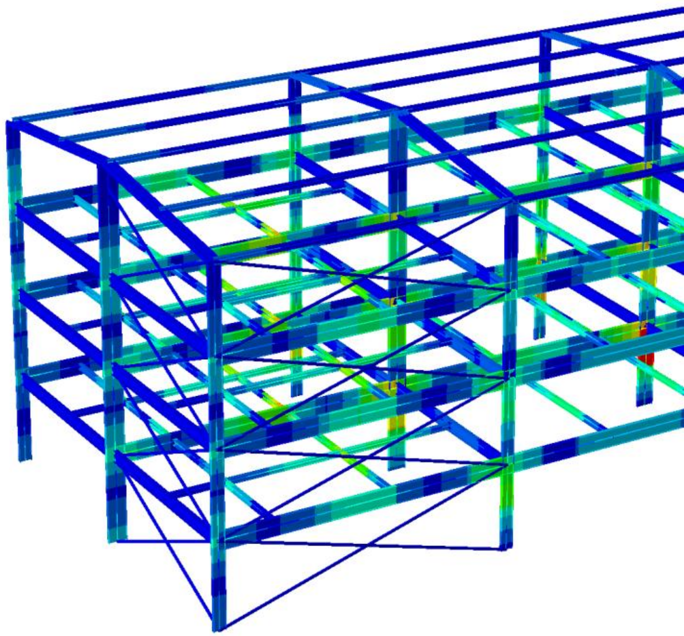
Folding process

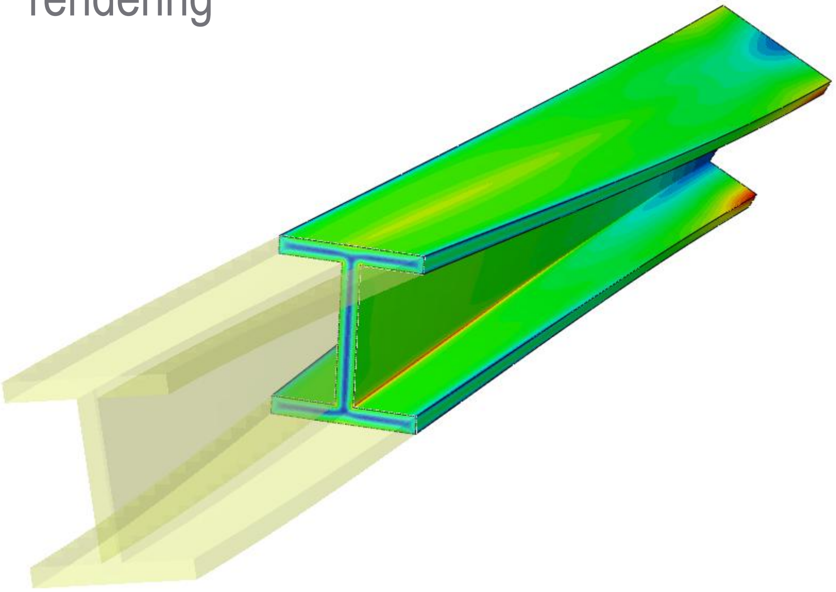


Beam Visualisation

Key Features

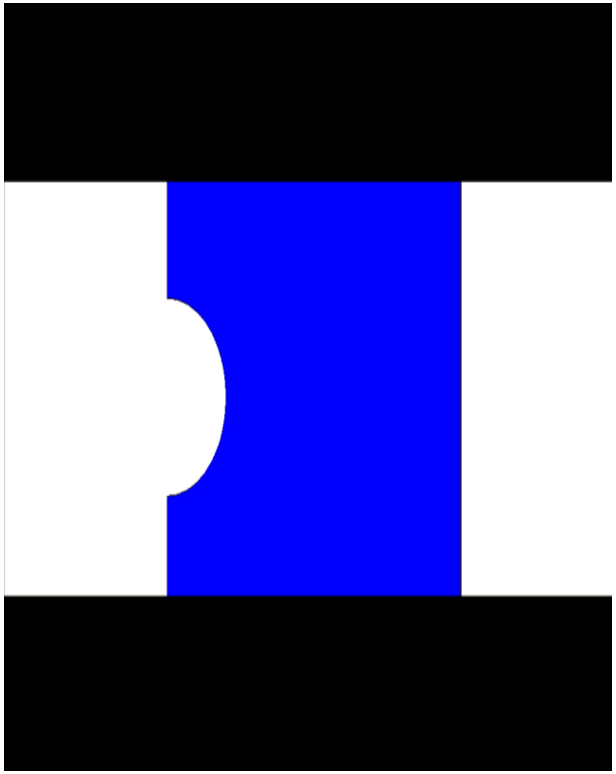
- Contour plots on rendered beam sections
- Nodal and element integration point variables are *constant* across the section
- Stress *variation* is derived from section force/moment using linear elastic theory
- View cuts now work with beam profile rendering





XFEM

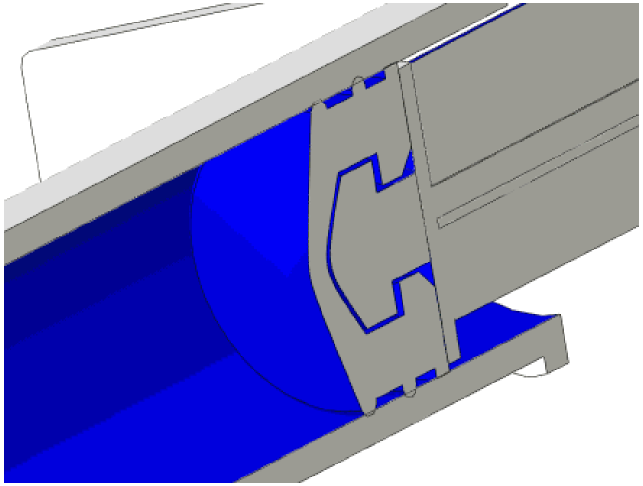
- User-defined damage initiation for XFEM
  - Allows multiple failure mechanisms
  - Works with existing damage evolution laws
  - Applications include composites & compressive failure
- Low cycle fatigue using XFEM & direct cyclic
  - Based on linear elastic fracture mechanics
  - Pre-existing crack is assumed
  - Crack follows arbitrary path based on cyclic loading
- XFEM w/ 2nd order tet elements



Static loading to nucleate a crack followed by a low cycle fatigue loading

3D pressure penetration

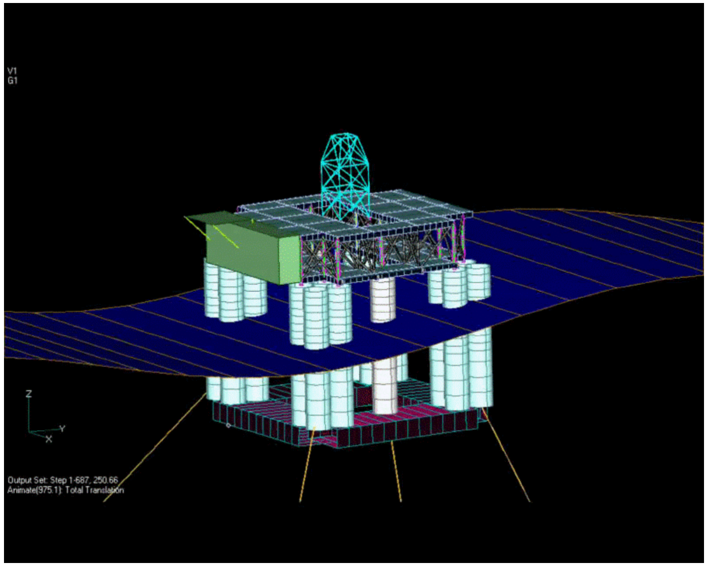
- Extension of existing 2D capability
- Applies pressure when contact surface open
- Works with contact pairs only
  - not general contact
- Parallel element calculations
  - also for 2D
- Use unsymmetric solver for large deformation problems
- Modelling support in Abaqus/CAE



Shrink fit followed by 3D pressure penetration analysis of a medical syringe

Aqua loading in Explicit

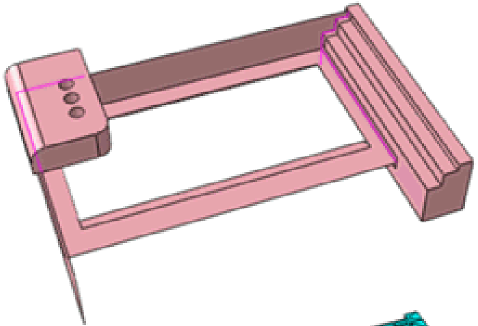
- Subset of Abaqus/AQUA
  - Apply wave drag and buoyancy loading to structures modeled using beam and pipe elements
  - Support for Stoke's 5th order waves (Airy waves only in Abaqus/Standard)
  - Pipe elements introduced into Abaqus/Explicit in 6.10

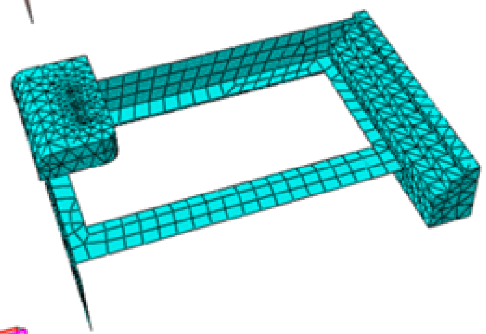


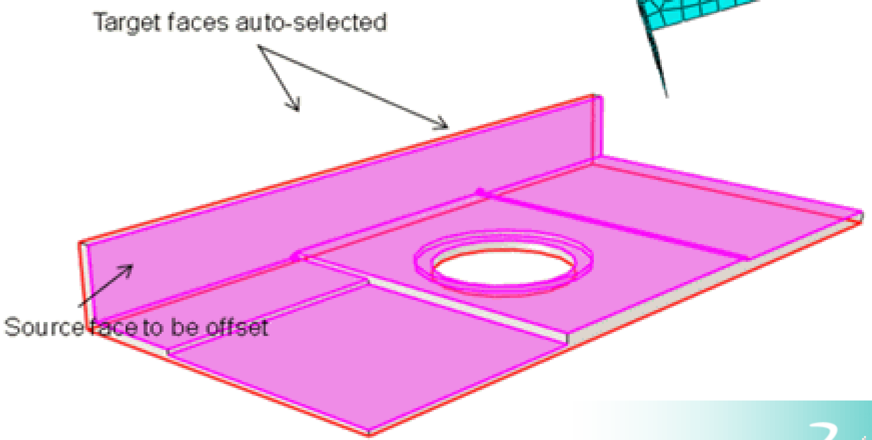
Courtesy: Horton Deepwater

Abaqus/CAE – Mid-surface

- More automated mid-surface extraction capability
  - Target faces for offset tool
  - Edge directions for extend tool
  - Thickness of newly created faces
  - Shell-to-solid couplings on mixed dimensional parts

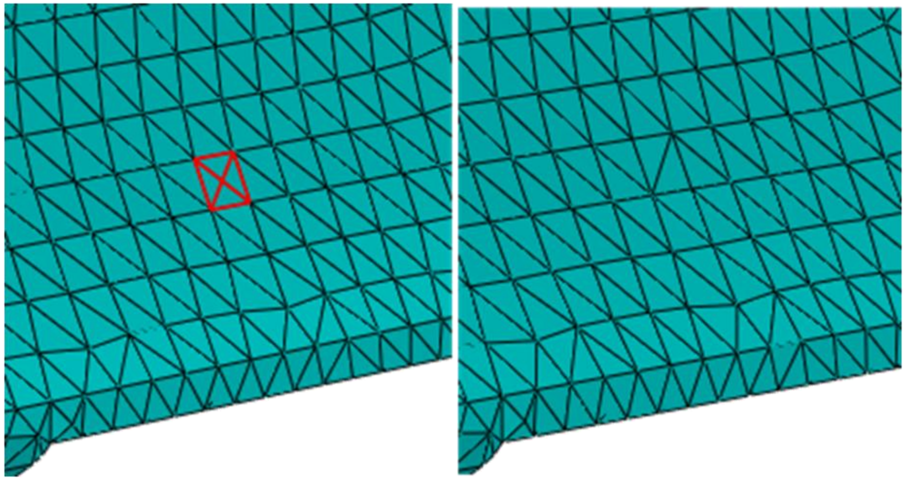






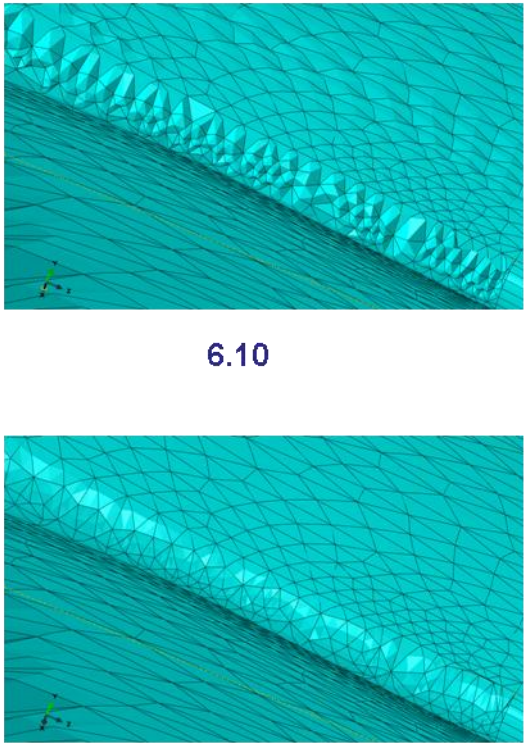
Abaqus/CAE - Meshing

- Improved accuracy of boundary meshes
  - Auto facet repair for poor geometry
  - Removed zero volume surface elements
- Default is now 2^{nd} order tets



6.10 Mesh:
A zero-volume tet

6.10-EF Mesh:
Zero-volume tet removed

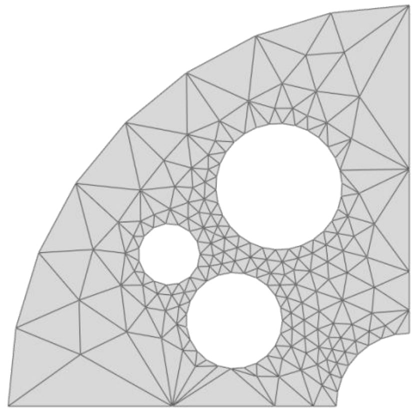


6.10

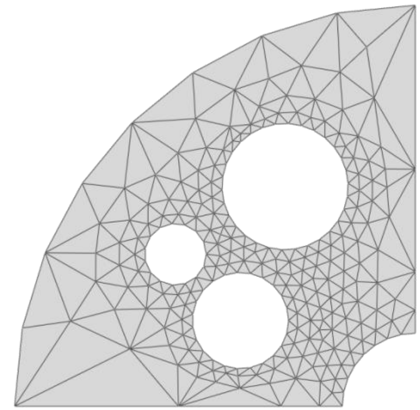
6.10-EF

Abaqus/CAE - Meshing

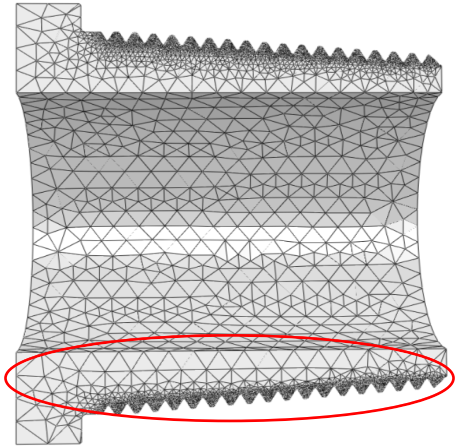
- More gradual surface mesh transitions



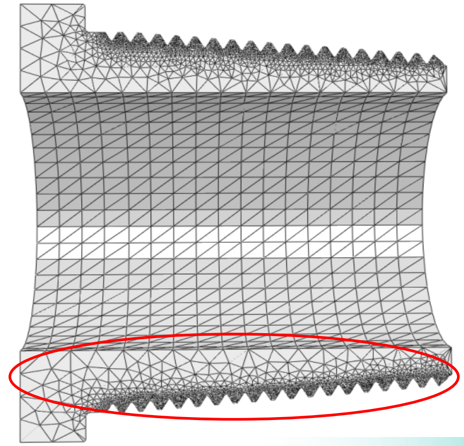
6.10
(330 tris)



6.10-EF
(426 tris)



6.10
(9,688 tris)

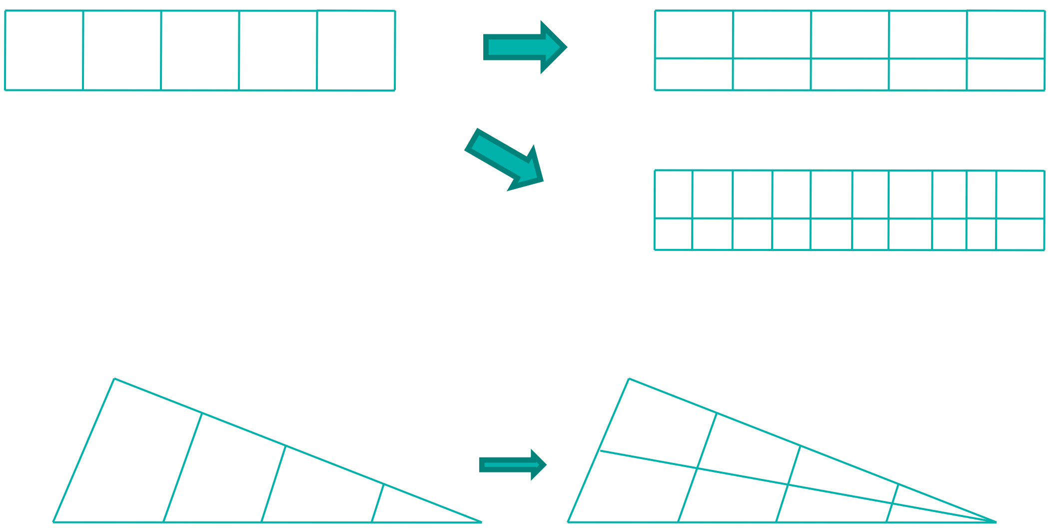


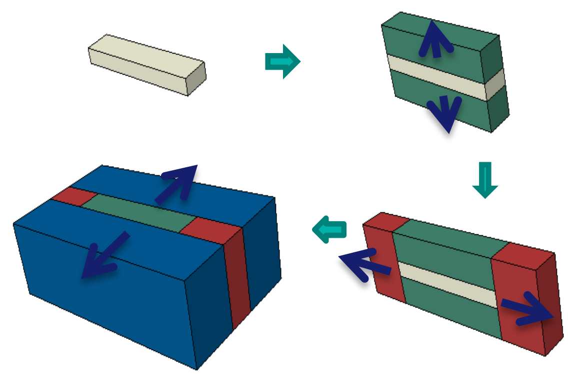
6.10-EF
(10,330 tris)

Abaqus/CAE - Meshing

Miscellaneous meshing enhancements

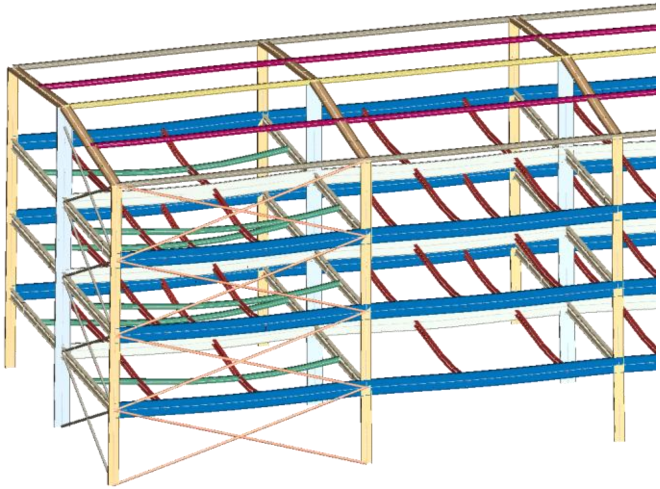
- Layer merge, split, and remove or inflate collapsed elements
- Performance and usability improvements
- Support for new pore-pressure & CFD wedge elements



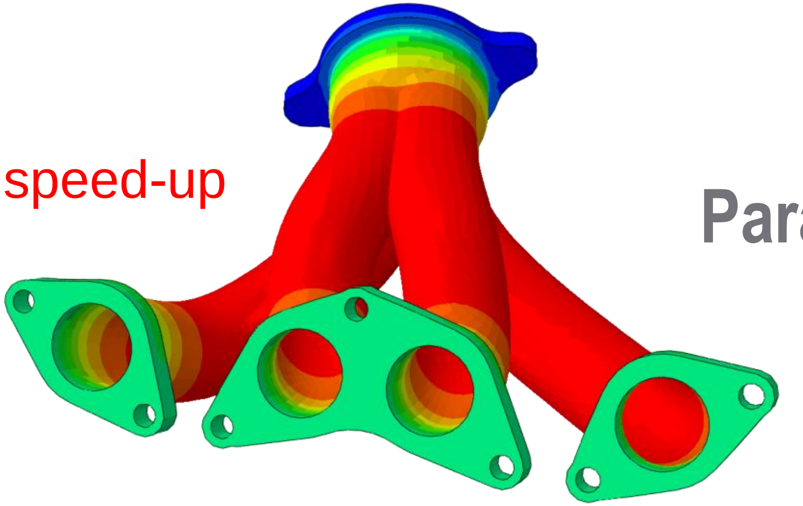


Radiation & Response Spectrum

Enhanced response spectrum procedure



8x speed-up

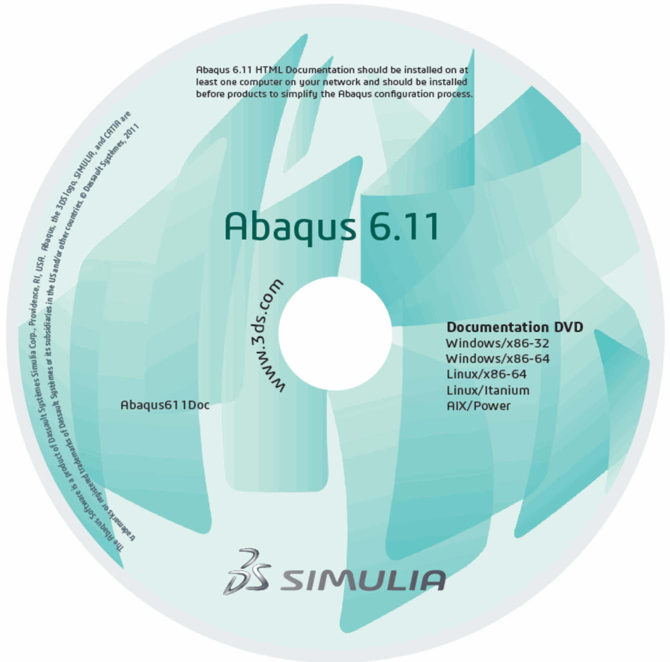


Parallel cavity radiation

Summary

- Abaqus 6.11 is another strong release!
  - New optimization capabilities
  - Improved solver performance with GPU acceleration
  - Significant expansion of multiphysics
    - Smoothed Particle Hydrodynamics (SPH)
    - CFD enhancements
    - Electromagnetics
  - And much, much more . . .

Thank You!



Drinks & Banquet

SIMULIA